



CEEAMA *Live Wire* E-NEWSLETTER

Published by Consulting Electrical Engineers Association of Maharashtra



Topic for June 2026
AI IN INDUSTRIES

Before immersing yourselves in this month's topic, revisit the last issue—take the quiz at the end and see how much you remember.

Electrical Consultants Newsletter
Volume No. 4 Issue #60
June 2026

CEEAMA Governing Council
Directors



Mr. Chidambar Joshi
Hon. President



Mr. Ulhas Vajre
Hon. Secretary



Mr. Anil Bhandari
Hon. Treasurer

Directors

Mr. Narendra Duvedi

Mr. Mohan Kelkar

Mr. Ulhas Vajre

Mr. Krishna S. Chandavar

Mr. Veejhay Limaaye

Mr. Subhash L. Bahulekar
Chief Editor - CEEAMA LIVEWIRE

From the Editors Desk,

Simplifying complex tasks, accelerating analysis, and enhancing decision-making accuracy are some of the most pressing objectives for engineering teams. For this, we need latest enhancements on the engineering tools that are empowering engineers and improving productivity.

Artificial intelligence is no longer a futuristic concept—it is now embedded in the daily operations of industries worldwide. From predictive maintenance in manufacturing plants to smart grids in energy distribution, AI is enabling efficiency, sustainability, and resilience.

Key Trends:

- o **Automation & Robotics:** AI-driven robots are reducing downtime and improving precision in production lines.
- o **Energy Management:** Smart AI systems are optimizing power usage, crucial for India's growing energy demands.
- o **Supply Chain Intelligence:** AI is helping industries anticipate disruptions and streamline logistics.

So, the questions we must ask: a) How to **automate manual processes** to transform engineering workflows into faster, more efficient, and seamless processes., b) How to use AI natural language queries to **interpret complex results**, reshaping the engineer's role from data processor to strategic decision-maker., and c) How to benefit from AI multilingual analysis interface and flexible reporting to ensure that global teams can **collaborate more effectively**.

So, let's deep dive into our quest and try to understand through this month's Livewire newsletter which emphasizes that **AI is not just a technological upgrade—it is a paradigm shift**. For industries in India and globally, the challenge lies in harnessing AI responsibly, ensuring that innovation aligns with sustainability, ethics, and human progress.

Wishing you all an electrifying, automated, yet always **SAFE**, period ahead.



Subhash L. Bahulekar
Chief Editor – CEEAMA

INDEX

Sr. No.	Article Title	Contributor	Page No.
1	From the President's Desk	Mr. Chidambar Joshi	1
2	<u>From the Secretary's Desk</u>	Mr. Ulhas Vajre	2
3	Agentic AI: The Next Evolution in Industrial Energy Management	Mr. Narendra Duvedi	4-7
4	Artificial Intelligence in Plant Engineering	Sarfaraj Ansari	8-11
5	AI in Plant Engineering – Electrical	Abhijeet Yadav	13-16
6	GEN AI for Plant Footprint Reduction	Vaidehi Khadse	17-20
7	<u>Transforming Plant Engineering with Artificial Intelligence</u>	Dhruvin Bambharoliya	23-25
8	AI in Lighting Systems	Rupenkumar Patel	26-27
9	AI in Industries: Redefining Roles	Chelsi Mayur Hansaliya	28-32
10	AI in Industry – Transforming the Future of Industrial Operations	Isha Y. Saswade	33-35
11	<u>AI in PE – Bridging Artificial Intelligence with Modern Plant Operations</u>	PAVITHRAA J	36-39
12	<u>AI in PE – Digital Twins to Net Zero Plants</u>	Mansi Vasant Wadhavane	40-42
13	<u>A Study on Artificial Intelligence in Industry</u>	Jayraj Godhani	43-46
14	<u>Quiz Winners - April 2025</u>	CEEAMA Editorial Team	47
15	Quiz – May 2026	CEEAMA Editorial Team	48-49

From the President's desk:

This month we take a look at Artificial Intelligence in Industries. What better option do we have than asking AI about the impact of AI? I prompted the problem statement to AI and got the following results:

Key Applications of AI in Industrial Power Systems and Power Grid are

- Predictive Maintenance - analysing real-time variables like temperature, vibrations, and current flow. This predicts component failures before blackouts or asset damage occur
- Load and Demand Forecasting - Deep learning methods like Long Short-Term Memory (LSTM) networks map power consumption patterns. This prevents expensive peak-demand penalties.
- Fault Detection and Diagnostics - Computer vision and Machine Learning (ML) rapidly classify ground faults, short circuits, and harmonic distortions. This isolates network anomalies faster than traditional relays
- Renewable and Microgrid Integration - Hybrid industrial grids use Neuro-Fuzzy systems and reinforcement learning. This helps manage battery storage and balance volatile wind or solar generation
- Power Electronics Optimization - Intelligent regression models continuously calibrate power electronic systems (PELS). This reduces transmission losses and improves the overall power factor.

Something that captured my mind was the 'Self-Healing Network'.

A self-healing network is an automated power distribution system that uses smart sensors, digital relays, and software algorithms to autonomously detect, isolate, and recover from faults within seconds without human intervention. Instead of waiting for a maintenance team to manually locate a physically damaged cable, a self-healing network acts like a living organism which can sense trouble, reroute energy and keep critical infrastructure powered.

When severe cyclones knock out transmission lines along the eastern coast on India (Odisha and West Bengal), traditional grids suffer massive blackouts. Self-healing microgrids automatically isolate damaged coastal corridors, keeping major regional hospitals, water treatment plants, and disaster management hubs continuously electrified using backup sources. Discoms (like TPCODL in Odisha) are deploying smart automated reclosers alongside underground cabling under national initiatives like the Revamped Distribution Sector Scheme (RDSS).

At the Khavda renewable hub in Gujarat, solar capacity was operationalised in March 2024. This was rapidly backed up by the commission of massive utility-scale Battery Energy Storage Systems (BESS) with capacities added in March 2026 and fully scaled up in May 2026 marking the definitive milestone for real-time, automated millisecond grid stabilization in India's highest-capacity green corridor.

There are of course certain Operational Challenges in implementation of AI that include cybersecurity issues, integration of traditional equipment and data quality. Over a period of time the AI will become more intelligent as well as more menacing.

The last month (May 2026) was really hot. I felt that trying to calculate the efficiency of an industrial microgrid in May is useless; even the Ohm's Law coefficients sweat. I wish we too had some liquid cooling along with some AI based GPU servers. Last month I dreamt that the weatherman's AI model predicted a 0% chance of rain and a 100% chance of my Clients transformer core melting. Hope my dream doesn't come true.

At the onset of monsoon, I wish we have sufficient rain this year. Have a wonderful June.

With warm regards,



Mr. Chidambar Joshi
Hon. President

From the Secretary's desk:

Dear Esteemed Members,

Welcome to our June 2026 association update. This month marks one of the most critical structural pivots in the history of Indian engineering, architecture, and real estate development.

The Bureau of Indian Standards (BIS) has officially notified the complete rewriting and rebranding of the National Building Code of India (NBC 2016) into the **National Building Construction Standards 2026 (SP 7:2026)**, effective from **30 April 2026**.

[Old Framework]	[New Framework]
National Building Code (NBC 2016)	National Building Construction Standards (NBS 2026)
(Perceived Legal Binding / "Shall")	(Performance-Oriented Advisory Guidelines / "Should")

This is not a routine technical update. Following directives from the Deregulation Cell under the Cabinet Secretariat, the framework has transitioned from a rigid, mandatory "Code" system to a performance-oriented "Standards" system to enhance the ease of doing business and foster structural innovation.

For us as electrical consultants, this alters how we frame engineering contracts, enforce design liabilities, and interface with municipal corporations across Maharashtra.

The core objective of the new National Building Construction Standards (NBS) 2026 is to reduce legal bottlenecks and empower local authorities to customize compliance metrics.

Transition from "Shall" to "Should"

- **The Advisory Paradigm:** The word "shall" (mandatory) has been systematically replaced with "should" (advisory) across several sections, including fire and life safety rules.
- **State & Local Enforcement:** Because the national standard acts as a guideline, the primary legal enforcement power shifts entirely to state regulations like the Maharashtra Unified Development Control and Promotion Regulations (UDCPR) and local municipal corporations.
- **Height Threshold Revisions:** The mandatory fire safety compliance threshold for residential buildings has been raised from **15 metres to 24 metres**.

Commercial & Healthcare Relaxation

- **Hospital Height Caps Removed:** The historic 45-metre height restriction for hospital buildings has been removed to address urban healthcare space shortages.
- **High-Level ICUs:** Intensive Care Units (ICUs) are now permitted above 45 metres, provided advanced, performance-based fire engineering and electrical redundancies are met.

Despite shifting to a performance-driven ethos, the underlying guidelines for electrical services, circuit integrity, and life-safety networks have been strengthened. Electrical consultants must align their schematics with the following primary contents of the **NBS 2026**

Circuit Integrity & Fire Survival Networks

- **Fire-Rated Enclosures:** Critical electrical safety services must feature functional integrity under active fire, smoke, and heat conditions.
- **Fire Survival Distribution Boards:** Dedicated clauses govern circuit integrity for fire survival distribution boards to prevent premature power failure during building evacuations.
- **Material Separation:** Passive fire containment rules strictly define the segregation of electrical shafts from plumbing and mechanical lines.

Emergency Power & Evacuation Systems

- **Emergency Power Supplies:** Refined metrics dictate the automated switchover times, generator capacity redundancies, and distribution paths for life safety infrastructure.
- **Escape Route Infrastructure:** Emergency lighting, mechanical smoke-extraction systems, and automated fire alarm routing must remain live throughout a progressive evacuation sequence.
- **Progressive Evacuation Systems:** Detailed electrical control layouts are mandated for complex setups, particularly in hospital configurations and multi-tier refuge zones in high-rises exceeding 60 metres.

Smart City & Green Integration

- **EV Charging Infrastructure:** Structural provisions mandate dedicated electrical sub-stations, demand-response load management, and safety protocols for Electric Vehicle charging zones inside basement and car parking areas.
- **Advanced Monitoring:** Integration benchmarks are established for AI-based monitoring systems, digital twins, and smart meters to support green building operations.
- **Advanced Tech Accommodation:** The document outlines engineering safety frameworks for buildings constructed using 3D concrete printing and automated pre-fabricated systems.
- **Operational Directives for CEEAMA Members**
- To maintain compliance and protect engineering practice from liability under the new NBCS 2026 guidelines, the Executive Committee issues the following directives to all practicing electrical consultants in Maharashtra:

CEEAMA COMPLIANCE CHECKLIST:

- Audit existing project specifications for outdated “NBC 2016” text
- Cross-reference design standards against Maharashtra UDCPR updates
- Update professional indemnity insurance policies to match NBCS
- Formally integrate EV load demands into basic load calculations
- **Update Document Specifications Immediately:** Review all ongoing project tenders, municipal submissions, and engineering drawings. Remove references to “National Building Code 2016” or “NBC 2016” and replace them with “**National Building Construction Standards 2026 (SP 7:2026)**”.
- **Review Client-Consultant Agreements:** Because the national framework uses advisory language (“should”), clearly state in your design briefs whether you are adhering to NBCS 2026 as a minimum design benchmark. This clarifies legal liability before projects undergo local municipal review.
- **Harmonise with Maharashtra UDCPR:** Ensure your electrical load designs, substation placements, and generator rooms comply with local regulations, as municipal authorities hold ultimate enforcement control under this decentralized model.
- **Mandate Fire Survival Systems:** Do not lower fire safety specifications on buildings between 15 and 24 metres despite the raised national threshold. CEEAMA strongly advises maintaining rigorous circuit integrity, fire-rated cabling, and localized distribution boards across all multi-story projects.

Let us embrace this shift toward flexibility, high-tech integration, and architectural innovation while maintaining the safety of our engineering designs.

Sincerely,



Ulhas Vajre
Honorary Secretary

DISCLAIMER

The information in all the articles of CEEAMA LiveWire is compiled using references from various sources. Although every attempt has been made to ensure the accuracy of this material, neither CEEAMA nor any of its contributors to this publication assumes responsibility for any inaccuracies or omissions in the data presented. For use in practice, we strongly advise that, information utilized from this publication should be verified from the relevant sources and to use document of actual standard published by respective institution.

Agentic AI: The Next Evolution in Industrial Energy Management

Introduction

Industrial energy management has undergone a remarkable transformation during the last four decades. From manual meter reading and monthly energy accounting, we progressed to SCADA systems, energy monitoring systems (EMS), intelligent electronic devices (IEDs), and cloud-based analytics platforms.

Today, another major technological shift is emerging: **Agentic Artificial Intelligence (Agentic AI)**.

While conventional Energy Management Systems provide visibility of energy consumption, Agentic AI has the potential to continuously analyze real-time data, identify inefficiencies, predict future conditions, and recommend corrective actions.

For electrical consultants involved in designing modern industrial facilities, understanding this technology is becoming increasingly important.

Evolution of Industrial Energy Management

Phase 1: Manual Energy Management

Traditionally, industries relied upon Monthly utility bills, Manual meter readings, Periodic energy audits, Spreadsheet-based analysis. Energy-saving opportunities were often identified months after losses had already occurred. Effectively, the exercise was created history.

Phase 2: Conventional EMS

The introduction of Energy Management Systems enabled Real-time metering, Data logging, Dashboards, Trend analysis, Alarm – Alert generation. Such systems were mostly developed by IT and computer experts – who had very little knowledge about various manufacturing domains.

Some parts of the plants are equipped with DCS systems. Large energy consuming utility equipment may be supplied with individual HMIs. As a result “Many data silos” are created within the plant and the analysis becomes difficult. Maintenance teams are busy in populating energy data into various formats as required by costing departments. The systems in this phase had not ability to “Think”.

Phase 3: AI-Enabled EMS

The next stage involved machine learning algorithms capable of Predictive maintenance, Load forecasting, Energy benchmarking, Pattern recognition etc. These systems improved analytical capability but still required significant human intervention for analysis and taking decisions. Even here the implementation was mostly driven by computer engineers and domain expertise was not involved in implementation.

Phase 4: Agentic AI

Agentic AI introduces autonomous decision-making capabilities. Unlike traditional AI tools that merely answer questions, agentic systems can Observe, Reason, Plan, Execute, Learn from outcomes. The system behaves like a virtual energy manager continuously monitoring plant performance. Computer engineers create a skeleton infrastructure here and the tool can be configured by domain experts.

What is Agentic AI?

An AI Agent is a software entity capable of independently performing tasks to achieve a defined objective. For industrial energy management, the objective may be Minimize energy cost, Reduce peak demand, improve power

factor, maximize equipment efficiency, keep furnace energy consumption within specified band, Reduce carbon emissions etc.

The agent (a resident computer program) continuously interacts with Smart meters, SCADA systems, Building Management Systems, Process historians, Weather databases, Electricity market data, Maintenance systems, It then takes actions or recommends actions based on real-time conditions.

