International IT Journal of Research (IITJR), ISSN: 3007-6706
Volume 2, Issue 3, July-September, 2024
Available online at: https://itjournal.org/index.php

Implementation and Impact of Artificial Intelligence on Human Resources in the Indian Automotive Industry

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ABSTRACT

Industry 4.0 represents a paradigm shift in manufacturing, characterized by intelligent systems and the integration of artificial intelligence (AI) across all operational domains. This research investigates the implementation and impact of AI on human resources within the Indian automotive industry, focusing on the western region of India. The study employs a mixed-method research approach combining qualitative and quantitative methodologies, utilizing structured questionnaires distributed to 223 middle and senior managers across eleven passenger vehicle manufacturing companies in Western India.

The research examines five key dimensions: AI applications in automotive manufacturing, impact on employee support functions, skill development requirements, organizational preparedness, and challenges in AI skill enhancement. Findings reveal that while AI adoption is still in its nascent stage in India due to infrastructure limitations, the technology is progressively transforming manufacturing processes, quality control, and decision-making functions. The study identifies that AI creates significant demand for continuous learning and upskilling, with 68.9% of respondents acknowledging the need for ongoing education. However, concerns regarding job displacement, security, and the lack of empathy in AI systems remain significant barriers to adoption.

The research concludes that effective AI implementation requires strategic investment in infrastructure, employee training, and the development of human-AI collaboration frameworks. Organizations must focus on reskilling rather than complete automation, recognizing that human expertise remains irreplaceable in tasks requiring emotional intelligence and complex decision-making.

Keywords— Artificial Intelligence, Human Resources, Automotive Industry, Industry 4.0, Skill Development, Workforce Transformation, Employee Behavior, Organizational Growth, Machine Learning, Smart Manufacturing

INTRODUCTION

Industry 4.0 has emerged as a transformative force in modern manufacturing, characterized by intelligent systems, interconnected devices, and the integration of artificial intelligence across all operational domains. This fourth industrial revolution builds upon the foundations laid by mechanization (Industry 1.0), mass production (Industry 2.0), and automation (Industry 3.0), introducing cyber-physical systems, the Internet of Things, and cognitive computing capabilities. The advancement of artificial intelligence has progressed to the point where it is beginning to approximate human intelligence in specific domains, garnering significant attention from both academic researchers and industrial investors worldwide [1], [2].

The Indian automotive industry represents one of the largest manufacturing sectors in the country, contributing approximately 5% to the national Gross Domestic Product (GDP) and ranking as the fourth-largest automotive market globally. During the fiscal year 2019, vehicle production reached 30.92 million units, with a compound annual growth rate of 6.96% from 2013 to 2019. The industry encompasses a diverse range of enterprises, from large-scale hierarchical organizations producing complete passenger vehicles to agile Tier-1 suppliers. The western region of India, encompassing Pune, Nashik, Aurangabad, and Ahmedabad, serves as one of the country's key automotive hubs, hosting numerous manufacturing facilities from both domestic and international manufacturers [3], [4].

Artificial intelligence technologies, including machine learning, deep learning, natural language processing, and computer vision, are increasingly being deployed across various business functions. In the automotive context, AI applications span autonomous vehicles, predictive maintenance, driver assistance systems, manufacturing automation, quality control, supply chain optimization, and customer service enhancement. However, the implementation of AI also

raises significant concerns regarding workforce displacement, skill obsolescence, and the changing nature of human-machine interaction within organizational settings [5], [6].

This research investigates the intersection of artificial intelligence and human resources within the Indian automotive industry, with a specific focus on the western region. The study aims to understand how AI technologies are transforming HR functions, employee behavior, skill requirements, and organizational structures. The researcher selected this prospective field of study due to interest in the potential implications that artificial intelligence may have on the duties and responsibilities associated with human resources management [7], [8].

