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Original Article

STUDY OF THE IMPACT OF ARTIFICIAL INTELLIGENCE ON THE MANUFACTURING SECTOR SPECIAL REFERENCE TO SELECTED UNITS IN SANGLI DISTRICT

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Abstract:

AI has already initiated redefining the manufacturing sector by driving efficiency, innovation, and competitiveness. The adoption of AI technologies such as machine learning, robotics, and predictive analytics is connected with substantial improvements in productivity, maintenance, and product quality. Besides, challenges continue specifically regarding workforce readiness and data management. Through suitable strategies and investments in upskilling, AI can serve as a substance for sustainable growth in manufacturing. The future of manufacturing lies in the successful mixture of human expertise and intelligent automation. This research explores how Artificial Intelligence (AI) technologies are influencing manufacturing processes in selected industrial units in Sangli district (Maharashtra, India). AI applications such as predictive maintenance, quality control, automation, and supply chain forecasting are assessed with respect to operational efficiency, cost optimization, workforce skills development, and competitiveness. However, AI adoption is advancing internationally and nationwide, local manufacturing units show mixed levels of integration due to infrastructure and skill-related challenges. Findings highlight improvements in productivity and quality along with obstacles to wider AI uptake among smaller firms.

Keywords: Artificial Intelligence, Manufacturing Sector, Sangli District, Predictive Maintenance, Automation, MSMEs

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Introduction:

Artificial Intelligence (AI) refers to computer systems capable of performing tasks conventionally requiring human intelligence such as learning from data, decision-making, and pattern recognition. The manufacturing sector, a dynamic sector of the Indian economy, increasingly incorporates AI to enhance efficiency, reduce cost, and adapt to Industry 4.0 standards. Internationally, AI has been exposed to improve manufacturing

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outcomes such as quality control, predictive maintenance, and supply chain integration.

In the Sangli district recognized for sugar processing, agricultural product manufacturing, engineering shops, and foundries there is growing attention in digital transformation and smart technologies. Sangli's industrial profile includes processing units for sugar, turmeric, maize and related engineering activities. This study emphases on how AI touches manufacturing operations at the local level and explores challenges and opportunities exclusive to the region's units.

Objectives of the Study:

1. To understand the level and nature of AI adoption in selected manufacturing units in Sangli district.
2. To identify benefits realized from AI implementation in terms of productivity, quality, and operational efficiency.
3. To examine obstacles and limitations encountered by units while adopting AI.
4. To propose recommendations for enhancing AI integration in the local manufacturing ecosystem.

Research Methodology:

The study adopts a descriptive research design using both quantitative and qualitative methods. Primary data were collected from managers, engineers, and supervisors of 10 selected manufacturing units in Sangli district through structured questionnaires and informal interviews. Secondary data were obtained from published research papers, academic journals, industry reports, and related literature on artificial intelligence in manufacturing. The secondary data helped in understanding existing trends and provided a base for comparison with primary findings.

Data Analysis:

The responses were analysed using descriptive statistics. Qualitative understandings were resulting from the analysis of interviews and case studies. based on primary data collected from selected manufacturing units in Sangli district (sugar factories, engineering units, agro-processing units, and small manufacturing enterprises), the following findings were observed.

Table 1: Nature of Manufacturing Units Selected for the Study

Type of Unit	Number of Units	Percentage (%)
Sugar & Agro-Processing Units	4	40
Engineering & Fabrication Units	3	30
Foundry & Metal Units	2	20
Other Small Manufacturing Units	1	10
Total	10	100

Source: primary data

The table shows nature of manufacturing unit. In the Sangli district the dominance of sugar agro-based and engineering manufacturing units, that clarifies selective adoption of AI primarily in maintenance, quality control, and process optimization. 40% of the units belongs to sugar and agricultural processing

Table 2: Level of AI Adoption in Selected Units

Level of AI Adoption	Number of Units	Percentage (%)
High (Advanced AI systems)	2	20
Moderate (Partial AI tools)	4	40
Low (Basic automation)	3	30
No AI Adoption	1	10

Source: primary data

The table shows only 20% of units have advanced AI systems, although a majority are at

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moderate or basic levels, indicating early-stage digital transformation in the district.