Traditional EMS versus Agentic AI

Parameter	Traditional EMS	Agentic AI EMS
Data Collection	Yes	Yes
Dashboards	Yes	Yes
Alarm Generation	Yes	Yes
Root Cause Analysis	Manual	Automatic
Predictive Analysis	Limited	Extensive
Decision Support	Basic	Advanced
Continuous Learning	No	Yes
Autonomous Actions	No	Possible
Multi-System Coordination	Limited	High
Optimization Capability	Reactive	Proactive

Traditional EMS answers “**What happened?**” whereas Agentic AI answers “**Why did it happen, what will happen next, and what should be done now?**”

Architecture of an Agentic Energy Management System

Layer 1 – Data Acquisition - Sources include Energy meters, Power quality analyzers, Transformer monitoring systems, Generator controls, Chiller controls, Compressed air systems, Production databases, Sensors collecting data on various non electrical shop floor parameters like temperature, flow, pressure, vibration etc.

Layer 2 – Data Platform - Data is collected through - OPC UA, Modbus, MQTT, Industrial IoT gateways, Cloud platforms

Layer 3 – AI Agent Layer - This layer performs - Pattern recognition, Root cause analysis, Forecasting, Optimization, Decision making – using real time data, “Meta data” related to equipment consuming energy, various rules related to use of equipment on shop floor, various process constraints fed into the Agentic AI tool during configuration – done by domain experts.

Layer 4 – Action Layer - Actions may include - Demand response control, Load shifting, Chiller optimization, Automatic reporting, Maintenance work order generation, prescriptive alerts to operators and escalation of such alerts if actions are not taken. Generating priority concerns related to energy optimization. Senior management support through chatbot interaction rather than query-based report generation.

Use Case 1:

Peak Demand Management

The AI agent continuously forecasts demand every few minutes. It may detect Production schedule changes,

increasing compressor loading, Rising ambient temperature.

The agent predicts that demand will exceed contract demand within 30 minutes and prescribe shutting off non-critical loads, Optimizes chiller sequencing, starts battery discharge, Sends recommendations to operators.

Result:

Peak demand penalties are avoided before they occur.

Use Case 2:

Chiller Plant Optimization

In many industries, chillers account for 20–40% of total electricity consumption.

Agentic AI identifies Fouling trends, Improper sequencing, address Excessive pumping energy, Low delta-T syndrome, The system continuously searches for the lowest kW/TR operating point.

Savings of 8–20% are commonly achievable.

Use Case 3:

Compressed Air System Optimization

Compressed air is one of the most expensive utilities in manufacturing plants. Agentic AI can detect leakage patterns, Unloaded compressor operation, Excessive pressure setpoints, Inappropriate compressor sequencing. The agent may recommend Pressure reduction, Compressor shutdown, Maintenance intervention. In several manufacturing facilities, compressed-air energy reductions of 10–25% have been achieved through continuous optimization.

Implications for Electrical Consultants

Electrical consultants will increasingly need to incorporate AI readiness into project designs.

Future specifications should consider:

Metering Infrastructure

High-quality data is essential. So, Projects should include strategically located Revenue-grade meters, Power quality meters, Digital protection relays, Environmental sensors

Communication Infrastructure

Designs should support OPC UA, Modbus, MQTT, Ethernet networks, Cybersecure architecture.

Data Integration - Future systems must allow integration with SCADA, EMS, ERP, and Building Management Systems

Cybersecurity

Agentic AI requires access to operational data and control systems. Consultants must ensure - Network segmentation, Access control, Encryption, Compliance with industrial cybersecurity standards

Challenges and Limitations

Despite its potential, Agentic AI is not a magic solution. Common challenges include - Poor Data Quality, Missing sensors, Incorrect CT/PT ratios, Communication failures, Incomplete data.

Older facilities may require significant upgrades. Operators often hesitate to trust autonomous recommendations.

Cybersecurity Risk. At present agentic AI and use of LLM for report generation needs cloud support and using large data centers run by different AI companies. Many times clients are reluctant to share data with clouds. Latency in getting response from an agent is also a cause of concern.

Future Outlook

Over the next decade, Agentic AI is likely to become the digital energy manager of industrial facilities.

Future systems may autonomously Optimize energy procurement, Participate in demand response programs, manage battery storage, Coordinate renewable generation, Minimize carbon emissions, Generate regulatory compliance reports. The role of human experts will evolve from data analysis toward strategic oversight and governance.

A very recent development in GPUs and hardware infrastructure will promise very powerful desktops and local servers minimizing necessity of cloud computing. These devices may provide very powerful “Edge computing devices” which will deploy AI agents close to plant equipment and only decisions and end results will be communicated to central infrastructure for reporting.

Future of Energy saving looks very promising.

Contributed By



Narendra Duvedi

Electrical Engineer and Energy Auditor with 40 Years of Industrial Experience

ASHIDA | 54
Agile Solutions Powerful Legacies

POWERING TOMORROW'S INFRASTRUCTURE

With over five decades of innovation, **ASHIDA** continues to lead the way in advanced power protection system. From intelligent electronic devices (IEDs) to comprehensive control and relay panel systems, our solutions are built for resilience, accuracy, and real-world performance.

Each product reflects our commitment to quality and adaptability — designed to meet the demands of modern transmission and distribution networks.

For more information ☎ +91-022-61299100/01/02 | ✉ sales@ashidaelectronics.com

- Protection Relays
- SAS & SCADA Solutions
- Gateway & Engineering Solutions
- Control & Relay Panels

ARTIFICIAL INTELLIGENCE IN PLANT ENGINEERING

1. Introduction

Artificial Intelligence (AI) is increasingly being integrated into plant engineering as a key enabler for enhancing system efficiency, reliability, and data-driven decision-making. With the growing complexity of modern industrial facilities, particularly in sectors such as oil & gas, petrochemicals, and power plants, conventional engineering approaches are often limited in managing large-scale data, multi-variable processes, and dynamic operating conditions. AI technologies, including machine learning, advanced analytics, and intelligent algorithms, facilitate the processing of high-volume operational and design data to support optimized engineering outcomes.



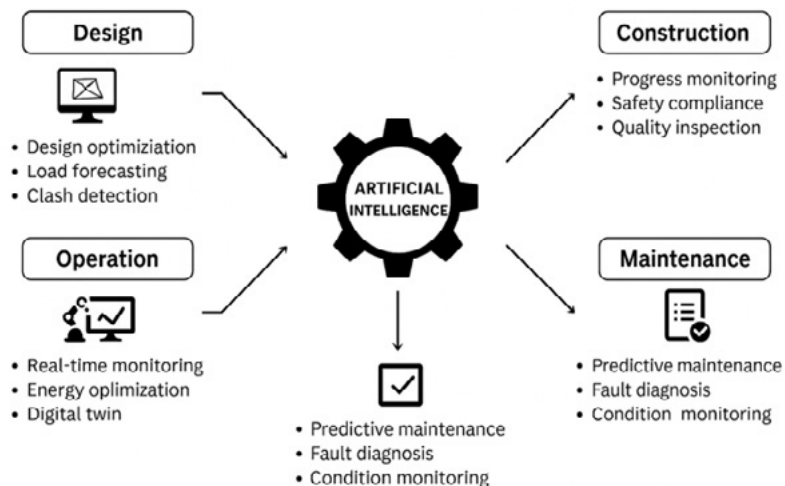
In plant engineering, the adoption of AI aligns with the broader transition towards digitalization and Industry 4.0 frameworks, where interconnected systems and real-time data exchange are fundamental. AI-driven tools enable improved accuracy in engineering calculations, support predictive analysis, and enhance system modeling capabilities. Moreover, integration of AI with plant data sources such as SCADA, DCS, and IoT-based sensors provides a foundation for developing intelligent systems capable of adaptive response and continuous performance improvement.

AI also enhances system integration by enabling seamless coordination between electrical, mechanical, and process subsystems through intelligent data exchange and unified platforms. This leads to improved system visibility, allowing engineers and operators to monitor and control plant performance more effectively. Advanced AI algorithms can continuously learn from operational data, enabling adaptive optimization of system parameters under varying load and process conditions.

Furthermore, the application of AI supports the development of autonomous and semi-autonomous plant operations by reducing dependency on manual intervention. By enabling real-time fault detection, anomaly identification, and intelligent decision support systems, AI contributes to improved safety, reduced operational risks, and enhanced lifecycle management of plant assets. These capabilities are essential for achieving reliable, efficient, and sustainable operation of modern industrial plants.

Thus, AI serves as a critical technological advancement in modern plant engineering, contributing to improved design validation, operational stability, lifecycle performance optimization, and the development of intelligent and autonomous industrial systems.

2. Role of AI in Plant Engineering



2.1 Design Phase

During the design phase of plant engineering, Artificial Intelligence (AI) enables advanced computational analysis, optimization, and data-driven validation of engineering parameters. AI-driven models, including machine learning and optimization algorithms, evaluate complex multi-variable design scenarios across electrical, mechanical, and process systems using historical data, vendor specifications, and standard design codes (IEC, IEEE, IS) to generate optimized and compliant design outputs.

In electrical design, AI improves load modeling and demand forecasting by analyzing historical load profiles and operational patterns, leading to more accurate transformer sizing, feeder selection, and system planning. It also supports optimized cable routing and sizing using advanced techniques such as genetic algorithms, ensuring compliance with voltage drop limits, short-circuit capacity, and thermal constraints while minimizing cost and power losses.

Furthermore, integration of AI with CAD and BIM platforms enhances design accuracy through automated clash detection, layout validation, and spatial optimization. AI systems can identify interferences between cable trays, busducts, piping, and structures at an early stage, reducing rework during construction. AI-based simulation tools also support load flow analysis, fault level calculations, and system performance validation under different operating conditions.

Additionally, AI facilitates automated generation and verification of engineering deliverables such as Single Line Diagrams (SLDs), cable schedules, and load lists, ensuring consistency and compliance with project requirements. Overall, AI integration in the design phase improves design accuracy, reduces engineering time, and enables development of efficient and reliable plant systems.

2.2 Construction and Commissioning Phase



During the construction and commissioning phase, Artificial Intelligence (AI) plays a significant role in enhancing execution efficiency, quality assurance, and safety compliance. AI-enabled computer vision systems, integrated with site cameras and drones, facilitate real-time monitoring of construction activities by analyzing images and video feeds to identify deviations from design specifications, improper installation practices, or unsafe working conditions. These systems can detect anomalies such as incorrect cable routing, improper termination, or non-compliance with installation standards, thereby reducing the likelihood of rework and ensuring adherence to project quality requirements.

In addition, AI supports construction planning and resource management by optimizing material utilization, workforce allocation, and project scheduling through predictive analytics. By analyzing historical project data and current progress trends, AI models can forecast potential delays and recommend corrective actions. During commissioning, AI-assisted diagnostic tools enable faster validation of electrical and mechanical systems by analyzing test data, identifying inconsistencies, and ensuring system readiness for operation. This results in reduced commissioning time, improved system reliability, and enhanced project delivery performance.

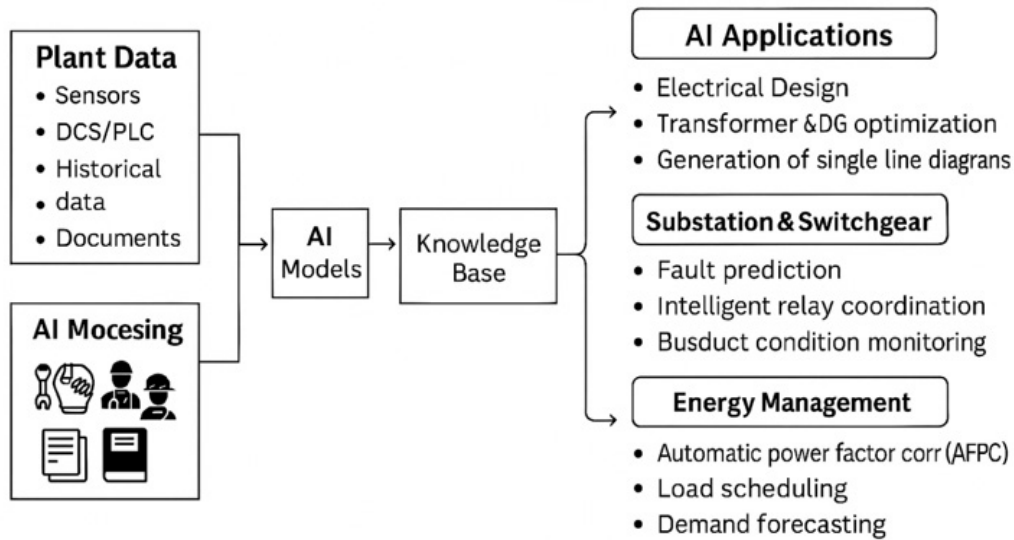
2.3 Operation Phase

In the operation phase, AI enables intelligent monitoring, control, and optimization of plant systems under varying load and process conditions. By integrating with Supervisory Control and Data Acquisition (SCADA), Distributed Control Systems (DCS), and Industrial Internet of Things (IIoT) platforms, AI systems continuously process real-time data from sensors, meters, and field devices to provide actionable insights into system performance. Advanced machine learning models are used to identify operational patterns, detect abnormalities, and optimize control strategies for improved efficiency and stability.

In electrical systems, AI facilitates dynamic load management, voltage regulation, and power factor correction by analyzing real-time load profiles and making adaptive control decisions. It also enhances energy management by predicting demand variations and optimizing the operation of critical equipment such as transformers, generators,

and motors. Furthermore, AI-driven digital twin models enable virtual representation of plant systems, allowing operators to simulate operating scenarios, assess system behavior under different conditions, and make informed decisions without affecting actual plant operations.

4. Applications



Artificial Intelligence (AI) has extensive applications in plant electrical engineering, particularly in design, system operation, and energy management. In electrical design, it enables automated cable sizing based on load, voltage drop, and thermal constraints, while optimizing transformer and DG selection and facilitating intelligent generation of Single Line Diagrams (SLDs). In substations and switchgear, AI supports predictive analysis, fault detection in HT/ LT panels, intelligent relay coordination, and condition monitoring of components such as busducts. Additionally, in energy management systems, AI enhances efficiency and reduces costs through automatic power factor correction (APFC), optimized load scheduling, and demand forecasting, enabling better planning and overall energy optimization in industrial plants.

5. Benefits

The implementation of Artificial Intelligence (AI) in plant engineering provides significant technical and operational advantages. AI enhances engineering efficiency by enabling faster data processing, automated analysis, and optimized system design, thereby reducing engineering cycle time. It improves accuracy in design and operation by minimizing human errors and ensuring compliance with engineering standards. AI-driven optimization techniques contribute to reduced capital and operational costs through efficient resource utilization, energy management, and system performance improvement.

In addition, AI enables predictive maintenance, which minimizes unplanned downtime and improves equipment reliability by identifying potential failures in advance. The integration of AI with real-time monitoring systems also enhances operational safety by detecting abnormalities and unsafe conditions at an early stage. Overall, AI supports data-driven decision-making, leading to improved plant performance, increased reliability, and cost-effective operations.

6. Conclusion

Artificial Intelligence (AI) is emerging as a critical technology in plant engineering, enabling advanced optimization, intelligent monitoring, and predictive capabilities across the plant lifecycle. Its integration with modern systems such as SCADA, DCS, and IoT enhances overall system efficiency, reliability, and operational flexibility. By supporting

improved design accuracy, efficient resource utilization, and proactive maintenance strategies, AI contributes to the development of intelligent and resilient plant systems.