LITERATURE REVIEW

A. Artificial Intelligence: Historical Evolution and Current Status

The concept of artificial intelligence has been evolving since the 1940s, when logician Walter Pitts and neurologist Warren McCulloch laid the groundwork for artificial neural networks. The term "artificial intelligence" was first coined by John McCarthy in 1955, who defined it as "the science and engineering of making intelligent machines." Over the following decades, AI research experienced periods of significant advancement followed by periods of reduced investment, known as "AI winters," when progress failed to meet expectations [9], [10].

According to Nilsson [11], artificial intelligence development aims to create intelligent machines capable of thinking and behavior comparable to living beings. Key applications include natural language processing, intelligent database information retrieval, mathematical theorem proving, autonomous robotics, expert consultation systems, and perception-based problem solving. Muller and Bostrom [12] conducted a comprehensive expert survey, forecasting a fifty percent probability of widespread AI exposure by 2040-2050, with a ninety percent probability by 2075.

B. AI Applications in Manufacturing

Monostori [13] discussed the benefits of machine learning and artificial intelligence for industrial systems, emphasizing the use of multiple AI-related technologies including artificial neural networks, pattern recognition algorithms, and fuzzy logic to cope with increasing complexity. Kempf [14] highlighted the role of human engineers in product design, process description, and execution, noting that traditional data processing is becoming insufficient for solving emerging business problems.

Dhanabalan and Sathish [15] examined AI and robotics in Industry 4.0, identifying three ways AI can benefit businesses: enhanced decision-making, adaptive supply chains, and easier demand forecasting. Yang and colleagues [16] explored the growing use of 3D printing in manufacturing, with AI playing a vital role in creating high-quality, intelligent, efficient, flexible, and versatile solutions. Aggour, Gupta, and Ruscitto [17] described how General Electric is digitalizing manufacturing, design, and quality control operations using a combination of physical principles, artificial intelligence, and machine learning.

C. AI and Human Resources Management

Barnett [18] asserted that human resource executives are increasingly recognizing the importance of data-driven insights for making less risky decisions regarding employee performance and management. The swift insights provided by AI technology enable HR directors to significantly improve recruitment, retention, and motivation of top personnel, ultimately improving financial performance. Meister [19] claimed that AI is a reality currently being used across various businesses, suggesting that HR executives should begin experimenting with all aspects of AI to boost organizational value.

Chamorro-Premuzic and Taylor [20] argued that curiosity is an essential quality for modern organizations to seek in potential employees. They contend that AI has limited learning capacities compared to humans, particularly in handling novel or equivalent situations. While AI will be more effective in performing repetitive tasks, it cannot replicate human responses to unexpected situations. Jarrahi [21] outlined a future where humans and AI work together, with humans relying on their instincts while AI performs essential but dangerous tasks.

Khatri and colleagues [22] addressed the possible implications of AI-based systems on talent management. The authors noted that Industry 4.0 creates a beneficial side effect of compelling people to retrain and improve existing skills while opening new professional opportunities. Nawaz [23] conducted a comprehensive literature review spanning three decades to understand the role of AI in human resources. Vrontis and colleagues [24] examined the social and technical consequences of Industry 4.0 technologies on human resource management, suggesting that organizations should provide employees with future-oriented training while determining how to adapt to technological advancements.

D. AI in the Automotive Industry

Lou and Huang [25] cited quality control in the automotive industry as a typical application of AI models, presenting a proactive quality control strategy for improving the vehicle painting process. The intelligent decision support system eliminates errors occurring during data processing. Kässer and colleagues [26] predicted that self-driving cars will

become the norm within twenty years, suggesting that AI will completely transform the automotive industry in terms of project management, research and development, manufacturing, and back-end support.

Hofmann, Neukart, and Back [27] explained how the automotive industry can increase customer attention across the product lifecycle using big data analytics, machine learning, and AI, enabling time savings while providing improved customer service. Xu and colleagues [28] examined the use of AI to assist the automotive sector in solving problems related to quality management, presenting the Intelligent Quality Problem-Solving System (IQPSS) that combines human and AI capabilities.

The European Automobile Manufacturers Association [29] identified AI as the most significant technical innovation in the automotive sector, listing prominent output fields where AI is currently being applied. The position paper highlights that AI is inherent to everything from value chains and business processes to manufacturing procedures and the products themselves.

