



AI for Engineers: The Future of Engineering with Smart Sensors and Intelligent Machines

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Introduction – Presenter



Dr. Ali Marzoughi

Dr. Ali Marzoughi is a professional engineer and researcher with over 20 years of combined industry and academic experience. He holds a Bachelor's degree in Electrical/Electronics Engineering, a Master's degree in Mechatronics and Automatic Control, and a PhD in Robotics and Automatic Control from the University of New South Wales (UNSW), Australia.

He began his career as an instrumentation engineer in the oil and gas sector and later progressed into senior technical and project management roles across major EPC projects, leading electrical and instrumentation activities in complex industrial environments.

Dr. Marzoughi has remained strongly connected to research and education throughout his career, working in both industry and academia across multiple countries. Since 2019, he has served at the Engineering Institute of Technology (EIT) as a unit coordinator, lecturer, and thesis supervisor, contributing to the development of the next generation of engineers in the fields of electrical, robotics, automation, instrumentation, and advanced control systems.



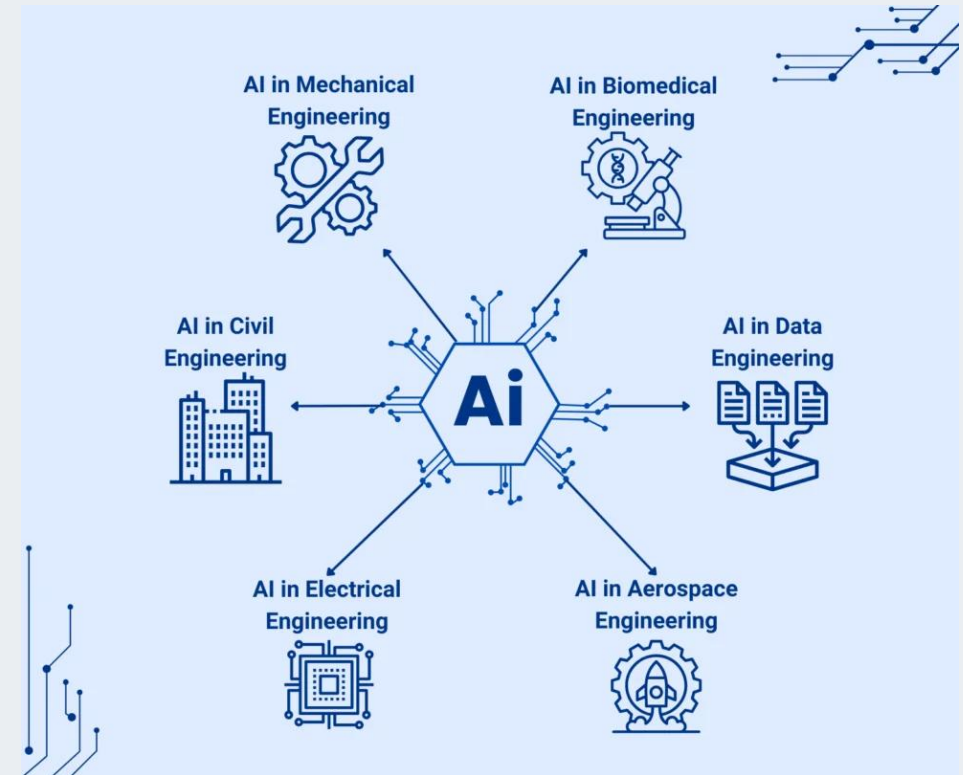
Agenda

1	AI Agents
2	Foundation Models
3	Edge AI + TinyML
4	AI embedded in PLCs and smart sensors
5	Live Digital Twins
6	Prescriptive Maintenance
7	AI-Augmented Engineers
8	Case Studies
9	Conclusion and Q&A



AI for Engineers

- AI is no longer a separate software topic
 - It is embedded inside machines, sensors, and industrial systems.
- Engineers already work with AI every day:
 - Predictive maintenance
 - Process optimisation
 - Robotics and automation
 - Fault diagnosis and monitoring. The question is no longer “Will AI affect engineering?”
- The question is “How should engineers use it effectively?”