As industries continue to adopt digitalization and Industry 4.0 frameworks, the role of AI will become increasingly important in achieving sustainable, efficient, and safe plant operations. Therefore, AI can be considered a key enabler for the future advancement of plant engineering.

Contributed By



Sarfaraj Ansari - Associate Electrical Engineer



Made in Italy, proven in India & Worldwide !

- Micro PLC**
DC, AC, Ethernet, RS485
- HMI**
7", 10.1", TFT LCD
- Moulded case circuit breakers**
3 pole, 100-800A, UL489, IEC
- Contractors**
3 & 4 pole up to 1600A
AC, DC, AC/DC, IEC/UL/CSA
- Motor Protection Circuit Breakers**
Up to 100kA @ 400V
magnetic & thermal protection,
certified UL type E, F
- Monitoring Relays**
1 & 3Ø, voltage, current,
frequency & multifunction
- Battery Chargers**
12V/24V, Industrial,
Lead-Acid, up to 12A



India Distributor
Madhura Power Technologies Pvt Ltd
Email : sales@madhura.net Web : www.madhura.net
Tel : + 91-20-25632783 / 25638494



PRABHA
ENTERPRISES

**DIGITAL MARKETING
IT & SOFTWARE
CONTENT CREATION**



grow your Digital Presence with us!!



- # Software Development
- # Business Process Automation / Re-engineering
- # Windows Application Development
- # Microsoft Technology Asp.Net, Win Forms, MS Access.
- # Website design & development
- # Android App development
- # Digital media marketing



- # People Networking
- # Marketing
- # Business Development
- # Team Building and management



- # Graphic designing
- # Brand designing
- # Visual and spatial consultancy
- # Print media content creation
- # Digital content creation
- # Photography and Videography Services



Contact Us:

- +91 9765150066
- prabhaenterprises09@gmail.com

www.prabhaenterprises.com

AI in Plant Engineering - Electrical

Introduction

The integration of Artificial Intelligence (AI) into plant engineering is transforming the way industrial facilities are designed, operated, and maintained. For electrical engineers, AI is no longer a futuristic concept—it is becoming a practical tool that enhances reliability, safety, energy efficiency, and decision-making in modern plants such as refineries, power plants, petrochemical industries, and manufacturing units.

AI in Electrical Plant Engineering

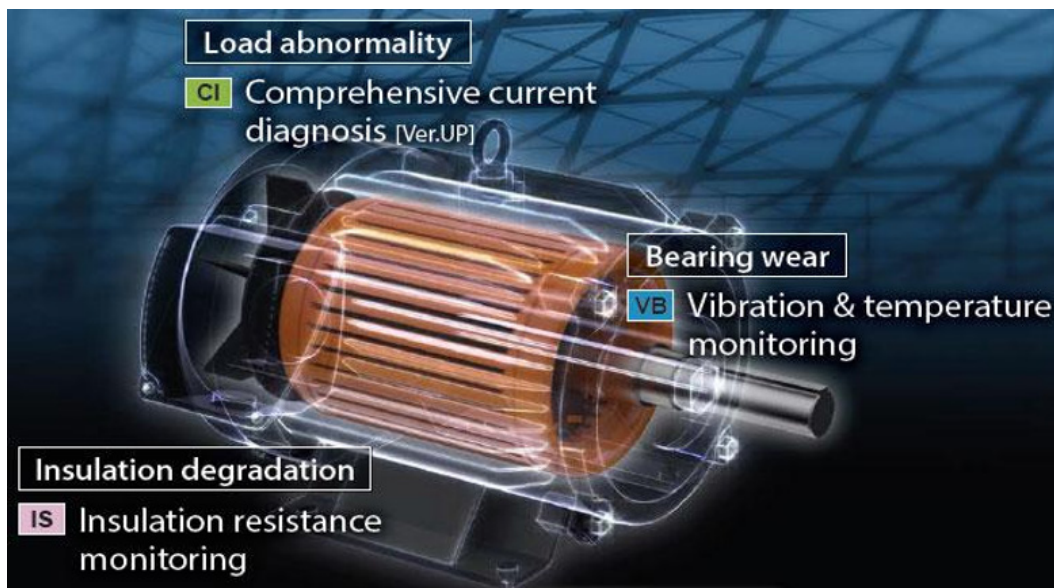
Electrical systems generate large amounts of operational data that can be leveraged using AI.

A. Cable Systems

AI enhances cable systems by automating sizing and selection per IEC 60364 and IS 3961, ensuring ampacity and voltage drop limits. Predictive analytics detects insulation degradation and partial discharge risks as per IEC 60270. AI optimizes routing, load balancing, and thermal performance, improving reliability, lifecycle efficiency, and compliance in industrial power networks.

Key Benefits

- Predict cable insulation degradation
- Identify overload conditions
- Analyze thermal performance
- Recommend cable replacement schedule



B. MCC and VFD Systems

AI is set to revolutionize MCC and VFD systems through predictive maintenance, adaptive motor control, and energy optimization aligned with IEC 61800 and IEC 61439 standards. Intelligent drives will self-tune for load variations, while MCCs evolve into smart hubs, enabling real-time diagnostics, fault isolation, and seamless integration with plant-wide digital twins.

Key Benefits: AI can monitor:

- Motor current signatures
- VFD operating parameters
- Starting characteristics

C. Earthing Systems

AI enhances earthing system design by optimizing electrode configuration as per IEEE 80 and IEC 60364-5-

54, ensuring safe touch and step potentials. It predicts soil resistivity variations, fault current distribution, and corrosion risks. AI-driven monitoring improves grid integrity, fault dissipation, and compliance, ensuring reliable grounding performance in complex industrial environments.

Key Benefits: AI-assisted tools can:

- Analyze soil resistivity trends
- Predict corrosion of grounding electrodes
- Optimize earthing system performance

AI integration in SCADA

AI in SCADA (Supervisory Control and Data Acquisition) is transforming how industrial plants are monitored, controlled, and optimized, especially in sectors like power, oil & gas, water, dairy plants, and manufacturing.



Examples are:

- SCADA shows high temperature
- AI correlates: load profile + ambient + cooling failure
- Suggests: fan failure or oil degradation.

Predictive Maintenance

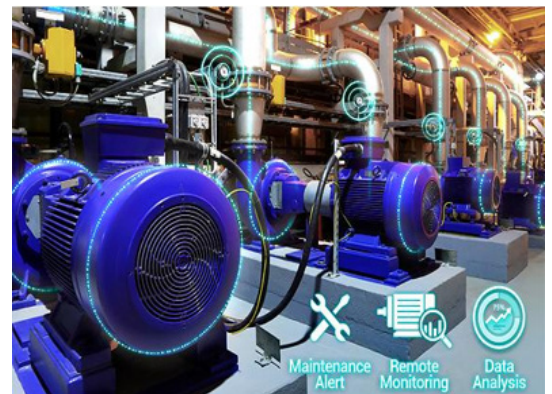
Industrial maintenance has evolved dramatically since the Industrial Revolution. In the early era, maintenance was largely reactive- equipment was repaired only after failure, resulting in frequent downtime and production losses. With the growth of mass manufacturing in the 20th century, preventive maintenance emerged, introducing scheduled inspections and servicing to improve reliability. The advent of automation and computerized systems led to predictive and condition-based maintenance, where equipment health is monitored using sensors and data analysis. Today, under Industry 4.0, maintenance has become intelligent and proactive, leveraging Industrial IoT, AI, digital twins, and real-time analytics to predict failures before they occur, optimize asset performance, reduce costs, and enhance plant safety and sustainability.

Key Benefits

- Early fault detection
- Reduced downtime
- Low maintenance costs
- Increased equipment reliability

Application includes

- Motor condition monitoring
- Pump performance analysis
- Transformer health assessment
- Bearing failure prediction



Limitation and challenges

Despite its advantages, AI implementation presents several challenges:

A. Data Quality

AI models depend heavily on accurate and reliable plant data.

B. Cybersecurity

- Increased connectivity exposes industrial systems to cyber threats.
- Integration Complexity
- Legacy systems often require upgrades before AI solutions can be implemented effectively.

C. Skill Gap

Engineers must develop competencies in:

- Data analytics
- Machine learning
- Industrial networking
- Digital transformation technologies
- Regulatory Compliance

Future trends

Tomorrow's plants will think, adapt, and act autonomously. AI will be able to predict and prevent failures, while processes continuously self-optimize. AI-assisted design will compress innovation cycles. Intelligent robotics will collaborate seamlessly with humans. Real-time risk assessments will preempt hazards, and advanced digital twins will mirror, simulate, and evolve entire facilities dynamically in future.

- Autonomous maintenance
- Self-optimizing processes
- AI – assisted engineering design
- Intelligent robotics
- Real-time risk assessment
- Advanced digital twins



Conclusion

AI is revolutionizing electrical engineering in plant environments by enabling smarter, safer, and more efficient systems. It supports engineers in design, operation, and maintenance while minimizing risks and operational costs.

For plant engineers, especially in industrial sectors, understanding AI-driven tools is becoming essential—not optional—for future-ready engineering solutions.

Contributed by:



Abhijeet Yadav



DPX³

NEW ELECTRONIC PROTECTIONS FOR MOULDED CASE CIRCUIT BREAKER

A new approach and concept of configurability and management for electronic circuit breakers, with enhanced ergonomics and features



PRODUCTS	APPLICATIONS	TECHNICAL CHARACTERISTICS
<ul style="list-style-type: none"> Main Distribution EMS/BMS Coordination and safety 	<ul style="list-style-type: none"> Maintenance Motor Control Central Coordination and safety Service continuity 	<ul style="list-style-type: none"> Coherent approach to every electronic protection, on all ranges Device setting and PC/App configurability through enhanced interfaces Easy upgrade during installation life More fine settings Flexible approach: full freedom to design appropriate tripping curve EMS interface for MCCB: connect your protection to EMS world High ergonomics: interface always up-to-date through connected Apps

ADVANTAGES

- Tailor made on projects: fit your protection on plans
- Simple tools and managements for all ranges
- Power connected: EMS and supervision
- Easy deprecation: cover competitors offers and more

To learn more about the product, download the sheet Confidential - Legrand Group Property - Internal use only

Complete Range of Panel & Switchboard Meters and T&M Instruments

Panel Meters 	Multifunction Meters 	Electrical Transducers
Digital Multimeters 	Clampmeters/Tong Testers 	Insulation Testers
Earth Resistance Testers 	Infrared Thermometers 	Environment Instruments

ISO 9001-2015 Certified Company

MECO INSTRUMENTS PRIVATE LTD.

EL-1, MIDC Electronic Zone, TTD Industrial Area, Mahape, Navi Mumbai - 400710, Maharashtra, INDIA

Sales: +91-9223-26325 North India & Goa: +91-9224-11552 South India: +91-9224-87248
East India, M.P. & Gujarat: +91-9224-05281 Maharashtra: +91-9272-11725

sales@meconst.com www.meconst.com

+60
ONE MISSION

Reliable Long-Lasting Affordable

SCAN & ORDER

ANUROOP SWITCHGEAR CO.

139, Kasba Peth, Near Kasba Ganpati, Pune - 411011, Maharashtra.
Ph : 020 29996184.

- SWITCHGEAR
- CONTROL PANEL INPUTS
- WIRES & CABLES
- SYSTEM ACCESSORIES
- INDUSTRIAL ELECTRICALS

Authorised Channel Partner

Anuroop Promise

Variety Quality Low Prices Service Guidance

SCAN QR TO SAVE CONTACT

We specialize in all types of electrical goods & components required for wide spectrum of Industries

Call : 8149923453 • 9834263605 E-mail : anuroop.swg@gmail.com

GEN AI FOR PLANT FOOTPRINT REDUCTION

Introduction

In today's industrial landscape, we as engineers face a constant challenge: designing electrical infrastructure that is reliable, economical, expandable, and space efficient. Whether it is an FMCG manufacturing facility, an oil & gas terminal, a refinery, or a chemical processing plant, the placement of substations, Motor Control Centers (MCCs), electrical rooms, and cable routes significantly influences the overall plant footprint and project cost.

Traditionally, electrical asset placement and cable routing are performed through engineering experience, design reviews, and multiple iterations between electrical, mechanical, civil, instrumentation and process teams. Although effective, this approach often leads to conservative layouts, longer cable routes, congested utility corridors, and underutilized plant space. With increasing pressure to reduce project costs and optimize land utilization, the industry is now exploring Artificial Intelligence (AI) as a design partner rather than just an operational tool.

This evolution has given rise to Intelligent Electrical Asset Placement and Cable Routing (IEAPCR), an AI-driven engineering methodology capable of automatically determining the most efficient locations for electrical assets and the most economical cable paths within an industrial facility.

This article focuses on Intelligent Electrical Asset Placement and Cable Routing (IEAPCR) leverages Artificial Intelligence (AI), Digital Twins, Graph Theory, GIS-based planning, and optimization algorithms to identify the most efficient arrangement of electrical assets while minimizing cable.

This technology can achieve:

- 10–20% reduction in electrical infrastructure footprint
- 10–25% reduction in cable quantities
- 8–15% reduction in project CAPEX
- 5–12% reduction in lifecycle carbon emission
- Improved system reliability and maintainability
- lengths, trench congestion, and utility corridor requirements.

The Engineering Challenge

During the conceptual and FEED stages of a project, electrical engineers decide where major assets should be located. These include:

- Main Receiving Substations
- Unit Substations
- MCC Buildings
- PCC Rooms
- UPS Rooms
- Control Rooms
- Transformer Yards
- Cable Trenches and Utility Corridors

A poor decision at this stage can result in thousands of additional meters of cable, larger trench networks, higher voltage drops, increased installation costs, and future maintenance challenges.

For example, relocating a substation by even 100 meters away from the plant load center can increase cable requirements by several kilometers when hundreds of feeders are involved. In large industrial projects, such decisions can impact project costs by millions of dollars over the facility lifecycle.

How AI Solves the Problem?

IEAPCR uses advanced optimization algorithms to evaluate thousands of possible asset arrangements and cable routing scenarios within minutes.

The AI model receives inputs such as:

- Plant plot plan
- Equipment coordinates
- Load list
- Single Line Diagram (SLD)
- Hazardous area classifications
- Future expansion requirements
- Road networks
- Pipe racks
- Utility corridors
- Fire and safety clearances

The system then creates a digital representation of the entire facility and evaluates every possible placement combination. Unlike human designers who may evaluate only a handful of alternatives, AI can analyze thousands of layout configurations simultaneously.

The optimization objective is to minimize:

$$\text{Total Engineering Cost} = \text{Cable Cost} + \text{Civil Cost} + \text{Electrical Losses} + \text{Maintenance Cost} + \text{Expansion Risk}$$

The result is a mathematically optimized plant layout that balances cost, reliability, and future flexibility.

AI-Based Substation Placement

One of the most impactful applications of IEAPCR is determining the ideal substation location. Conventionally, substations are placed based on available space or process team preferences. However, AI identifies the electrical center of gravity of the plant by analyzing the distribution of connected loads.