RESEARCH METHODOLOGY

A. Research Design

This study employs a mixed-method research approach combining both qualitative and quantitative methodologies. The research process included a pilot test, field survey, and comprehensive survey to gather primary data from respondents. A stratified random sampling method was used to examine and evaluate content validity and reliability of the test survey. Structural equation modeling and confirmatory factor analysis using SPSS IBM 21 and AMOS were employed to understand population variability during survey administration and model testing [30], [31].

Author(s)	Year	Focus Area	Key Contribution
Nilsson	2014	AI Principles	Identified key AI applications including NLP, robotics, expert systems
Monostori	2003	Manufacturing	Discussed AI techniques for industrial complexity management
Barnett	2016	HR Management	Highlighted data-driven insights for HR decision making
Jarrahi	2018	Human-AI Symbiosis	Proposed collaborative framework for humans and AI
Kässer et al.	2017	Automotive AI	Predicted transformation of auto industry through AI
ACEA	2020	Policy Framework	Provided guidelines for AI implementation in automotive

TABLE I: SUMMARY OF KEY LITERATURE FINDINGS

B. Sample Selection and Geographic Distribution

According to the Society of Indian Automotive Manufacturers (SIAM), India is home to 21 of the world's top 25 automobile manufacturers. The western region hosts thirteen manufacturing facilities across eleven companies, which collectively produce the majority of passenger vehicles. The researcher selected eleven western passenger vehicle manufacturers to participate in the study. Two hundred twenty-three managers from relevant disciplines, including middle-level and top-level management, were included in the sample.

Region	Manufacturing Hubs	Major Manufacturers
Pune Region	Pune, Nashik, Aurangabad	Tata Motors, Mahindra, Bajaj, Volkswagen
Ahmedabad Region	Sanand, Halol, Hansalpur	Ford, MG Motors, Honda
Delhi NCR Region	Noida, Gurgaon, Manesar	Maruti Suzuki, Honda, Toyota
Chennai Region	Kanchipuram, Bangalore, Sricity	Hyundai, Renault-Nissan, Ford

TABLE II: GEOGRAPHIC DISTRIBUTION OF AUTOMOTIVE MANUFACTURING IN WESTERN INDIA

C. Variable Definition and Hypothesis Formulation

Exogenous Variable (Independent): Artificial Intelligence in Automotive Functioning, encompassing AI applications in manufacturing processes (production planning, logistics management, quality control, guided robotics) and AI automation in human support functions.

Mediating Variable: Impact of Artificial Intelligence on Human Resources, including employee support functions, skill development, and employee behavior modification.

Endogenous Variable (Dependent): Impact on Job Structure, covering full-time, part-time, contract, and temporary employment patterns, along with changes in staff levels and employment dynamics.

D. Instrumentation and Data Collection

A structured questionnaire containing 38 scale items was developed and validated by subject matter experts. The instrument was designed using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The questionnaire was divided into two sections: demographic information and scale items measuring various constructs. Data collection occurred between April 2019 and April 2021, following a pilot test with 50 respondents to ensure reliability and validity.

Characteristic	Category	Frequency	Percentage
Gender	Male	208	93.3%
	Female	14	6.3%
Education	Graduate	122	54.7%
	Postgraduate	101	45.3%
Experience	<15 years	76	34.1%
	16-20 years	62	27.8%
	30+ years	85	38.1%

TABLE III: DEMOGRAPHIC CHARACTERISTICS OF RESPONDENTS (N=223)

RESULTS AND DISCUSSION

C. Reliability and Validity Assessment

Cronbach's alpha was utilized to measure the internal consistency of the research instrument. The overall Cronbach's alpha coefficient was 0.89, exceeding the acceptable threshold of 0.70 established by Nunnally [32]. Construct validity was assessed through both convergent and discriminant validity measures. Factor loadings exceeded 0.5 for all items, and the Average Variance Extracted (AVE) values were greater than 0.5, confirming convergent validity.