Source:[<https://devomech.com/how-is-ai-used/>]

What Changed in 2025-2026

- Three major shifts accelerated AI adoption

1. Foundation Models

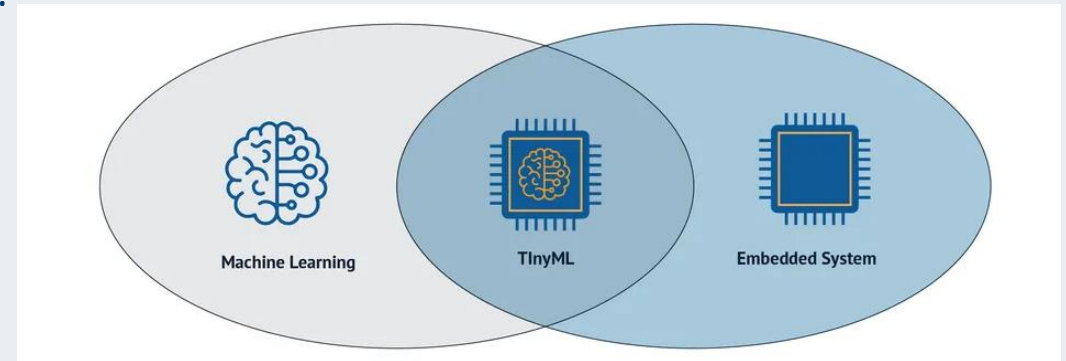
- AI systems trained across multiple tasks and environments.

2. Edge AI + TinyML

- AI running directly inside sensors and controllers.

3. AI Agents

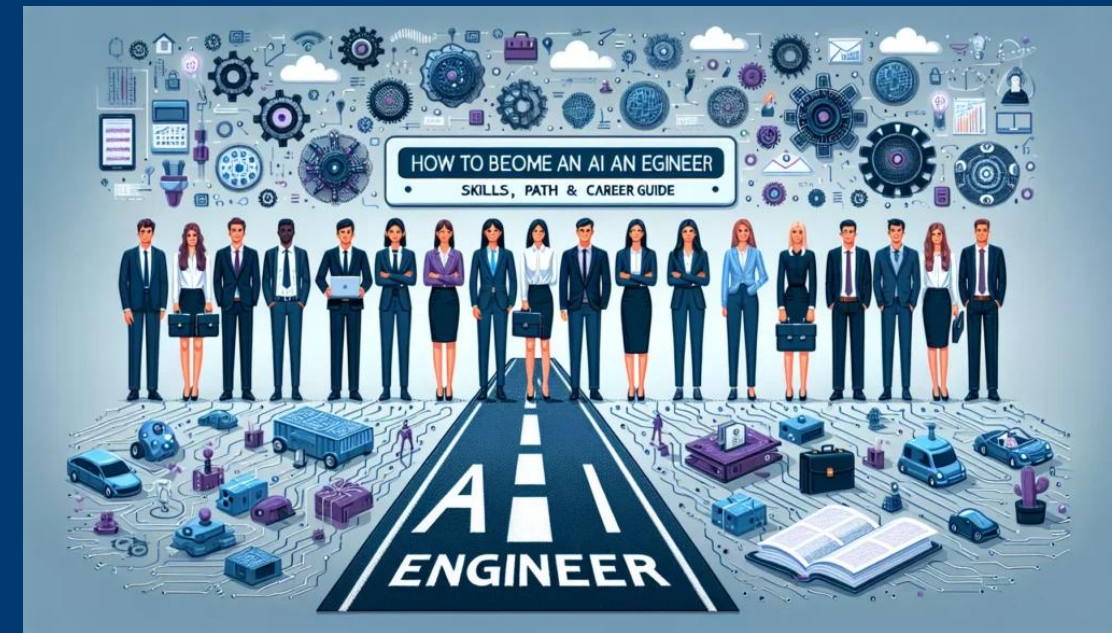
- Systems that recommend or take actions autonomously.
- AI moved from analysis → decision support → action