Consider a process facility with:

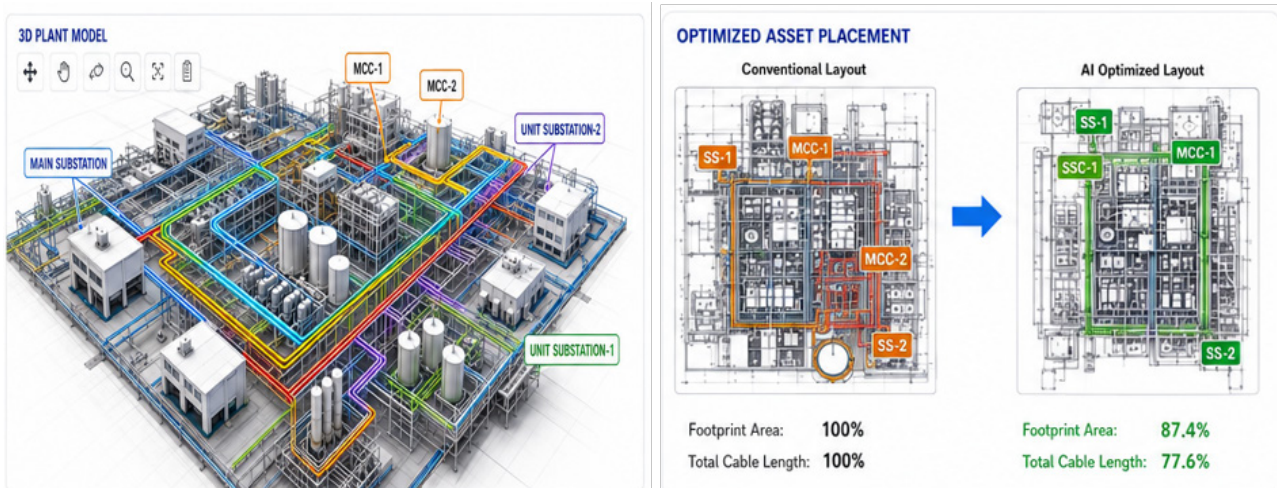
Process MCC Load = 8 MW, Utility MCC Load = 5 MW, Packaging Load = 4 MW, Warehouse Load = 2 MW

Rather than placing the substation near the plant boundary, AI calculates the optimum location that minimizes the cumulative cable distance to all major load centers.

The result can reduce:

- Cable length by 15–30%
- Voltage drop by 10–20%
- Trench requirements by 15%
- Electrical losses by 5–10%

while maintaining compliance with electrical safety and maintenance standards.



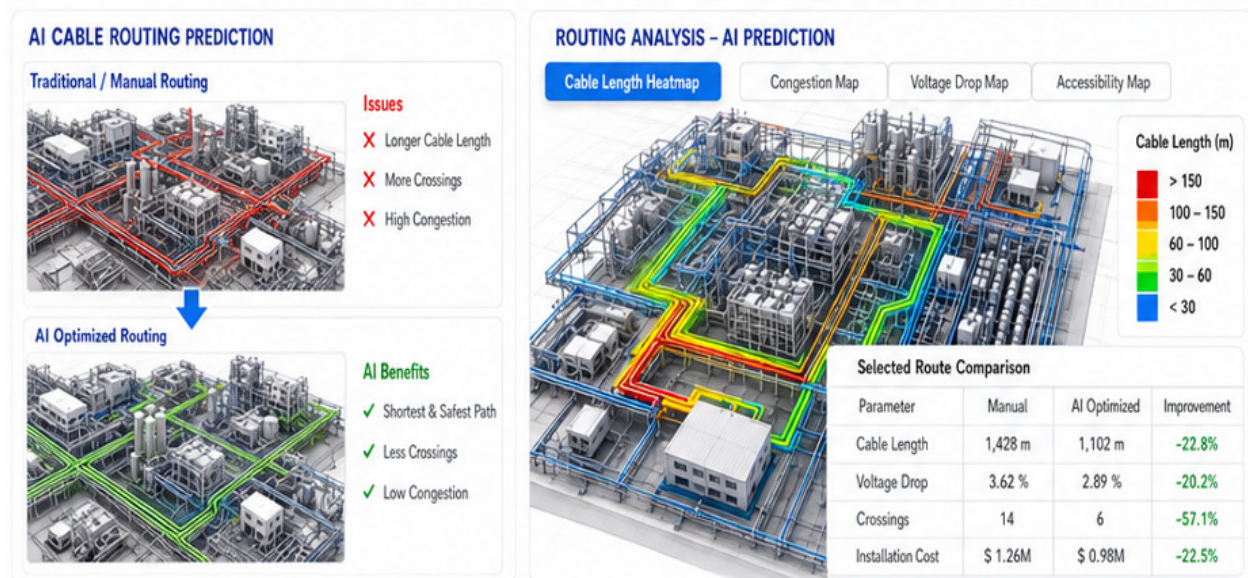


FIG: GEN AI IEAPCR MODEL FOR ASSET POSITIONING AND FOOTPRINT OPTIMIZATION

Intelligent Cable Routing

Cable routing is another area where AI delivers substantial value. In a typical industrial plant, cables must navigate around:

- Process units
- Storage tanks
- Roads
- Pipe racks
- Firewater systems
- Hazardous zones
- Existing underground utilities

Traditional routing methods rely heavily on designer experience and manual optimization. AI approaches cable routing similarly to how modern navigation systems calculate the shortest travel route.

Each routing path is assigned a cost factor based on:

1. Physical distance
2. Installation complexity
3. Hazard exposure
4. Future accessibility
5. Trench congestion
6. Voltage drop impact

The AI then determines the most efficient route while satisfying engineering constraints. Instead of simply finding the shortest path, the system identifies the lowest lifecycle cost path.

For example, a slightly longer route may be selected if it avoids multiple road crossings and reduces future maintenance challenges.

Reducing Plant Footprint Through AI

The primary objective of IEAPCR is not only reducing cable length but reducing overall plant footprint. Electrical infrastructure occupies a significant portion of industrial facilities through:

Substation buildings:

- MCC rooms
- Cable trenches
- Utility corridors
- Transformer yards
- Access roads

AI identifies opportunities to consolidate electrical infrastructure and improve space utilization.

Typical improvements achieved include:

Parameters	Conventional Design	GENAI Optimized Design
Cable Length	100%	70–85%
Trench Network	100%	75–90%
Utility Corridor Width	100%	80–90%
Electrical Building Area	100%	85–95%
Overall Plant Footprint	100%	80–90%

Thus, a footprint reduction of even 10% can translate into significant savings in land acquisition, civil construction, structural steel, and utility infrastructure.

Digital Twin Integration

Modern IEAPCR platforms are increasingly integrated with Digital Twin technology. A Digital Twin creates a virtual model of the plant where engineers can simulate:

- Equipment relocation
- Future expansions
- Load growth scenarios
- Additional MCC installations
- New process units

The AI continuously evaluates these scenarios and recommends optimal infrastructure arrangements before physical construction begins. This significantly reduces engineering revisions during later project phases.

Engineering Standards and Compliance

A critical advantage of AI-based design is that optimization occurs within predefined engineering constraints. The system can automatically verify compliance with:

- IEC 60364
- IEC 61936
- IEC 60502
- IEEE 141
- IEEE 242
- NFPA 70 (NEC)
- IEC 60079 Hazardous Area Standards
- API Recommended Practices

Therefore, the final design remains technically compliant while achieving maximum optimization.

Future of AI-Driven Plant Engineering

The next generation of IEAPCR systems will move beyond optimization and into autonomous engineering. Future platforms are expected to:

- A. Automatically generate electrical plot plans
- B. Create cable schedules
- C. Perform voltage drop calculations
- D. Optimize substation layouts
- E. Predict future load growth and recommend expansion strategies within a single integrated environment.

Conclusion

Intelligent Electrical Asset Placement and Cable Routing represents one of the most promising applications of Artificial Intelligence in plant engineering. By combining advanced optimization algorithms, digital twins, and engineering intelligence, AI can significantly reduce cable lengths, improve electrical efficiency, optimize substation locations, and minimize overall plant footprint.

For industries seeking lower project costs, faster execution, improved sustainability, and better utilization of available land, IEAPCR offers a practical pathway toward smarter infrastructure design. The future industrial plant will not simply be engineered through experience alone it will be engineered through the collaboration of human expertise and artificial intelligence, delivering designs that are faster, more efficient, and mathematically optimized from the very beginning.

Contributed by:



VAIDEHI KHADSE



POWERING PROGRESS

SINCE THREE DECADES



MANUFACTURERS OF
**WIRES &
CABLES**

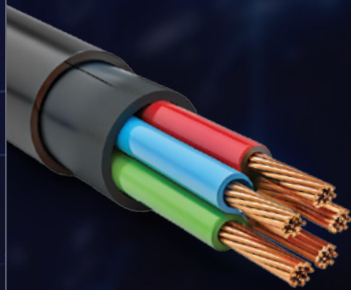
CUSTOMISED CABLE SOLUTIONS

PRODUCT RANGE

- BMS Cables
- Fire Survival Cables
- Flexible Cables
- Solar Cables
- Control Cables
- Panel Wiring
- Industrial Automation Cables
- Instrumentation Cables
- Submersible Flat Cables
- Power Cables
- House Wiring
- Special Application Cables

PRODUCT FEATURES

- Heavy Duty LV Cables
- PVC
- FRLS
- LSZH
- Copper
- XLPE
- HR
- TPE
- Aluminium
- XLPO
- ZHFR
- TPU



APPLICATIONS



Metro Rail



Airports



Oil & Gas



Infrastructure



Data Centers



Industrial Automation



Solar



Wind



Smart Cities



IS 694 / IS 1554 /
IS 7098



INTERCERT



INTERCERT



Send Your
Enquiry Instantly

We're Exhibiting at
EL Asia 2026

INTERNATIONAL EXHIBITION
ON POWER, ELECTRICAL AND LIGHTING

MAY 14-17, BANGALORE

HALL - 2 | STALL F20

sales@vcables.com www.varshacables.com

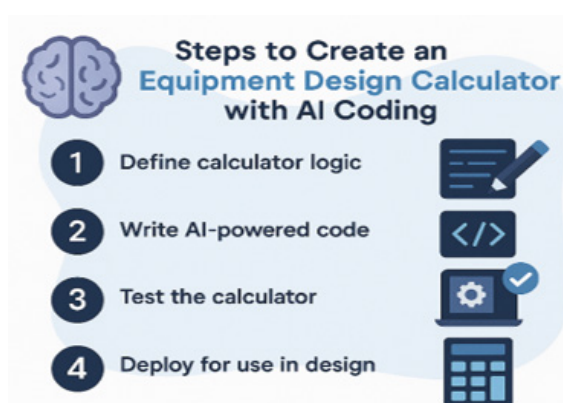
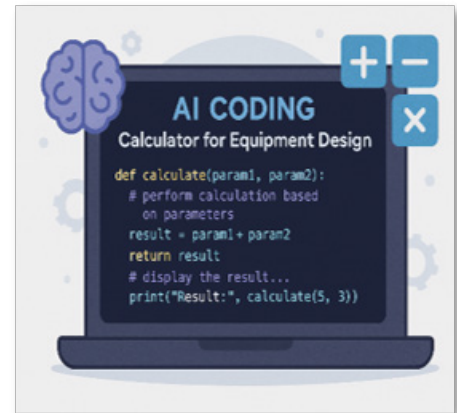
0821-4282013 V Cables | Varsha Cables Private Limited

Transforming Plant Engineering with Artificial Intelligence

AI coding-based Calculator

-In modern plant engineering, Artificial Intelligence (AI) is increasingly being used to develop intelligent calculators for the design and sizing of process equipment such as pressure vessels, heat exchangers, pumps, and reactors. Traditionally, equipment design involves manual calculations based on standard formulas, design codes (ASME, TEMA, API), and iterative trial-and-error methods. However, AI-based coding approaches are transforming this process by automating calculations, reducing human error, and improving design efficiency. These smart calculators are developed using programming languages such as Python, JavaScript, or HTML-based interfaces combined with AI algorithms that can handle complex engineering relationships.

AI-based equipment calculators are designed to take multiple input variables such as flow rate, temperature, pressure, material properties, and design constraints. Unlike conventional calculators, AI-enabled systems can intelligently adjust intermediate parameters and suggest optimized values. For example, in pressure vessel design, an AI-based calculator can automatically determine the optimal diameter and height by analyzing the required volume and L/D ratio. The AI system can integrate standard design equations and adapt dynamically based on user input, ensuring accurate and code-compliant results.



Despite their advantages, the implementation of AI-based design calculators requires careful consideration of data quality, validation, and engineering judgment. Engineers must ensure that AI-generated results are verified against design codes and practical constraints. AI should be used as a decision-support tool rather than a complete replacement for engineering expertise. With continuous advancements, AI-based coding is expected to play a major role in automating plant engineering design workflows, improving accuracy, and enabling faster project execution in EPCM industries.

AI Validation with Engineering Codes & Standards



-The validation process begins by aligning AI models with standard engineering practices and design rules. In traditional engineering, design decisions are based on well-defined equations, safety factors, and empirical correlations provided in codes. Similarly, AI models must be trained or programmed with constraints that reflect these standards. For instance, in process optimization, an AI system may recommend operating conditions that maximize efficiency, but these recommendations must remain within allowable pressure, temperature, and material limits specified by relevant codes. This ensures that AI suggestions do not compromise the integrity of the plant or equipment.

Validation also involves cross-verification with established engineering tools and real-world operational data. AI outputs should be compared with results from industry-accepted software such as Aspen HYSYS, AFT Fathom, or HTRI, as well as historical plant data. Any discrepancies must be analyzed to ensure that AI models are not deviating from physically accurate behavior. This benchmarking process is essential, especially for applications like process control and equipment performance prediction, where incorrect outputs can lead to operational inefficiencies or safety risks.

One of the major challenges in implementing AI in plant engineering is the difficulty of training AI systems with complete and authentic engineering codes and standards, as most of these standards such as ASME, API, TEMA, and IEC are proprietary and require paid licenses for access. Unlike open data, these codes cannot be freely used, shared, or embedded directly into AI models without legal restrictions, which limits the ability of AI systems to fully understand and apply all design guidelines accurately. Additionally, these standards are not simple formula-based documents; they contain complex rules, exceptions, interpretations, and engineering judgments that are difficult to translate completely into machine-readable logic. As a result, AI may lack full awareness of detailed clauses, updates, or revision changes in standards, leading to potential gaps in compliance.



AI Agent For Automation

An AI agent in plant engineering refers to an intelligent digital system that can independently analyze engineering data, make decisions, and perform tasks to achieve specific project or operational objectives. Unlike traditional software, which only follows predefined instructions, an AI agent has the capability to learn from data, adapt to changing conditions, and optimize outcomes over time. In the context of plant engineering and EPCM projects, an AI agent acts as a virtual assistant or digital engineer that supports activities such as design, analysis, optimization, and decision-making across different stages of the project lifecycle.



The functioning of an AI agent is based on a continuous cycle of perception, reasoning, and action. The agent first collects data from various sources such as process simulations, field instruments, historical project databases, P&IDs, or RFP documents. This data can include parameters like flow rates, pressures, temperatures, equipment specifications, or cost information. The AI agent then processes this information using algorithms, engineering rules, or machine learning models to derive insights or identify patterns.