D. Demographic Analysis

Among 223 respondents, 93.3% were male and 6.3% female, reflecting the gender distribution in the Indian automotive manufacturing sector. Regarding educational qualifications, 54.7% held graduate degrees while 45.3% possessed postgraduate qualifications. Experience levels showed that 34.1% had less than fifteen years, 27.8% had sixteen to twenty years, and 38.1% had thirty years or more of work experience. Management level distribution indicated 26% from senior management and 74% from middle management.

C. AI Adoption in Manufacturing Processes

Survey results indicated that 86.1% of respondents confirmed AI implementation in their organizations. Manufacturing and production accounted for 21.7% of AI applications, followed by quality control (12.2%), research and development (12.7%), and maintenance and utilities (12.7%). The mean scores for AI's impact on manufacturing functions ranged from 3.91 to 4.39, indicating generally positive perceptions.

Respondents strongly agreed that AI improves inspection quality (mean 4.39, 66.8% agreement), enhances production planning (mean 4.16, 45.7% strong agreement), improves material logistic planning (mean 4.09, 38.1% strong agreement), and reduces manufacturing costs (mean 4.00, 36.8% strong agreement). However, concerns about AI-induced insecurity and stress among employees were also evident (mean 3.48, 40.8% agreement).

E. Impact on Human Resource Functions

Regarding the impact on HR functions, respondents agreed that AI assists with HR planning predictions (mean 3.64, 54.7% agreement), facilitates decision-making (mean 3.80, 50.0% agreement), and creates demand for continuous education and training (mean 3.98, 53.4% agreement). However, 54.3% of respondents agreed that AI would ultimately replace humans in certain jobs, indicating significant workforce concerns.

AI was perceived as enhancing employee support functions (mean 4.04, 41.3% agreement) and improving employee communication and collaboration (mean 3.49, 38.1% agreement). Regarding skill development, respondents agreed that AI improves potential skill efficiency (mean 3.81, 48.0% agreement), creates demand for newer skill sets (mean 4.18, 39.9% agreement), assists in career development (mean 3.66, 42.2% agreement), and aids in prediction and decision-making (mean 3.95, 48.0% agreement).

F. Impact on Job Structure and Employment

Respondents indicated that AI promotes horizontal job structures (mean 3.77, 55.2% agreement) while also reinforcing vertical structures (mean 3.47, 39.5% agreement). AI was seen as improving managerial functions (mean 3.79, 62.3% agreement) and strategic functions (mean 3.91, 58.7% agreement). The need for specially skilled human resources was strongly emphasized (mean 3.91, 54.7% agreement).

Concerns about job displacement were evident, with 37.7% agreeing that AI increases retrenchment and 48.0% agreeing that AI creates job insecurity. However, 57.0% of respondents agreed that AI is gradually replacing natural intelligence in organizational contexts.

G. Organizational Preparedness

Regarding organizational responses to AI implementation, 49.8% of respondents agreed that organizations provide special motivation to address job insecurity. Organizations were perceived as supporting employee individual learning (mean 4.12, 66.8% agreement) and providing training for reskilling existing human resources (mean 4.09, 69.5% agreement). Leadership was seen as providing opportunities for knowledge sharing (mean 4.09, 51.6% agreement) and facilitating career development (mean 3.90, 50.7% agreement).

Construct	Mean Score	Interpretation
AI in Automotive Functioning	3.64	Good/Very Good
Impact on HR (Support Functions)	3.80	Good/Very Good
Skill Development	3.84	Good/Very Good
Job Structure	3.45	Good
Organizational Preparedness	3.98	Good/Very Good

TABLE IV: SUMMARY OF GRAND MEAN SCORES BY CONSTRUCT

DISCUSSION

H. Key Findings and Interpretation

The research reveals several significant findings regarding the implementation and impact of AI on human resources in the Indian automotive industry. First, AI adoption in India remains in its nascent stage, primarily due to inadequate backup infrastructure and limited investment in AI research laboratories. The general population perceives AI merely as machine control rather than a transformative technology capable of augmenting human capabilities [33].

