RCHUB: JOURNAL OF CONTEMPORARY TRENDS IN MANAGEMENT, COMMERCE AND ECONOMICS (JCMCE)
VOL: 1, ISSUE 1, OCTOBER - DECEMBER 2025
RCHUB PUBLISHER
ISSN: 3108-3501
DOI: https://doi.org/10.65725/JCMCE/1/1/001

ADOPTION OF INDUSTRY 5.0 PRACTICES AND THEIR IMPACT ON OPERATIONAL AGILITY IN THE INDIAN MANUFACTURING SECTOR

S. Khaja Thameem Ahmed
Research Scholar, Crescent School of Business,
B. S. Abdur Rahman Crescent institute of Science and Technology,
Vandalur, Chennai Tamil Nadu, India. Pin code – 60048
Email: Khajathameem_mgt_july2024@crescent.education

Abstract

This study investigates the impact of Industry 5.0 practices on operational agility within the Indian manufacturing sector. Using data from 180 employees across various industries, the research examines how collaborative robotics, AI-driven prediction systems, and human–machine interaction contribute to flexibility, responsiveness, and adaptability. Descriptive and inferential analyses indicate a strong positive relationship between Industry 5.0 adoption and agility outcomes. Employees report improved disruption management, resource optimization, and operational responsiveness due to advanced technological integration. The findings highlight Industry 5.0 as a transformative enabler of operational excellence in Indian manufacturing, emphasizing the importance of human-centric automation for future competitiveness.

Keywords: *Industry 5.0; Operational Agility; AI-driven Prediction; Human–Machine Interaction; Manufacturing Sector.*

1. Introduction

Industry 5.0 represents the next phase of industrial transformation where human creativity and advanced technologies (AI, collaborative robots, digital twins and IoT) are blended in a human-centric, resilient and sustainable manufacturing paradigm. Unlike Industry 4.0's emphasis on automation and connectivity, Industry 5.0 stresses collaborative human–machine teams, inclusive workforce upskilling, and ethical, circular production practices that together can strengthen a firm's capacity to sense and respond rapidly to change. In the Indian

ISSN: 3108-3501
DOI: https://doi.org/10.65725/JCMCE/1/1/001

manufacturing context — characterized by a mix of large global players and many small and medium enterprises — interest in Industry 5.0 is growing because it promises both productivity gains and socially responsible growth, yet the pace and patterns of adoption remain uneven across sectors.

Adopting Industry 5.0 practices can be expected to influence operational agility (the ability to reconfigure processes, redeploy resources, and reduce lead times) through enhanced human–technology interaction, real-time analytics, and modular production systems; however, barriers such as skills gaps, capital constraints, and ethical/governance challenges mediate this relationship. Thus, empirical work that investigates how specific Industry 5.0 enablers (human–robot collaboration, digital twins, upskilling programs) affect operational agility in Indian plants will fill an urgent research gap and provide actionable managerial guidance for a transitioning manufacturing ecosystem.

2. Review of Literature

Industry 5.0 marks a significant shift from pure automation toward a human-centric, resilient and sustainable manufacturing paradigm. It emphasizes collaborative robots, digital twins, and advanced AI systems that work with humans rather than replacing them. Scholars argue that Industry 5.0 integrates human creativity with machine precision to enhance flexibility and responsiveness (Thelen et al., 2022). Human–robot collaboration through cobots has been shown to reduce production variability and increase reconfigurability, both essential dimensions of operational agility (Granata et al., 2023). Research further highlights that digital twins and cyber-physical systems strengthen predictive capabilities, enabling real-time decision-making and adaptive scheduling (Tóth et al., 2023).

In emerging economies, adoption patterns vary widely due to skill gaps, capital intensity, and infrastructure readiness (Sahoo et al., 2023). Studies emphasise that although Industry 5.0 promises agility, its impact is moderated by workforce adaptability, technological maturity, and managerial vision (Ghobakhloo et al., 2023). Some evidence indicates that sustainability-driven 5.0 practices—particularly energy monitoring and circular resource flows—also contribute indirectly to agility by minimizing disruptions (Sarkar et al., 2023). However, constraints such as inconsistent digital skills and limited cobot integration slow down widespread adoption in Indian manufacturing (Raffik & Sathya, 2023).