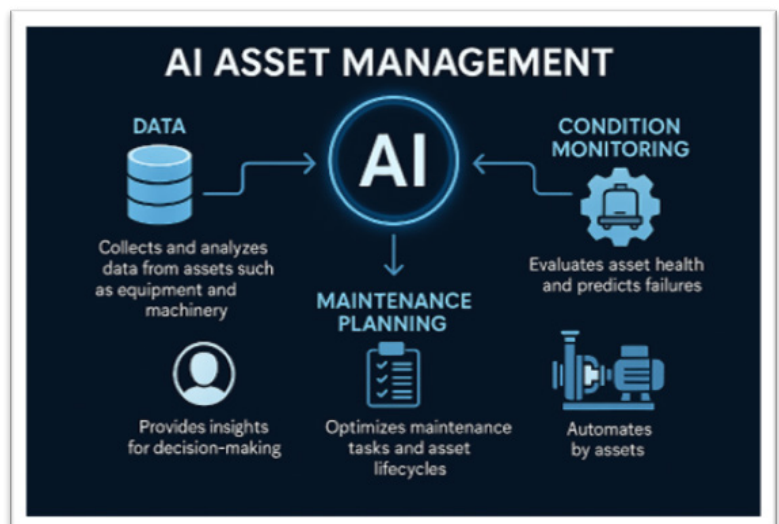
Types of AI Agents

- 1) Reactive Agent
- 2) Model-Based Agent
- 3) Goal-Based Agent
- 4) Learning Agent

AI in Asset Management

In plant engineering, AI-based asset management focuses on monitoring, analyzing, and optimizing the complete lifecycle of plant equipment, from installation to operation, maintenance, and replacement. The process begins with data collection from assets such as pumps, compressors, heat exchangers, pipelines, and electrical systems. This data is obtained through sensors, SCADA systems, DCS, and maintenance records, including parameters like temperature, vibration, pressure, run-time hours, and failure history. AI systems continuously collect and store this data in centralized databases, forming the foundation for intelligent decision-making.

AI also supports asset lifecycle optimization by tracking the complete history of each equipment unit. It evaluates performance over time, maintenance costs, and failure frequency to determine whether an asset should be repaired, upgraded, or replaced. For instance, if a heat exchanger shows repeated fouling and high maintenance costs, the AI system may recommend replacement with a more efficient design. This helps in long-term capital planning (CAPEX decisions) and ensures optimal utilization of plant assets.



Another important function is integration with enterprise systems, such as ERP (Enterprise Resource Planning) and CMMS (Computerized Maintenance Management Systems). AI can automatically generate work orders, schedule maintenance activities, and manage spare parts inventory. For example, if AI predicts a likely bearing failure in a pump, it can trigger a maintenance request and ensure that required spare parts are available in advance. This reduces downtime and improves operational efficiency.

Contributed by:



Dhruvin Bambharoliya
(Associate Engineer)



L&T Technology Services

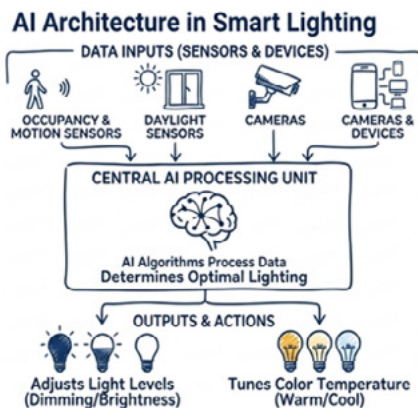
AI in Industry for Lighting

1. Introduction



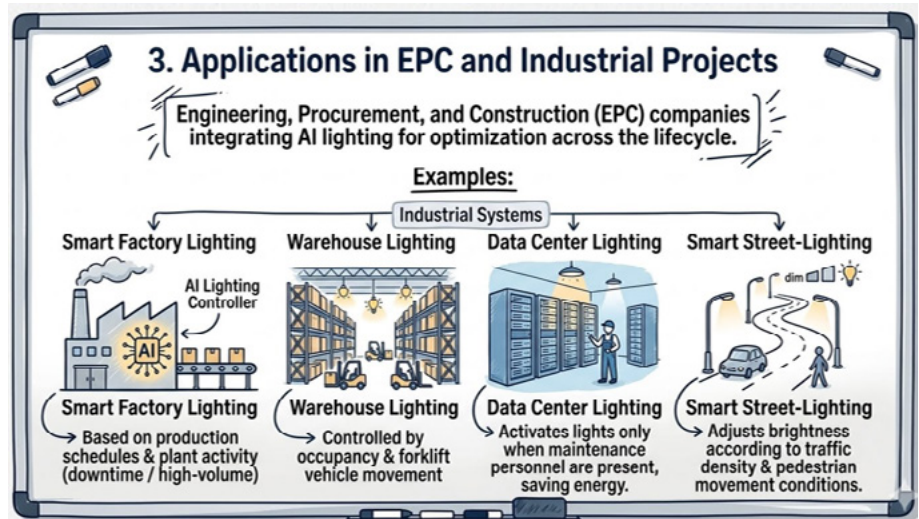
The lighting industry is rapidly evolving with the adoption of Artificial Intelligence (AI). Traditional lighting systems operate using fixed schedules or manual controls, whereas AI-enabled lighting systems can learn, analyze, and make decisions automatically. By combining sensors, data analytics, machine learning, and Internet of Things (IoT) technologies, AI helps organizations improve energy efficiency, reduce operating costs, and enhance user comfort.

2. AI Architecture in Smart Lighting



AI-based lighting systems collect information from occupancy sensors, daylight sensors, cameras, and connected devices. The data is processed using AI algorithms that determine the optimal lighting level for a specific location and time.

Engineering, Procurement, and Construction (EPC) companies are increasingly integrating AI-based lighting solutions into commercial buildings, factories, warehouses, airports, data centers, and smart-city projects. AI helps optimize lighting design, operation, and maintenance throughout the project lifecycle.



Examples:

- Smart factory lighting based on production schedules.
- Warehouse lighting controlled by occupancy and vehicle movement.
- Data center lighting that activates only when maintenance personnel are present.
- Smart street-lighting systems that adjust brightness according to traffic conditions.

4. Key Benefits

- Energy savings of 30–60% in many applications.
- Reduced carbon emissions and sustainability improvements.
- Lower maintenance costs through predictive maintenance.
- Improved worker productivity and safety.
- Better operational control and asset management.

5. Challenges

Organizations may face challenges such as higher initial investment, cybersecurity concerns, integration with legacy systems, and the need for trained personnel. However, declining technology costs are making AI solutions increasingly practical.



6. Future Trends

Future AI lighting systems will offer personalized lighting experiences, deeper integration with smart-city infrastructure, advanced energy analytics, and autonomous optimization. AI will become a key contributor to net-zero and sustainability initiatives.



7. Conclusion

AI is transforming the lighting industry from a simple utility into an intelligent system capable of improving efficiency, safety, and sustainability. For EPC contractors, facility managers, and industrial operators, AI-powered lighting offers measurable business and environmental benefits.

CONTRIBUTED BY: -



RUPENKUMAR PATEL

Discipline Lead (Electrical)



AI in Industries: Redefining roles

Abstract

Artificial Intelligence (AI) is transforming industries by enhancing efficiency, safety, and decision-making. While applications like predictive maintenance and process optimization are already widely used, AI's real potential lies in reshaping industrial systems and the roles of engineers. It reduces repetitive tasks, improves operational reliability, and supports informed decision-making. As a result, industries are becoming smarter, more adaptive, and increasingly human-centered, paving the way for sustainable and future-ready industrial environments.

Introduction

Artificial Intelligence has evolved from theory into a key driver of modern industries such as oil & gas, chemicals, manufacturing, and pharmaceuticals. Traditional operations relied on manual monitoring and reactive decisions, but AI integration with DCS and SCADA enables predictive, data-driven control. This shift is both technological and human-centered, allowing engineers to move from routine tasks to strategic and analytical roles.

Conventional Applications for AI in Industries

AI has already established strong foundations in industrial environments through several key applications. These provide the base for more advanced innovations. Predictive maintenance allows early detection of equipment failures by analyzing trends in operating data. Similarly, AI-driven process optimization continuously adjusts operating parameters to improve efficiency and reduce energy usage.

Key conventional applications include:

- **Predictive Maintenance:** Uses real-time equipment data to anticipate failures and reduce downtime
- **Process Optimization:** Dynamically adjusts parameters such as pressure, flow, and temperature
- **Quality Control:** Applies computer vision and machine learning to detect defects
- **Supply Chain Optimization:** Enhances forecasting, inventory management, and logistics



While these applications significantly improve operational performance, they primarily focus on efficiency. The next stage of AI evolution goes beyond this, integrating intelligence into both systems and human workflows.



Applications for AI beyond convention

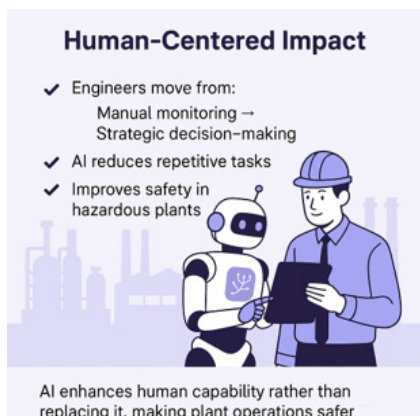
AI is now enabling innovative ideas that extend beyond traditional automation and optimization. One of the most significant developments is the emergence of self-learning plants, where systems continuously learn from historical data and adapt operations accordingly. These plants develop an internal memory of past performance and make proactive adjustments without requiring constant human input.

Another transformative concept is AI acting as a virtual senior engineer, capable of providing troubleshooting guidance, process insights, and design suggestions in real time. This not only improves decision-making but also supports knowledge transfer within industries.

Some key out-of-the-box applications include:

- **Self-Learning Plants:** Systems adapt based on past operational patterns
- **Virtual Expert Systems:** AI provides real-time engineering support
- **Emotion-Aware Control Rooms:** Detect operator fatigue and reduce human errors
- **Predictive Failure Simulation:** Uses digital twins to simulate future failures
- **Intelligent Material Discovery:** Supports development of advanced materials and catalysts
- **AI-Driven Sustainability:** Optimizes operations with reduced environmental impact
- **Digital Knowledge Retention:** Preserves expertise for future generations
- **Invisible Loss Detection:** Identifies hidden inefficiencies and energy losses

These advancements show how AI is evolving into a strategic partner in industrial decision-making, rather than just a supporting tool.



AI Redefining the Role of Engineers

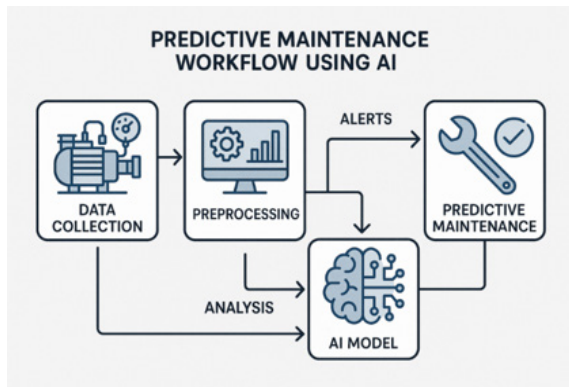
One of the most profound impacts of AI is the transformation of the engineer's role. Traditionally, engineers were heavily involved in monitoring, manual data analysis, and reactive troubleshooting. This often limited their ability to focus on higher-level problem-solving.

With AI handling repetitive and data-intensive tasks, engineers can now shift toward more impactful responsibilities such as innovation, optimization, and strategic planning.

This transformation includes:

- Moving from continuous monitoring to exception-based supervision
- Shifting from reactive troubleshooting to predictive strategies
- Transitioning from data collection to data interpretation and optimization

As a result, engineering roles are becoming more engaging, analytical, and value-driven.



Reducing Cognitive Load and Enhancing Work Experience

Industrial systems generate vast amounts of data that can overwhelm human operators. AI addresses this challenge by processing and analyzing data in real time, identifying patterns and anomalies with high accuracy.

This significantly reduces cognitive load and allows engineers to focus on meaningful tasks rather than routine analysis. From a human-centered perspective, this leads to:

- Improved focus on critical decisions
- Reduced stress and mental fatigue
- Increased operational clarity and efficiency

Engineers transition from “watching systems” to understanding and improving them.

Enhancing Safety and Reliability

Safety remains a critical priority in industries, and AI plays a vital role in strengthening it. Human factors such as fatigue and delayed response can contribute to incidents, but AI provides consistent monitoring and faster detection of abnormal conditions.

By predicting potential failures and improving alarm systems, AI enables proactive safety measures.

Key benefits include:

- Reduced dependency on constant human vigilance
- Lower probability of human error
- Faster response to abnormal conditions

AI acts as an additional layer of protection, enhancing both plant safety and human reliability.

Enabling Smarter and Flexible Work Practices

AI is also transforming industrial work culture by enabling more flexible and efficient workflows. With remote monitoring capabilities and intelligent systems, engineers are no longer required to always be physically present.

This shift allows work to become more outcome-driven rather than shift-driven, improving productivity and job satisfaction.

Key advantages include:

- Better work-life balance
- Reduced reliance on rigid operational roles
- More efficient utilization of human expertise

Such changes are essential in modern industries, where adaptability and talent retention are increasingly important.



AI Beyond Plant Boundaries

AI is extending its impact beyond individual plants to entire industrial ecosystems. It enhances supply chains by predicting disruptions and enabling proactive decision-making. It also supports sustainability through circular economy initiatives, identifying ways to reuse waste and optimize resources.

Additionally, AI optimizes utilities such as water, steam, and electricity, while supporting integration of renewable energy.

Key ecosystem contributions include:

- **Smart Supply Chains:** Improved logistics and disruption management
- **Circular Economy Support:** Resource reuse and waste minimization
- **Smart Utility Management:** Efficient energy and resource utilization

Challenges in AI Implementation

Despite its potential, AI adoption comes with several challenges. Data quality remains a major concern, as AI systems rely heavily on accurate input. Integration with legacy systems can be complex and resource-intensive.

Another key challenge is the need for skilled engineers who understand both process engineering and AI technologies. Additionally, cybersecurity risks must be managed carefully in increasingly digital systems.

Major challenges include:

- Data quality and reliability issues
- Integration with existing systems
- Skill gap in AI knowledge
- Cybersecurity risks

Outlook: Towards Human-Friendly Intelligent Industries

The future of industries lies in combining intelligence with human-centric design. AI will continue to evolve toward creating cognitive and semi-autonomous systems that work seamlessly with human operators.

Future developments will include:

- Autonomous and self-optimizing plants
- AI-driven real-time simulations
- Stronger human-AI collaboration
- Increased focus on innovation-driven roles

Industries will not only become smarter but also more aligned with human needs, creating environments that are efficient, safe, and fulfilling.

Conclusion

Artificial Intelligence is transforming industries by improving efficiency, safety, and performance while enhancing the role of engineers. By automating routine tasks and enabling smarter decisions, AI allows engineers to focus on innovation and strategic work. The future depends on balancing human expertise with AI to create intelligent, sustainable, and human-centered systems.

