

AI IN MANUFACTURING – SCIENCE & TECHNOLOGY

NEWS: The manufacturing sector is undergoing a paradigm shift, powered not by steam or steel, but by smart algorithms and intelligent systems.

WHAT'S IN THE NEWS?

Role of AI in Modern Manufacturing

- **Virtual Replication of Systems:** AI is used to build **digital twins**—virtual replicas of production lines, factories, and supply chains—which simulate, analyze, and optimize performance in real-time.
- **Modernizing Operations:** AI is transforming outdated, manual facilities into **state-of-the-art smart plants** that are more efficient, connected, and intelligent.
- **Enhanced Performance:** Through real-time adaptability and intelligent design, AI enables **higher production output, reduced material waste**, and optimized workflows.

Market Size and Adoption Trends

- **Global Market Projection:** The global market for AI in manufacturing is projected to grow from **\$4.1 billion in 2024 to over \$25 billion by 2029**, reflecting rapid technological transformation.
- **India's Rising Adoption:** AI adoption in India's manufacturing sector rose from **8% to 22% in just one year (FY2024)**, indicating accelerating integration of AI in industrial processes.
- **GDP Contribution Potential:** By 2025, data and AI are expected to contribute **\$450–500 billion to India's GDP**, making it a critical driver of economic growth.

Key Applications of AI in Manufacturing

- **Predictive Maintenance:** Uses sensor data and machine learning algorithms to **predict equipment failures**, reducing unplanned downtime by up to **30%** (McKinsey).
- **Quality Control:** AI-powered **computer vision systems** can detect micro-defects or irregularities in real time, ensuring better product quality and consistency.
- **Process Optimization:** AI enables **dynamic adjustments to production workflows**, helping reduce waste, energy use, and improving process efficiency.
- **Supply Chain Forecasting:** AI enhances **forecasting accuracy and responsiveness** by over **20%**, allowing better inventory and logistics decisions (IBM).
- **Robotics & Automation:** AI-enabled **collaborative robots (cobots)** support humans in repetitive or hazardous tasks, boosting **workplace safety and productivity**.

Sector-Specific AI Innovations

- **Automotive:** AI-driven robotic systems are used to **automate assembly lines, perform inspections**, and improve precision in manufacturing.
- **Electronics:** **Machine vision technology** ensures micro-level accuracy in placing and assembling small electronic components.

- **Pharmaceuticals:** AI systems oversee **large-scale production**, ensure **compliance with regulations**, and monitor drug quality.
- **Textiles:** AI-integrated **CAD/CAM tools** enhance the design, cutting, stitching, and quality inspection processes.

Challenges to AI Adoption in Manufacturing

- **Talent Deficit:** There is a **shortage of skilled professionals** trained in AI, data science, and machine learning, especially in the manufacturing sector.
- **High Integration Costs:** Implementing AI solutions involves **significant upfront investment**, which deters **MSMEs** (Micro, Small and Medium Enterprises).
- **Data Governance Issues:** Manufacturers face concerns regarding the **transparency, bias, and explainability** of AI algorithms and decisions.
- **Digital Infrastructure Gaps:** In **tier-2 and tier-3 cities**, **internet reliability and cloud infrastructure** remain insufficient, slowing AI deployment.
- **Low MSME Adoption:** Currently, **only about 15% of Indian SMEs** use AI in their manufacturing operations, limiting the sector's overall transformation.
- **Leadership Hesitation:** Around **44% of manufacturing leaders** are cautious about scaling generative AI, due to its **uncertain accuracy and lack of explainability**.

Government Initiatives to Promote AI in Manufacturing

- **National Programme on AI (MeitY):** Launched by the Ministry of Electronics and IT, it promotes **responsible and ethical AI adoption** across industries, including manufacturing.
- **Samarth Udyog Bharat 4.0:** An Industry 4.0 initiative that supports **smart factory development, automation**, and the integration of **digital technologies** in Indian manufacturing.
- **IndiaAI Mission:** With a **₹10,300 crore** budget, this mission aims to build **AI compute infrastructure**, support indigenous AI models, and promote safe, large-scale deployment.
- **Centres of Excellence (CoEs):** Set up across domains such as **manufacturing, healthcare, education, and agriculture**, to drive **AI-led innovation and skilling**.

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