Source: [<https://www.wevolver.com/article/2023-edge-ai-technology-report-chapter-v-tinyml>]

Engineers Are Becoming AI System Integrators

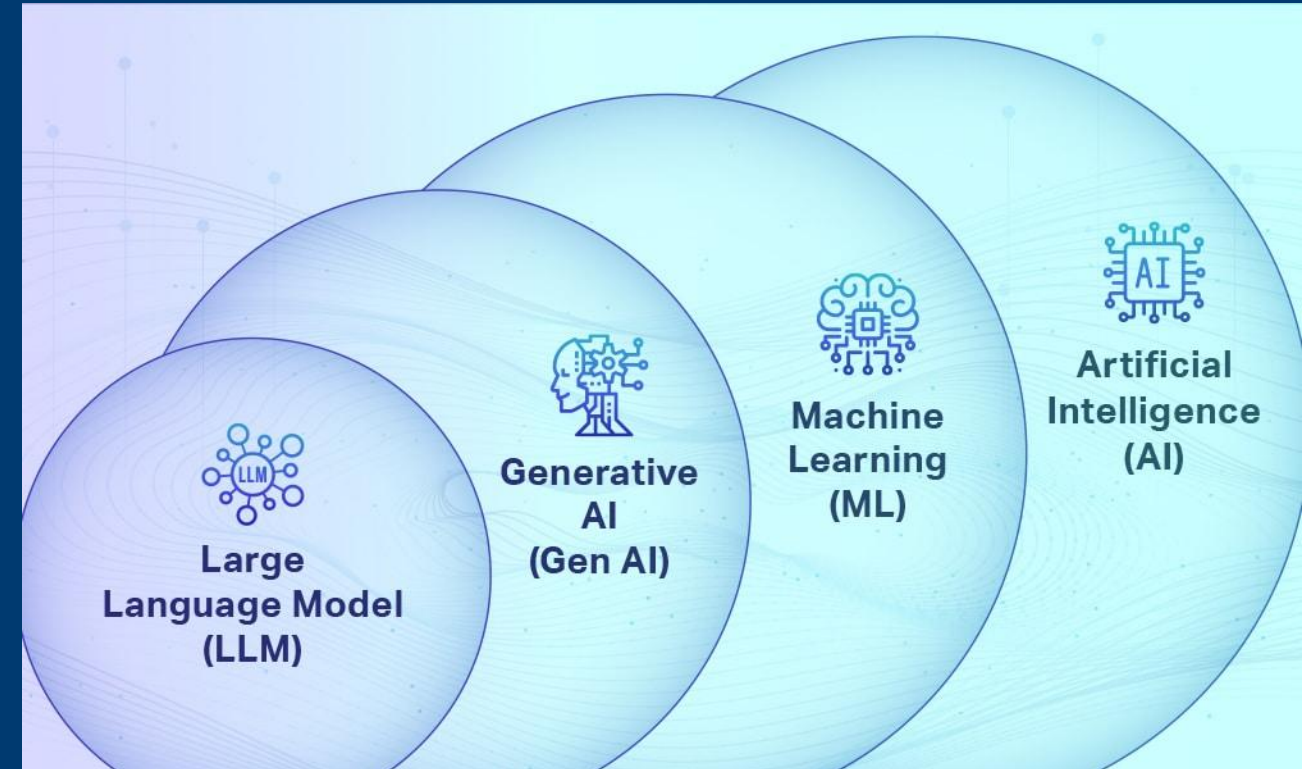
- Traditional engineering focused on design and operation.
- Modern engineering requires integration of:
 - Sensors
 - Embedded intelligence
 - Data-driven decision systems
 - Automation platforms
- Engineers now connect physics + control + AI.
- The future engineer is both a domain expert and an AI integrator.



Source:[<https://algotcademy.com/blog/how-to-become-an-ai-engineer-skills-path-career-guide/>]

AI ≠ ChatGPT

- AI in engineering is different from generative AI.
- **Generative AI.**
- Language, text, code, reports.
- **Engineering AI.**
- Sensing, prediction, control, optimisation
- Engineering AI works in physical systems:
 - Real-time decisions.
 - Safety constraints.
 - Real-world consequences.
- Robotics AI is grounded in physics, not only language.