Contributed By:



Chelsi Mayur Hansaliya





One Stop for Specialised Electrical Engineering and Fire and Life Safety Services

Helping You to:

- Identify the Potential Electrical Fire & Shock Hazards” by conducting Electrical Safety Audits, and Periodic Inspections of Electrical Installations as per Central Electricity Authority (Measures Relating to Safety and Electric Supply) Regulations 2023, through Chartered Electrical Safety Engineer, CESE.
- Conserve Energy and reduce electricity bills”, by Conducting Energy Audits, as per Bureau of Energy Efficiency, BEE, MoP, Govt. of India, guidelines.
- Provide Provisional and Final Fire NoCs, for buildings up to 32 metres of height” and Conducting Fire and Life Safety Audits for Multi-Storeyed Buildings.
- Design your Plants and Electrical Installations CEA Safety Regulations 2023, NEC 2023, NBC 2016, and IS 732, IS 3043 compliant, by Providing Electrical Consultancy Services.
- Comply with the PESO requirements by Testing and Certification of Hazardous Storage facilities and Classification of Hazardous Areas, as per Petroleum and Explosives Safety Organisation, PESO” guidelines.
- Carry out Third Party Inspections of HV/EHV Transformers, Circuit Breakers, GIS Sub stations, Cables, Motors, PCCs, MCCs etc. and Green Building Certifications” by ASSOCHAM GEM Certifications.

Contact Today: SUMIT ENGINEERING SERVICES,
B-13, “SURYAGAYATRI”, PLOT NO. D-14/15, SECTOR-6, NEW PANVEL (E),
NAVI MUMBAI – 410206, MAHARASHTRA, INDIA.
Tel.: 022 27462016, Mobile: 9821672242, E-mail: ulhasvajre@gmail.com
Web: <https://www.sumitengineeringservices.com>

Contact Person: Ulhas Vajre
C.ENG.(I), DEE, MIE, BE, FIV, FISLE, CEM, CEA, MIIE, FIAEMP, GEM CP, CESE.
Authorised CHARTERED ELECTRICAL SAFETY ENGINEER
Empanelled FIRE AND LIFE SAFETY AUDITOR
BEE Certified ENERGY AUDITOR
RECOGNISED COMPETENT PERSON, Under Petroleum Rules 2002, by PESO.

AI in Industry - Transforming the Future of Industrial Operations

Introduction

Artificial Intelligence (AI) is revolutionizing the plant engineering industry by enhancing efficiency, reliability, safety, and decision-making processes. Modern industrial plants generate vast amounts of data through sensors, instruments, control systems, and maintenance records. AI enables engineers to analyze this data in real time, identify patterns, predict failures, and optimize plant performance.

As industries move toward Industry 4.0 and digital transformation, AI has become a key technology in engineering design, operation, maintenance, and asset management.



Applications for AI in Plant Engineering

1. Predictive Maintenance

AI algorithms analyze equipment data such as vibration, temperature, pressure, and flow rates to predict potential failures before they occur. This reduces unplanned shutdowns and maintenance costs.

2. Process Optimization

AI continuously monitors process parameters and recommends optimal operating conditions to maximize production efficiency while minimizing energy consumption.

3. Intelligent Instrumentation and Control

AI enhances traditional control systems by learning from historical process data and making intelligent adjustments in real time.

4. Safety and Risk Management

AI-based monitoring systems can identify abnormal operating conditions, detect gas leaks, monitor worker safety, and provide early warnings for potential hazards.

5. Engineering Design Automation

AI assists engineers in creating optimized plant layouts, piping routes, equipment selection, and documentation, reducing design time and human errors.

Real-Time Case Study: SHELL's AI-Based Predictive Maintenance Program

- **Background**

Shell implemented AI-driven predictive maintenance solutions across several industrial facilities to improve equipment reliability and reduce maintenance costs.

- **Challenge**

Critical rotating equipment such as pumps, compressors, and turbines experienced unexpected failures, resulting in production losses and expensive repairs.

- **AI Solution**

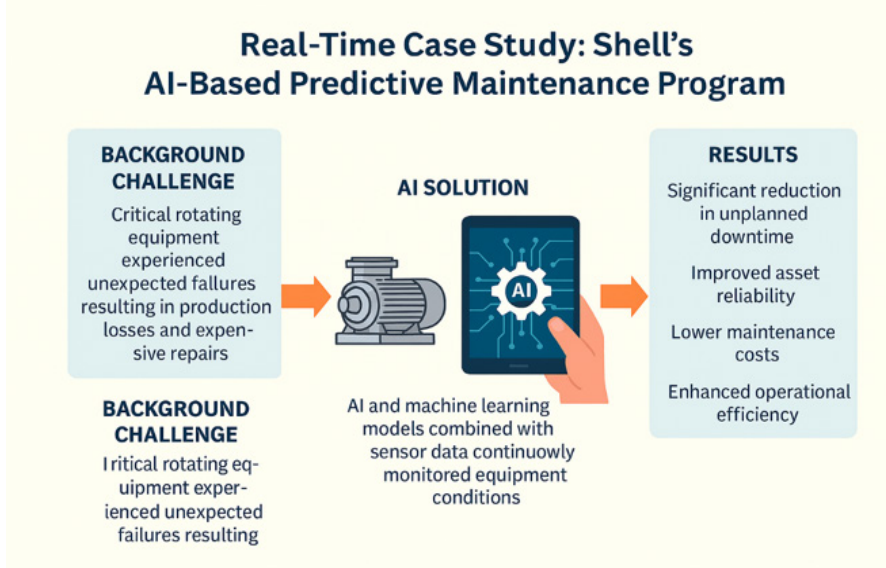
Shell integrated AI and machine learning models with data collected from sensors installed on critical

equipment. The system continuously monitored vibration levels, temperature readings, pressure variations, and equipment operating conditions.

- **Results**

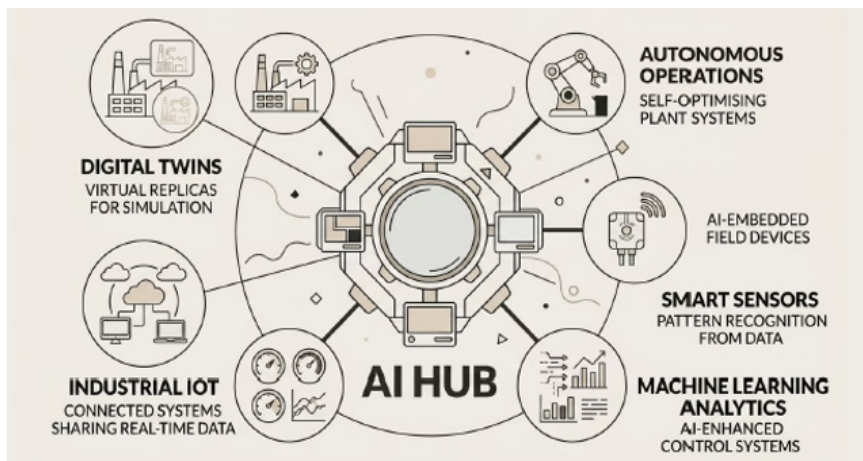
Significant reduction in unplanned downtime, improved asset reliability, lower maintenance costs, enhanced operational efficiency, and better maintenance planning through early fault detection.

- **Pictorial Representations of Case Study**



Future of AI in Plant Engineering

The future of plant engineering will increasingly rely on AI-powered technologies such as Digital Twins, Autonomous Operations, Smart Sensors, Machine Learning Analytics, Advanced Process Control, and the Industrial Internet of Things (IIoT).



AI in Instrumentation & Control Engineering

Instrumentation and Control (I&C) engineering plays a critical role in monitoring and controlling industrial processes. With the integration of Artificial Intelligence, traditional control systems are becoming smarter and more efficient.

AI Applications in Instrumentation & Control

- Smart Monitoring
- Predictive Instrument Maintenance
- Advanced Process Control
- P&ID and Engineering Documentation Automation

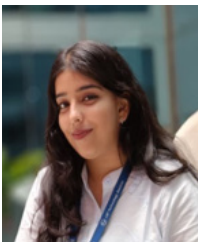
-
- Improved process safety
 - Reduced maintenance costs
 - Faster engineering execution
 - Enhanced decision-making through data analytics

Conclusion

Artificial Intelligence is no longer a futuristic concept but a practical tool that is reshaping plant engineering. From predictive maintenance and process optimization to intelligent control systems and safety management, AI enables industries to improve operational performance while reducing costs and risks.

“From data to decisions — AI redefining plant performance.”

Contributed By -



Isha Y. Saswade



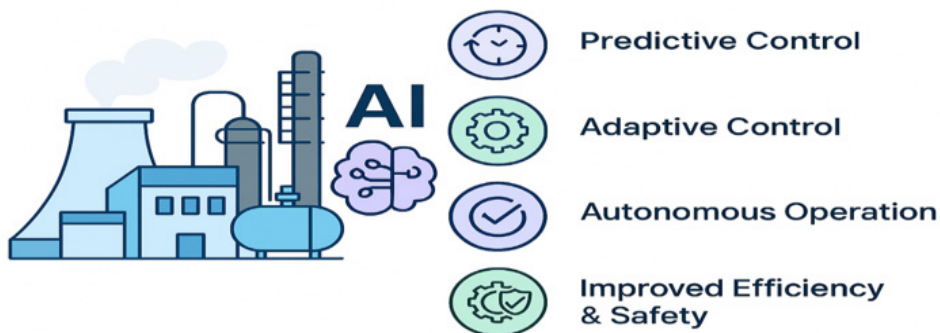
L&T Technology Services

INTRODUCTION

Artificial Intelligence (AI) is increasingly transforming plant engineering by enabling a shift from conventional, static systems towards dynamic, and data-driven operations. In modern industrial plants such as chemical processing units, power generation facilities, and manufacturing industries, vast amounts of real-time data are continuously generated through instrumentation systems, sensors, and control platforms like DCS and SCADA. AI leverages this data using advanced analytics, machine learning models, and pattern recognition techniques to improve plant design, monitor system performance, and identify inefficiencies. As a result, plant engineers can move beyond traditional rule-based approaches and implement intelligent systems capable of learning from operational data, thereby enhancing overall plant productivity and reliability.

The integration of AI into plant engineering facilitates predictive, adaptive, and autonomous control of industrial processes. Predictive capabilities allow early detection of equipment failures and process deviations, reducing downtime and maintenance costs. Adaptive systems continuously adjust operating parameters such as temperature, pressure, and flow to optimize performance under varying conditions. Furthermore, autonomous control systems enable minimal human intervention by making real-time decisions based on process conditions, improving safety and operational consistency. This transformation leads to significant improvements in energy efficiency, resource utilization, and environmental sustainability, positioning AI as a key enabler for smart, future-ready industrial plants.

AI in Plant Engineering



IMPORTANCE OF AI IN PLANT ENGINEERING

1. Predictive Maintenance and Equipment Reliability

AI-powered predictive maintenance allows plants to anticipate machine failures before they occur. Machine learning models analyze sensor data—vibration, temperature, pressure, and power consumption—identifying early warning signs of equipment wear or malfunction.

Benefits include:

- Reduced unplanned downtime
- Lower maintenance costs
- Extended equipment lifespan
- Transition from reactive to proactive maintenance culture



2. Real-Time Monitoring and Anomaly Detection

Centralized dashboards and AI-driven anomaly detection tools integrate with SCADA systems and IoT networks

to provide operators with a live view of all processes.

Outcomes:

- Immediate identification of process deviations
- Rapid response to potential quality defects
- Enhanced safety by preempting critical failures

3. AI in Quality Control

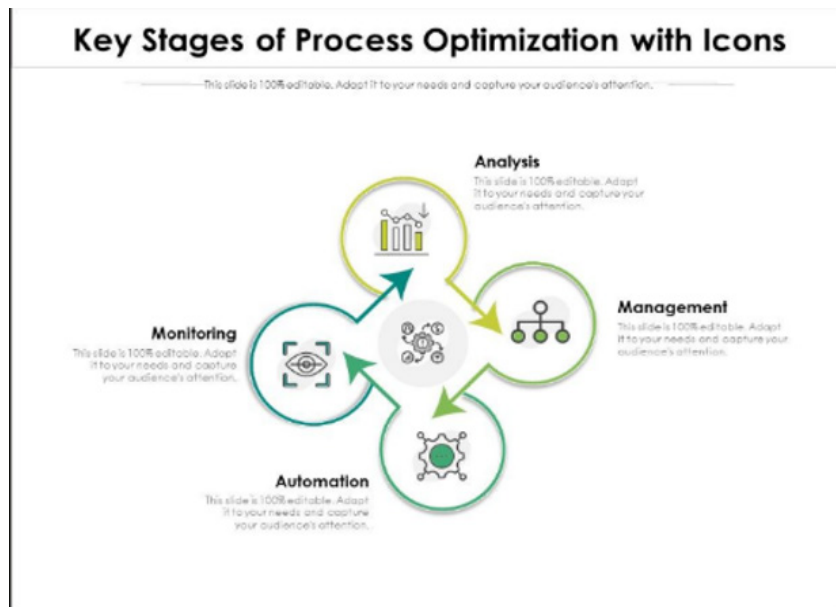
Computer vision systems powered by AI inspect products at production speeds beyond human capability, detecting surface flaws, geometric deviations, and assembly inconsistencies.