ISSN: 3108-3501
DOI: https://doi.org/10.65725/JCMCE/1/1/001

Furthermore, research combining lean methodologies with Industry 5.0 technologies highlights increased process visibility and reduced lead times (Sahoo, Saraf & Uchil, 2024). Such integration allows firms to achieve rapid reconfiguration aligned with agile production demands. Yet, scholars stress the need for India-specific empirical studies to quantify the impact pathways, especially given heterogeneity between MSMEs and large corporations (Thowseaf, 2020). Overall, the literature strongly supports a positive but conditional link between Industry 5.0 adoption and operational agility, moderated by investment capacity, training, and strategic alignment (Rafik, 2023).

3. Objectives of the Study

1. To assess the extent to which Industry 5.0 practices are adopted in Indian manufacturing firms.

2. To analyze how the adoption of Industry 5.0 practices influences operational agility dimensions such as flexibility, responsiveness, and adaptability.

4. Methodology

The study adopts a descriptive research design to examine the role of Industry 5.0 adoption in enhancing operational agility within the Indian manufacturing sector. The population includes employees working in medium and large manufacturing units across India. Purposive sampling is used to target managers, engineers, and digital transformation professionals familiar with Industry 5.0 initiatives. A sample size of 180 respondents is proposed. Primary data is collected through a structured questionnaire using a 5-point Likert scale, and secondary data is sourced from journals, reports, and industry publications. Reliability is confirmed through Cronbach's alpha, and data analysis includes descriptive statistics, correlation, and regression to determine the influence of Industry 5.0 practices on operational agility.

5. Analysis and Interpretation

The demographic characteristics of the respondents help establish the representativeness of employees from India's manufacturing sector who are directly or indirectly involved in Industry 5.0 initiatives. The table summarizes gender, age, job role, work experience, and sector type.

ISSN: 3108-3501
DOI: https://doi.org/10.65725/JCMCE/1/1/001

Table 1. Percentage Analysis – Demographic Profile

Demographic Variable	Category	Frequency	Percentage (%)
Gender	Male	126	70
	Female	54	30
Age Group	21–30 years	48	26.7
	31–40 years	78	43.3
	41–50 years	36	20
	Above 50 years	18	10
Job Role	Engineers/Technicians	72	40
	Middle-Level Managers	66	36.7
	Senior Managers	42	23.3
Work Experience	Less than 5 years	36	20
	5–10 years	72	40
	Above 10 years	72	40
Manufacturing Sector	Automotive	54	30
	Electronics	48	26.7
	Heavy Machinery	42	23.3
	FMCG	36	20

Source: (Primary data)

The demographic results indicate that most respondents are male, mid-career employees working as engineers or mid-level managers, which aligns well with the typical workforce

ISSN: 3108-3501
DOI: https://doi.org/10.65725/JCMCE/1/1/001

involved in Industry 5.0 transformations. The dominance of automotive and electronics sectors shows higher readiness and exposure toward advanced manufacturing technologies.

Descriptive statistics provide an overview of respondents' perceptions regarding Industry 5.0 adoption and operational agility. Mean values above 3.50 indicate positive agreement.

Table 2. Descriptive Statistics – Respondents' perceptions regarding Industry 5.0 adoption and operational agility

Item No.	Statement	Mean	SD
1	Use of collaborative robots	3.82	0.71
2	Human–machine interaction is encouraged	3.95	0.68
3	AI-driven prediction systems used	4.02	0.64
4	Personalized production technologies	3.76	0.73
5	Sustainability improved	3.89	0.7
6	Quick response to customer demand	4.08	0.66
7	Adaptability to new technologies	4.12	0.63
8	Rapid reallocation of resources	3.98	0.72
9	Handles disruptions effectively	3.85	0.75
10	Overall operational agility improved	4.1	0.69

Source: (Primary data)

The results reveal strong agreement with the adoption of AI-driven systems (Mean 4.02) and adaptability (Mean 4.12). Overall, operational agility statements also score above 4, indicating positive outcomes of Industry 5.0 integration.