Second, India possesses a substantial pool of talented, actively engaged workers. The research suggests that more effective use of human resources would involve reskilling rather than complete automation. Organizations should focus on training people in new skills rather than attempting to fully automate processes using AI, as human workers remain more productive when equipped with appropriate tools and technology [34].

Third, expert systems facilitate decision-making under uncertainty, while neural networks reduce human resource requirements in specific operational areas. For large-scale implementation, machines require significant investments in infrastructure, energy consumption, and network connectivity. Cobots (collaborative robots) are valuable because humans are more productive when provided with tools and technology support.

A. Challenges and Barriers

The research identified several challenges to AI adoption in the Indian automotive industry. These include high implementation costs, lack of skilled professionals, data dependency, lack of AI awareness among workers, infrastructure limitations, and resistance to change from employees who fear job displacement. Additionally, AI's lack of empathy and emotional connection capabilities makes it unsuitable for understanding human behavior, which remains essential for Indian business operations [35].

AI systems are dependent on ready-to-use data that may contain inherent biases, potentially leading to discriminatory outcomes if not carefully monitored. The growing AI market will continue to expand to support human resources, and AI will be widely used for modernization purposes. However, organizations must carefully balance the benefits of AI automation with the need to maintain human engagement and job satisfaction.

B. Implications for Practice

Several practical implications emerge from this research. Organizations should develop clear strategies for AI implementation that prioritize employee development alongside technological advancement. HR departments should focus on creating skill development programs that prepare workers for AI-augmented roles, emphasizing cognitive flexibility, emotional intelligence, and complex problem-solving capabilities that AI cannot easily replicate [36].

Additionally, organizations should invest in change management initiatives that address employee concerns about job security and provide clear pathways for career advancement in AI-enabled environments. Leadership should foster a culture of continuous learning and innovation, recognizing that human-machine collaboration rather than complete automation represents the optimal path forward.

CONCLUSION

This research provides a comprehensive examination of artificial intelligence implementation and its impact on human resources within the Indian automotive industry. The study reveals that while AI adoption is still in its early stages in India due to infrastructure and awareness limitations, the technology is progressively transforming manufacturing processes, quality control, decision-making functions, and employee skill requirements.

Key findings indicate that AI significantly improves inspection quality, production planning, material logistics, and cost reduction in manufacturing operations. However, the technology also creates concerns regarding job insecurity, skill obsolescence, and the need for continuous learning. Organizations are responding by providing training for reskilling existing human resources and supporting employee individual learning, though significant gaps remain in addressing psychological impacts on the workforce training programs, and the development of human-AI collaboration frameworks. Organizations must focus on reskilling rather than complete automation, recognizing that human expertise remains irreplaceable in tasks requiring emotional intelligence, complex decision-making, and nuanced understanding of human behavior. The growing AI market will continue to expand to support human resources, and AI will be widely utilized for modernization purposes, making it imperative for organizations to prepare their workforce for this technological transformation.

Key Conclusion: Artificial intelligence presents both opportunities and challenges for the Indian automotive industry. While AI enhances operational efficiency and quality, successful implementation requires balanced attention to technological advancement and human resource development. Organizations that invest in reskilling and maintain human-centric approaches will be better positioned to leverage AI's benefits while mitigating its disruptive impacts.

LIMITATIONS AND FUTURE RESEARCH

This research has several limitations that should be acknowledged. The study focused exclusively on the western region of India, which may limit generalizability to other regions. The sample consisted primarily of managerial-level respondents, potentially missing perspectives from operational staff directly affected by AI implementation. The cross-sectional design captures perceptions at a single point in time, while AI adoption is an evolving process that may produce different results over longer observation periods. Future research should expand geographic coverage to include other automotive manufacturing regions in India, incorporate multiple stakeholder perspectives including operational staff and trade unions, and employ longitudinal designs to track changing perceptions over time. Additionally, comparative studies between organizations at different stages of AI adoption could identify best practices for successful implementation. Research examining specific AI technologies and their differential impacts on various HR functions would provide more granular insights for practitioners.

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