This ensures:

- Consistent high-quality output
- Minimization of defective products reaching customers
- Less manual inspection labor



4. Process Optimization and Dynamic Control



AI integrates with advanced process control (APC) systems to dynamically adjust plant operations, including material flow, energy consumption, and production scheduling:

- Real-time optimization of manufacturing lines
- Agile adaptation to changing demand or production conditions
- Reduction in waste, energy usage, and operating costs

5. Digital Twins and Virtual Modeling

By creating digital replicas of plants, AI enables simulation and testing of layout changes, routing strategies, and process modifications without physical intervention:

- Reduced risk and accelerated modernization
- Enhanced planning for safety, efficiency, and capacity
- Virtual training environments for operators

6. Automation and Workforce Augmentation

AI-driven robotics and autonomous systems enable humans to focus on supervision, optimization, and decision-

making rather than repetitive or high-risk tasks. Advantages include:

- Collaborative human-robot work environments
- Faster workforce onboarding through AI-assisted guidance
- Enhanced operational consistency

7. Energy Management and Sustainability

AI-based energy management systems optimize consumption and integrate renewable energy sources, providing:

- Minute-by-minute adjustment of energy flows
- Detailed digital carbon footprints for each production batch
- Support for sustainable manufacturing practices

8. Holistic Enterprise Integration

Modern AI solutions in plant engineering are not isolated but embedded into entire plant ecosystems using hybrid edge-cloud architectures:

- Seamless data mobility with rich contextual analytics
- Unified, embedded AI tools integrated with ERP, MES, and automation platforms
- Accelerated ROI through robust, suite-based implementations

9. Strategic Insights and Decision Support

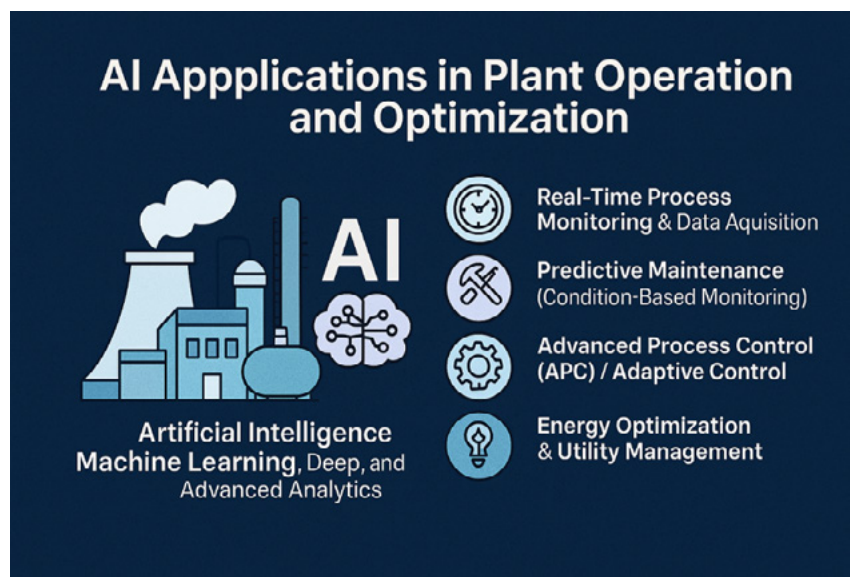
Beyond operational efficiencies, AI augments strategic decision-making by:

- Combining historical, real-time, and unstructured data
- Providing contextual recommendations for maintenance, production planning, and design optimization
- Enabling faster, data-backed decisions across the enterprise

AI APPLICATIONS IN PLANT OPERATION AND OPTIMIZATION

Artificial Intelligence (AI) plays a significant role in plant operation and optimization by enabling intelligent, data-driven management of industrial processes. In modern plants, large volumes of real-time data are collected from instrumentation systems such as pressure, temperature, flow, and level transmitters. AI analyzes this data continuously to monitor process conditions, detect abnormalities, and optimize system performance. It enhances operational efficiency by dynamically adjusting process parameters to achieve optimal output with minimal resource consumption. Through advanced process optimization techniques, AI helps in maintaining stable operations, reducing process variability, and improving overall productivity.

In addition, AI is widely used for predictive maintenance, where it analyzes equipment condition data to identify early signs of failure and estimate the remaining useful life of components such as pumps, compressors, and control valves. This minimizes unplanned downtime and reduces maintenance costs. AI also improves control system performance by enabling adaptive and self-tuning control strategies, ensuring better response to changing process conditions. Furthermore, AI supports energy optimization by improving the efficiency of utilities such as boilers, compressors, and cooling systems, leading to reduced energy consumption and operational costs. Overall, AI enables smarter, more efficient, and increasingly autonomous plant operations, contributing to improved reliability, safety, and sustainability.



CONCLUSION

Artificial Intelligence (AI) plays a transformative role in plant operation and optimization by enabling data-driven, intelligent, and efficient industrial systems. By integrating AI with instrumentation and control systems, plants can achieve real-time monitoring, predictive maintenance, and adaptive process control, leading to improved reliability and reduced operational costs. AI-driven optimization ensures better utilization of resources such as energy, raw materials, and utilities, while also enhancing product quality and consistency.

As industries move toward digitalization and Industry 4.0, AI is becoming essential for developing smart, autonomous plants with minimal human intervention. Its ability to improve safety, support decision-making, and drive sustainability makes it a key technology for future-ready plant engineering. Overall, the adoption of AI not only enhances plant performance but also provides a strong competitive advantage in modern industrial environments.

**“Transforming Industrial Plants through Intelligent
Engineering And Smart Automation”**

CONTRIBUTED BY



PAVITHRAA J

(ASSOCIATE ENGINEER)



AI IN PE - Digital Twins To Net Zero Plants

The global industrial sector is undergoing a significant transformation driven by the dual need for operational efficiency and environmental sustainability. Process industries such as oil & gas, chemicals, and power plants are under increasing pressure to reduce carbon emissions and achieve net-zero targets.

In this context, Artificial Intelligence (AI) combined with Digital Twin technology is emerging as a powerful solution. By enabling real-time monitoring, predictive analytics, and advanced simulations, AI-powered digital twins are helping industries transition towards smart, efficient, and low-carbon plant operations.



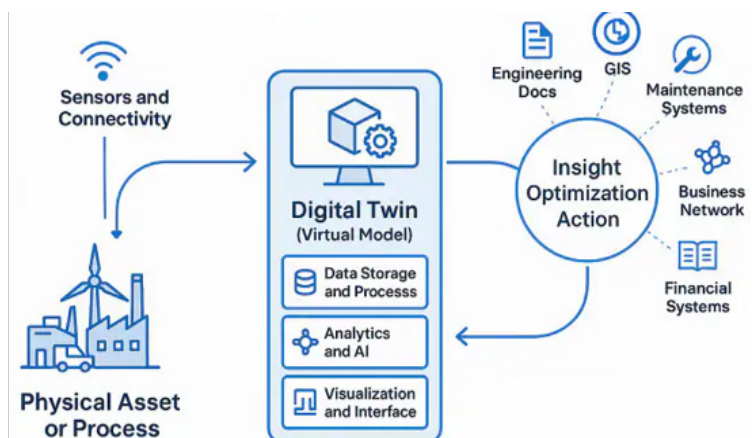
“Instead of reacting to plant problems, digital twins allow engineers to predict and optimize plant performance, which directly supports net-zero goals.”

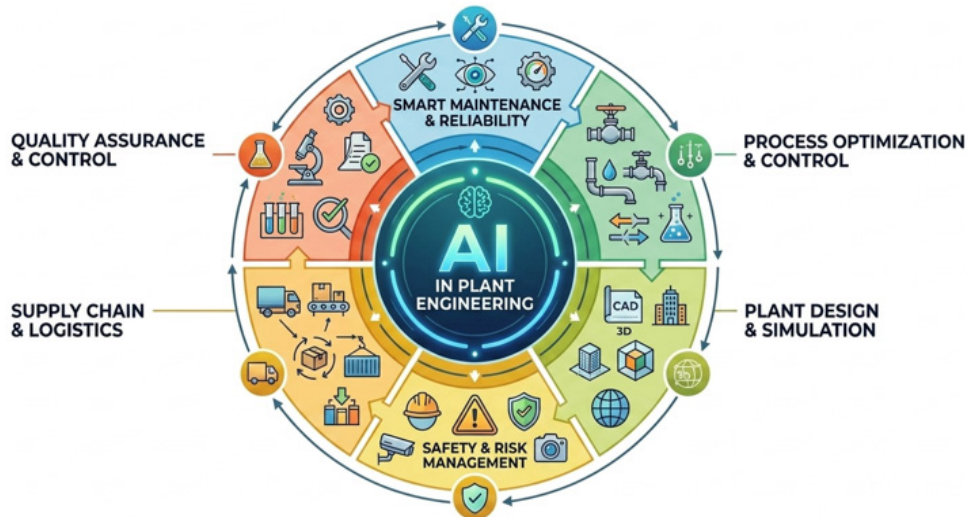
Plant inefficiency problem

In most process plants, inefficiency does not arise from a single major issue but from small deviations that develop during operation. Equipment such as heat exchangers gradually lose performance due to fouling, control systems drift from optimal settings, and utilities often operate with excess margins. These changes are usually not visible immediately, but over time they lead to higher energy consumption and increased fuel usage. As a result, emissions increase without any obvious indication at the plant level. This gap between design performance and actual operation is one of the key challenges in achieving net-zero targets.

Digital Twin

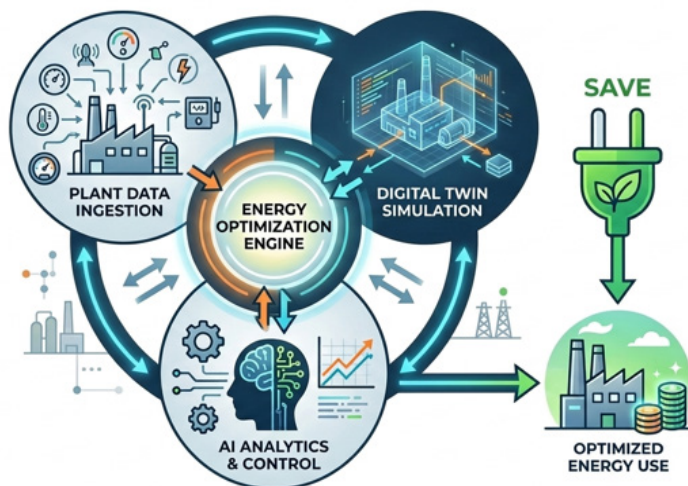
A digital twin provides a way to continuously compare plant performance with its intended design behavior. It is not just a model, but a system that combines real-time plant data with process calculations to represent how the plant should perform under given conditions. By linking actual operating data with engineering models, it becomes possible to identify where the plant is deviating and quantify how much efficiency is being lost. This makes it more of a performance evaluation tool rather than just a visualization system.





The addition of AI enhances the usefulness of the digital twin by enabling it to learn from plant data over time. Instead of relying only on predefined models, the system can detect patterns, identify recurring inefficiencies, and predict future deviations. This is particularly useful in process plants where behavior is non-linear and influenced by multiple interacting variables. With AI, the digital twin moves beyond monitoring and becomes capable of providing predictive and optimization-based insights.

Energy optimization



Achieving net-zero in process plants largely depends on reducing unnecessary energy consumption rather than only adopting new energy sources. Digital twins play a key role in this by identifying areas where energy is being wasted. For example, inefficiencies in heat transfer, excess steam usage, or mismatch between process demand and utility supply can be detected by continuously comparing actual and expected performance. Even small improvements in these areas can lead to significant reductions in fuel consumption, which directly reduces carbon emissions.

Future Perspective

The future of digital twin-enabled net-zero plants includes:

- Fully autonomous energy-optimized plants
- AI-driven carbon footprint tracking
- Smart integration with renewable energy
- Self-optimizing process units

As industries move towards Industry 4.0 and sustainability goals, digital twins will become a critical enabler of net-zero transformation.

Conclusion

AI-driven digital twins are transforming plant engineering by bridging the gap between physical operations and digital intelligence. Digital twin technology is a game-changer for achieving net-zero plants in process industries. They enable industries to monitor, simulate, and optimize processes in real time, significantly reducing emissions and improving efficiency.

As industries strive toward net-zero goals, digital twins will play a crucial role in designing and operating sustainable, intelligent, and future-ready plants.

*“Sustainability becomes achievable when complexity becomes understandable
and digital twins make that possible.”*



Contributed By:

Mansi Vasant Wadhavane



L&T Technology Services

A STUDY ON ARTIFICIAL INTELLIGENCE IN INDUSTRY

ABSTRACT:

Artificial Intelligence (AI) is a transformative force reshaping industries and society across various domains. It has a profound impact on multiple facets of human life, influencing how systems operate and decisions are made. While AI offers significant advantages such as improved productivity, efficiency, and innovation, it also introduces important challenges and risks. Key concerns include ethical issues related to autonomous decision-making, threats to data privacy, and the potential to widen social and economic inequalities. The adoption of AI requires careful consideration of its societal, legal, and ethical implications. Organizations, individuals, and policymakers must work collaboratively to ensure responsible implementation. By balancing opportunities with risks, stakeholders can guide the development of AI in a manner that maximizes societal benefits while minimizing potential harm.

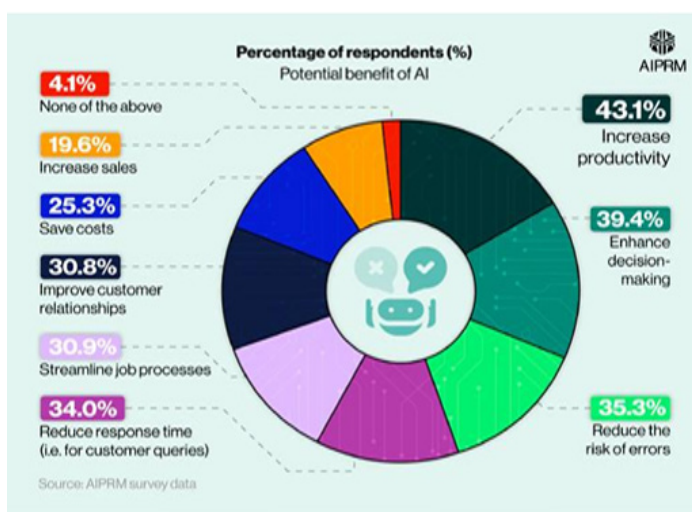
INTRODUCTION:

Artificial Intelligence (AI) represents the cutting edge of technological advancement and signifies a major shift in how humans interact with and utilize technology. Defined as the simulation of human intelligence by machines, AI encompasses a broad range of techniques and applications designed to replicate cognitive functions such as learning, reasoning, problem-solving, and decision-making. The origins of artificial intelligence date back to the mid-20th century, when pioneers such as Alan Turing laid the theoretical foundation for intelligent machines. Over time, significant advancements in computing power, algorithm design, and data availability have transformed AI from a conceptual idea into a practical and widely deployed technology. Today, AI plays a critical role across numerous domains, including robotics, computer vision, machine learning, natural language processing, and expert systems. These capabilities enable AI to influence and reshape modern life at multiple levels, driving innovation while simultaneously raising important questions. Its rapid expansion highlights the need to understand both its transformative potential and the broader implications it carries. Ethical concerns related to autonomous decision-making, issues surrounding data privacy, and the wider societal impact of automation are central to ongoing discussions.

ARTIFICIAL INTELLIGENCE IMPACTS ON DIFFERENT INDUSTRIES:

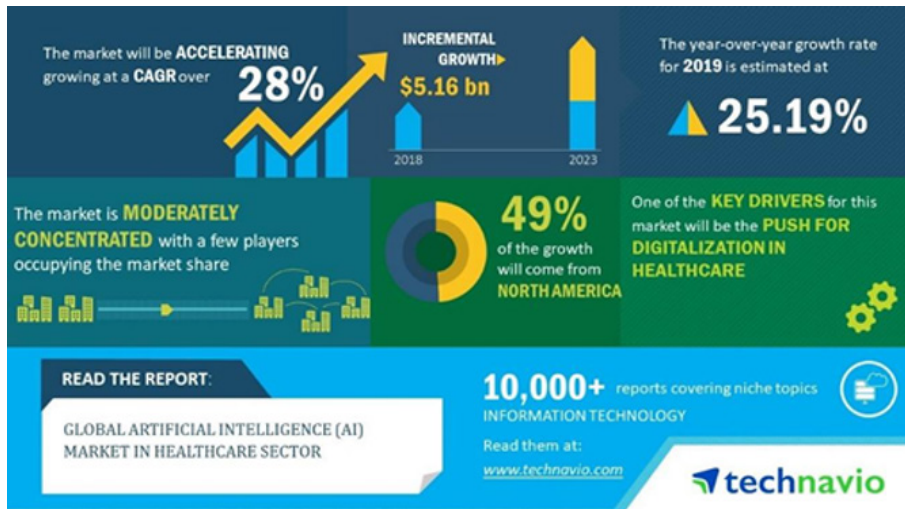
FINANCE AND BANKING INDUSTRY:

Algorithmic trading, fraud detection, risk assessment, and chatbot customer support are all powered by AI. Through predictive analytics, AI provides individualized financial advice, streamlines the loan underwriting procedure, and improves client experiences. Artificial intelligence (AI) has a huge and diverse impact on the banking and financial sectors.