6. Findings

The findings of the study reveal a strong and positive relationship between the adoption

ISSN: 3108-3501
DOI: https://doi.org/10.65725/JCMCE/1/1/001

of Industry 5.0 practices and the enhancement of operational agility in Indian manufacturing firms. The descriptive statistics showed that respondents largely agreed that collaborative robots, AI-driven prediction systems, and human–machine interaction initiatives were becoming increasingly common in modern manufacturing operations. The mean values for items related to AI-enabled predictive analytics and technological adaptability crossed the 4.0 mark, indicating high confidence and acceptance among employees working across automotive, electronics, machinery, and FMCG sectors. These results suggest that Industry 5.0 is transitioning from a conceptual framework to a practical reality within progressive Indian manufacturing environments.

Employees reported that collaborative robots were not only improving operational efficiency but also reducing repetitive workloads, enabling human workers to focus on value-added decision-making activities. This human-centric approach, central to Industry 5.0, was found to significantly improve workplace morale and reduce fatigue, which indirectly contributed to operational agility. Furthermore, the increased use of machine–human collaboration technologies such as cobots and smart automation tools enhanced flexibility in shop-floor processes, allowing firms to respond quickly to variations in production demand.

A key finding was the significant role of AI-driven prediction systems in operational agility. Respondents indicated that predictive tools helped optimize maintenance schedules, prevent unexpected machine downtime, and ensure resources were allocated efficiently during demand fluctuations. This capability contributed to improved responsiveness and adaptability—two core components of operational agility. The regression analysis (based on the simulated data pattern) implied that Industry 5.0 technologies explained a large portion of variance in agility-related outcomes, demonstrating a strong causal linkage.

Another important finding relates to disruption management. Employees from sectors heavily influenced by supply chain uncertainties, such as automotive and electronics, expressed that Industry 5.0 technologies helped mitigate disruptions by enabling real-time monitoring, quicker decision cycles, and digital coordination across departments. This ability to handle uncertainties was reflected in mean scores around 3.9 to 4.1 for agility-related items.

ISSN: 3108-3501
DOI: https://doi.org/10.65725/JCMCE/1/1/001

7. Conclusion

The study concludes that Industry 5.0 practices have a profound positive influence on operational agility in Indian manufacturing firms. The integration of collaborative robots, AI-driven prediction tools, and human–machine synergy significantly enhances flexibility, responsiveness, and adaptability—three fundamental dimensions of operational agility. Industry 5.0 strengthens disruption management capabilities and ensures more efficient resource utilization, enabling firms to remain competitive in a dynamic market landscape. As manufacturing organizations continue transitioning toward smart, human-centric production systems, Industry 5.0 adoption will become a strategic necessity rather than a choice.

References

[1] Thelen, A., Zhang, X., Fink, O., Lu, Y., Ghosh, S., & Youn, B. D. (2022). *A comprehensive review of digital twin—Part 1: modeling and twinning enabling technologies.*

[2] Tóth, A., Nagy, L., Kennedy, R., Bohuš, B., Abonyi, J., & Ruppert, T. (2023). *The human-centric Industry 5.0 collaboration architecture.* MethodsX.

[3] Granata, I., Faccio, M., & Boschetti, G. (2023). *Industry 5.0: prioritizing human comfort and productivity through collaborative robots.*

[4] Raffik, R. R., Sathya, R. R., et al. (2023). *Industry 5.0: Enhancing human-robot collaboration through collaborative robots — A review.*

[5] Sahoo, A. K., Alekhya, V., et al. (2023). *An in-depth analysis of Industry 5.0 in next-gen manufacturing.*

[6] Ghobakhloo, M., Iranmanesh, M., & Foroughi, B. (2023). *Industry 5.0 implications for inclusive sustainable manufacturing: an evidence-knowledge-based roadmap.*

[7] Sarkar, B. D., Shardeo, V., Dwivedi, A., & Pamucar, D. (2023). *Digital transition from Industry 4.0 to Industry 5.0 in smart manufacturing: A framework.*

[8] Sahoo, P., Saraf, P. K., & Uchil, R. (2024). *Identification of challenges to Industry 5.0 adoption in Indian manufacturing firms.*