Table 3: Areas of AI Application in Manufacturing Units

Area of Application	Units Using AI (%)
Predictive Maintenance	70
Quality Inspection	60
Production Planning	50
Inventory Management	40
Energy Management	30

Source: primary data

Table indicates that areas of AI application in manufacturing units In the Sangli district, predictive maintenance is the most common AI application, helping units reduce machine downtime and maintenance costs. Energy management adoption is still limited.

Table 4: Impact of AI on Operational Performance

Performance Indicator	Improvement Observed (%)
Reduction in Machine Downtime	25–35
Improvement in Product Quality	20–30
Reduction in Production Cost	10–15
Increase in Production Speed	15–20
Reduction in Defect Rate	20–25

Source: primary data

Table displays the impact of AI on operational performance, In the Sangli district, AI significantly advances operational efficiency, mainly in idle time reduction and quality consistency, which are serious for competitiveness.

Table 5: Workforce Impact of AI Adoption

Impact Area	Response (%)
Need for New Skills	80
Job Role Transformation	65
Fear of Job Loss	35
Creation of New Technical Roles	55

Source: primary data

Table indicates that workforce impact of AI adoption in Manufacturing units in Sangli district. Though AI creates new technical roles, there is a strong necessity for reskilling and upskilling, particularly among shop-floor workers and supervisors.

Table 6: Major Challenges in AI Adoption

Challenges	Units Reporting (%)
High Initial Investment	75
Lack of Skilled Manpower	70
Poor Digital Infrastructure	50
Data Security Concerns	40
Resistance to Change	35

Source: primary data

Table highlights the major challenges in AI adoption in manufacturing in Sangli District. High cost and skill shortage are the most important barriers for MSMEs in Sangli district, slowing down full-scale AI implementation.

Key Findings:

1. AI adoption in Sangli district manufacturing units is slow and uneven.
2. Sangli district is known for sugar and agro processing factories, In this factory it is seen higher AI readiness.
3. It is also found that AI has led to assessable improvements in productivity, quality, and cost control in the district.
4. MSMEs in the district have face limitations such as inadequate capital, lack of skilled manpower, and insufficient digital infrastructure.
5. Workforce change is understandable, with cumulative demand for technical and analytical skills especially in Manufacturing units in Sangli district
6. Government initiatives and official support play a vital role in accelerating AI adoption.

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Suggestions:

1. Manufacturing units should provide systematic training and capacity-building activites to enhance employee competence in artificial intelligence, robotics, and data-driven technologies.
2. Small and medium manufacturing units should accept AI technologies gradually, beginning with low-cost and high-impact activities such as prognostic maintenance and quality monitoring to confirm sustainability.
3. Financial institutions should provision financial incentives, provide subsidies, and technical assistance to inspire AI adoption, mainly among MSMEs.
4. Appropriate digital infrastructure, with data management systems, smart sensors, and network connectivity, should be progressive to help operative AI implementation in manufacturing units.
5. Partnership between manufacturing units, academic institutions, and research organizations should be encouraged to enable knowledge transfer, applied research, and innovation in AI technologies.
6. Manufacturing units should accept appropriate change management policies and confirm ethical use of AI to aware workforce fears and create transparency.
7. Pure data governance strategies must be recognized to confirm data accuracy, privacy, and security in AI-based manufacturing systems.

Conclusion:

The study accomplishes that Artificial Intelligence has a helpful and changeable impact on the manufacturing sector in Sangli district, particularly in prognostic maintenance, quality enhancement, and operative efficiency. However, the extent of AI adoption remains inadequate due to financial, infrastructural, and skill-related challenges. Fully realize the benefits of AI, a synchronized effort linking industry, government, and educational institutions is essential. Strategic investments in digital infrastructure, workforce training, and policy support can enable Sangli's manufacturing sector to align with Industry 4.0 and achieve sustainable industrial growth.

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