HEALTHCARE INDUSTRY:

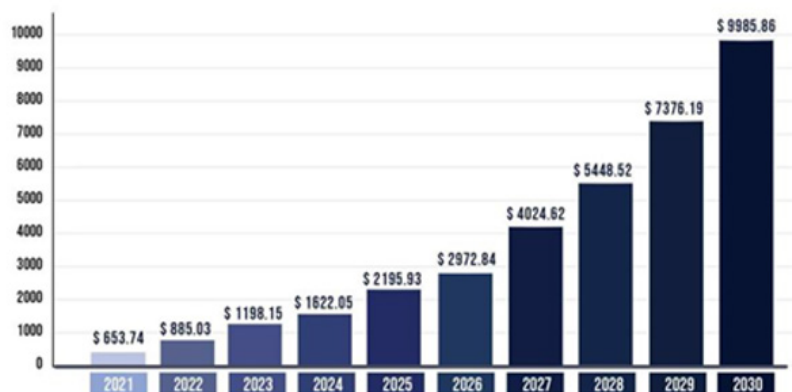
Artificial intelligence (AI) in healthcare enables medication discovery, individualized treatment regimens based on patient data, medical imaging analysis for early illness identification, and virtual health aids for patient monitoring. Predictive analytics powered by AI also improve clinical decision-making, resource management, and hospital operations.



MANUFACTURING INDUSTRY:

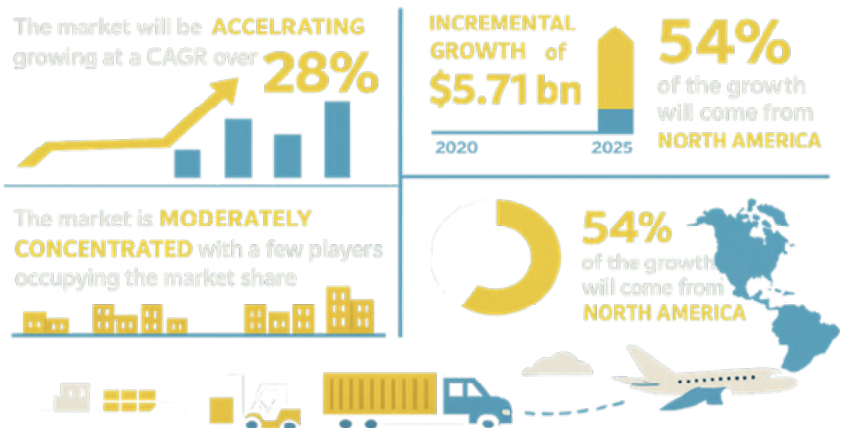
Automation powered by AI improves production schedules, quality control, predictive maintenance, and industrial processes. Automation and computer vision enhance assembly line productivity, and AI-driven predictive analytics cut expenses and downtime.

PRECEDENCE RESEARCH ARTIFICIAL INTELLIGENCE IN AVIATION MARKET SIZE, 2021 TO 2030 (USD MILLION)



TRANSPORTATION AND LOGISTICS INDUSTRY:

AI is transforming logistics and transportation with its applications in autonomous vehicle technology, predictive maintenance for infrastructure and vehicles, and route optimization. Algorithms powered by AI enhance last-mile delivery effectiveness, supply chain optimization, and fleet management.



TELECOMMUNICATION INDUSTRY:

Through network optimization, predictive maintenance, and customized consumer experiences, artificial intelligence (AI) improves telecoms. Virtual assistants and chatbots enhance customer support, and AI-powered analytics maximize network efficiency and resource distribution.



CHALLENGES OF ARTIFICIAL INTELLIGENCE:

1) Data Privacy and Security Challenges

One of the most critical challenges of AI across industries is ensuring data privacy and security. AI systems require large volumes of data for training, which often includes sensitive information such as customer details, financial records, or medical histories. In industries like healthcare and finance, improper handling or breaches can lead to severe legal and ethical consequences.

2) High Implementation and Maintenance Costs

The adoption of AI involves significant investment in infrastructure, software, and skilled manpower. Industries such as manufacturing, logistics, and utilities face high upfront costs for deploying AI systems, including sensors, cloud computing, and automation tools.

3) Lack of Skilled Workforce

AI implementation requires expertise in data science, machine learning, and domain-specific knowledge. Many industries struggle with a shortage of skilled professionals who can design, implement, and maintain AI systems.

4) Integration with Existing Systems

In traditional industries such as oil & gas, power plants, and chemical processing, integrating AI with legacy systems is a major challenge. Existing infrastructure is often outdated and not compatible with modern AI technologies. This requires significant modifications, system upgrades, or complete redesigns, which can disrupt ongoing operations and impact productivity.

5) Reliability and Accuracy Issues

AI systems rely heavily on the quality of data used for training. Inaccurate, biased, or incomplete data can lead to unreliable predictions and poor decision-making. For example, in autonomous vehicles or industrial safety systems, even minor errors can result in significant accidents or losses. Ensuring accuracy and validation of AI output remains a major concern across industries.

6) Ethical and Legal Concerns

The use of AI raises important ethical questions related to decision-making transparency, accountability, and fairness. In sectors like finance, hiring, and law enforcement, AI systems may introduce biases that lead to unfair outcomes. Moreover, lack of clear regulations and legal frameworks creates uncertainty in AI deployment and responsibility in case of failures.



FUTURE PROSPECTS OF ARTIFICIAL INTELLIGENCE:

Advanced automation, personalized healthcare, self-driving cars, augmented intelligence, natural language processing, reducing global warming, developing ethical AI, and cooperative robotics are the prospects of artificial intelligence (AI). Artificial intelligence (AI) can transform many industries, improve human capabilities, and solve difficult societal issues. However, ethical and responsible research are essential to guaranteeing AI’s beneficial effects on society.

CONCLUSION:

Artificial Intelligence (AI) demonstrates significant transformative potential along with important ethical and societal implications. Across industries such as manufacturing, healthcare, finance, and transportation, AI has the capability to transform workflows, enhance productivity, and improve overall human well-being. Its application enables greater efficiency, accuracy, and innovation, reshaping modern systems and processes. However, the widespread adoption of AI also introduces several challenges, including algorithmic bias, job displacement, data privacy concerns, and complex ethical dilemmas. These issues underline the need for responsible development and implementation of AI systems that ensure fairness, transparency, and accountability. Addressing these challenges requires collaboration among policymakers, industry leaders, academics, and society. Interdisciplinary approaches that integrate insights from law, ethics, sociology, and computer science are essential for managing the broader implications of AI technologies.

“AI will not just shape the future—it will define how responsibly we choose to build it.”

Contributed by:



Jayraj Godhani
Associate Engineer



**WINNERS OF QUIZ
MAY 2026**

**KAUSHIKA PUROHIT
ABHIMANYU GAONKAR
LALITKUMAR AHUJA
KAUSTUBH DESHPANDE
ADUDE KARAN**

Congratulations

QUIZ - JUNE 2026

1. Which of the following is a primary benefit of AI in electrical design engineering?
 - a) Increased manual drafting
 - b) Predictive maintenance and fault detection
 - c) Reduced automation
 - d) Higher dependency on human intuition
2. In AI-assisted CAD tools, what feature enables automatic optimization of circuit layouts?
 - a) Neural network-based design suggestions
 - b) Manual schematic entry
 - c) Static rule-based checks only
 - d) Paper-based drafting
3. Which AI technique is most commonly used for predictive load forecasting in power systems?
 - a) Regression analysis
 - b) Convolutional Neural Networks (CNNs)
 - c) Reinforcement Learning
 - d) Genetic Algorithms
4. When integrating AI into industrial electrical systems, what is the biggest cybersecurity concern?
 - a) Overheating of transformers
 - b) Unauthorized access to control systems
 - c) Manual wiring errors
 - d) Increased downtime due to maintenance
5. Which AI-enabled process helps reduce energy consumption in smart factories?
 - a) Randomized switching
 - b) Demand-side management using machine learning
 - c) Manual scheduling of loads
 - d) Increased redundancy in circuits
6. In design engineering, AI can assist in fault detection by analyzing:
 - a) Historical maintenance logs only
 - b) Real-time sensor data and patterns
 - c) Manual inspection reports
 - d) Employee feedback forms
7. Which of the following is a limitation of AI in industrial design engineering?
 - a) AI cannot process large datasets
 - b) AI models require high-quality training data
 - c) AI eliminates all human involvement
 - d) AI reduces computational efficiency
8. AI-enabled digital twins in electrical engineering are primarily used for:
 - a) Creating physical prototypes faster
 - b) Simulating and monitoring real-time system performance
 - c) Reducing the need for sensors
 - d) Manual fault analysis



9. Which machine learning algorithm is most suitable for anomaly detection in industrial electrical systems?

- a) K-Means Clustering
- b) Linear Regression
- c) Decision Trees
- d) Support Vector Machines (SVM)

10. In AI-driven design engineering, reinforcement learning is particularly useful for:

- a) Static circuit analysis
- b) Optimizing dynamic control strategies in power systems
- c) Manual drafting of schematics
- d) Reducing the need for sensors

Rules for the QUIZ:

- The Quiz will be open for 10 days from the date of EMAIL.
- Each correct answer received on DAY 1 will get 100 points
- Next days the points will reduce as 90 – 80 – 70 and on 10th day points will be ZERO even if the answer is correct.
- All participants will receive E certificate signed by CEEAMA President with the points earned mentioned on the same.

Please use following google form link to participate in this month's QUIZ.

<https://forms.gle/oH4nEnDiGEzMegm6>

“Thank you all for the overwhelming response to the E-NEWS in general and E-Quiz in particular. MCQ based quiz is always tricky and surprisingly can take us aback when we realise our conceptions (misconceptions) about the subject / system / product.

The aim of the feature was to create inquisitiveness in your mind and help you check your technical quotient quickly. The response will also help us to present articles and webinars on subjects which are important, but which lack enough awareness / knowledge in general.

It can open a pandora box for our discussions and arguments and probable solutions. Engineering evolves with conception. It gets fuelled with community discussions and capitalist actions. All stakeholders start realising the need to take a closer look and help improve standards as we have seen in the past century. Surely it makes the world a better place.

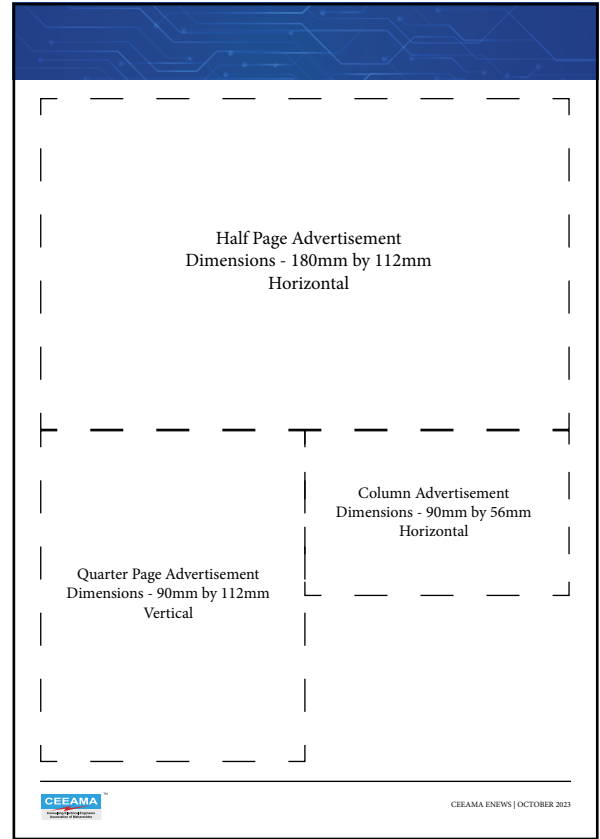
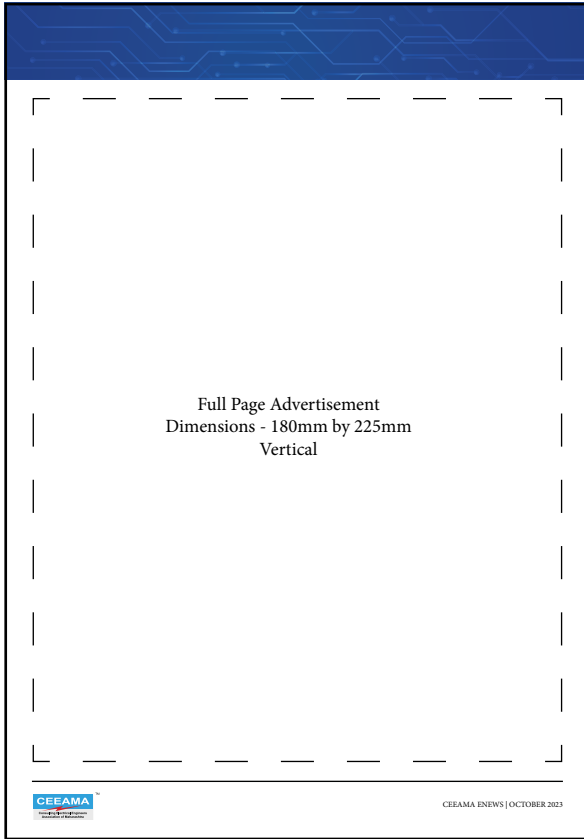
Wish you all a better luck this time.

Do spread the word.

May 2026 Quiz Answers

1. B. Transformer impedance
2. C. Reliability and availability
3. C. Limit voltage and current distortion
4. C. Predictive maintenance
5. B. No damage or only minor contact welding
6. C. Ultrasonic detector
7. B. Harmonic-rich non-linear loads
8. B. Breaking capacity
9. C. Verify DG capability under actual load
10. B. Periodic arc flash risk assessment

ADVERTISEMENT RATES



Above given layouts are only for understanding the advertisement sizes. Actual positions of ads may vary as per space available in the issues.

Below given rates are for advertisement size and number of issues published monthly.

E-Newsletter Ad	3 months	6 months	9 months	12 months
Full Page Ad	INR 1000/-	INR 2000/-	INR 2700/-	INR 3300/-
Half Page Ad	INR 800/-	INR 1600/-	INR 2200/-	INR 2800/-
Quarter Page Ad	INR 600/-	INR 1200/-	INR 1600/-	INR 2100/-
Column Ad	INR 400/-	INR 800/-	INR 1000/-	INR 1400/-
Website Ad	INR 1000/-	INR 2000/-	INR 2700/-	INR 3300/-

GST @18% will be additional on all the above rates.

Please send the E-Newsletter Advertisement in PDF or JPG format ONLY.

Please send the Website Advertisement in JPG or PNG format ONLY.



CEEAMA *Live Wire*

E-NEWSLETTER

Published by Consulting Electrical Engineers Association of Maharashtra

Electrical Consultants Newsletter
Volume No. 4 Issue #60
JUNE 2026

A-103. Sanpada Railway Station Building, 1st floor Sanpada East, Navi Mumbai – 400705
Email: admin@ceeama.org