Different types of AI [Source: <https://glossypurifier.com/what-is-llm-in-ai/>]

AI Agents in Industry

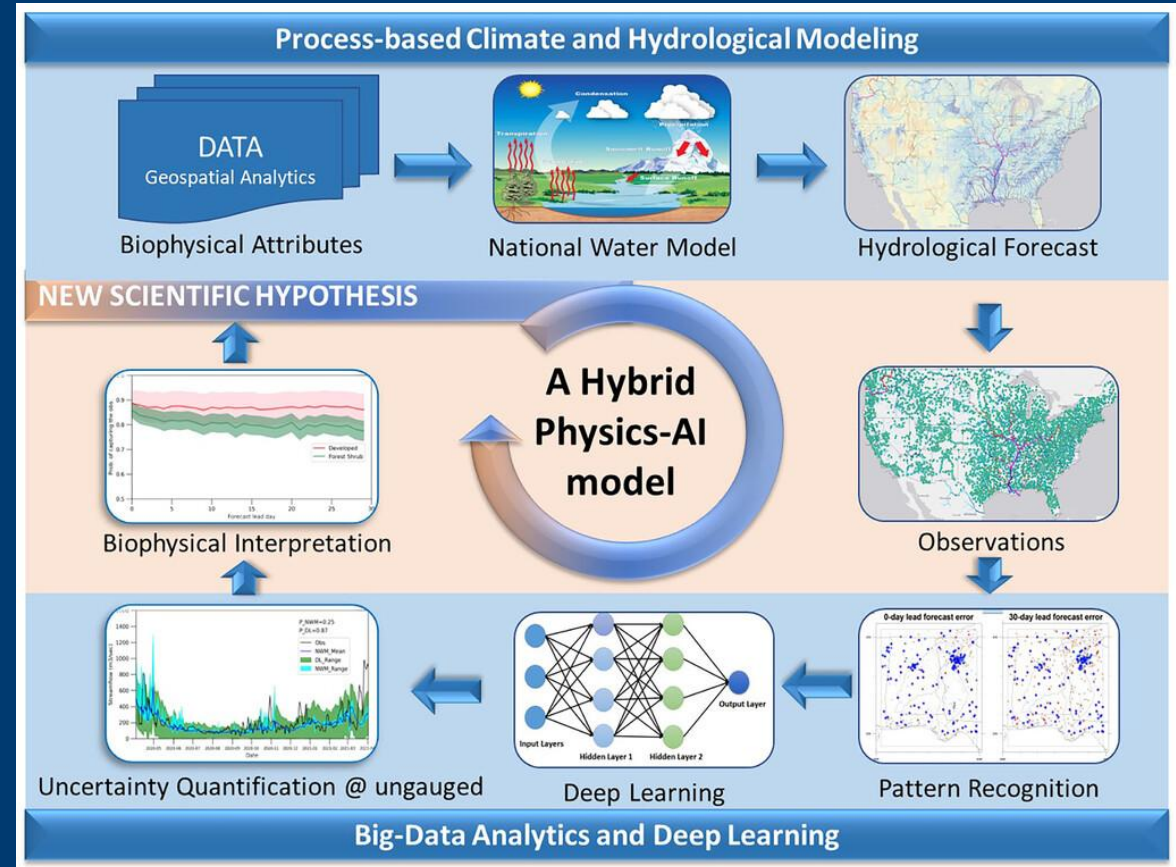
- AI agents move beyond prediction to action.
- Traditional AI.
- Predicts faults or recommends actions.
- AI Agents.
- Analyse → decide → trigger response
 - Autonomous maintenance scheduling.
 - Production optimisation.
 - Quality control decisions.
 - Energy management systems.
- Shift from reactive engineering → proactive engineering



Source: [<https://leverageai.solutions/augmentir-launches-industrial-ai-agent-studio-to-empower-autonomous-agents-in-manufacturing-frontline-operations/>]

Hybrid AI: Physics + Machine Learning

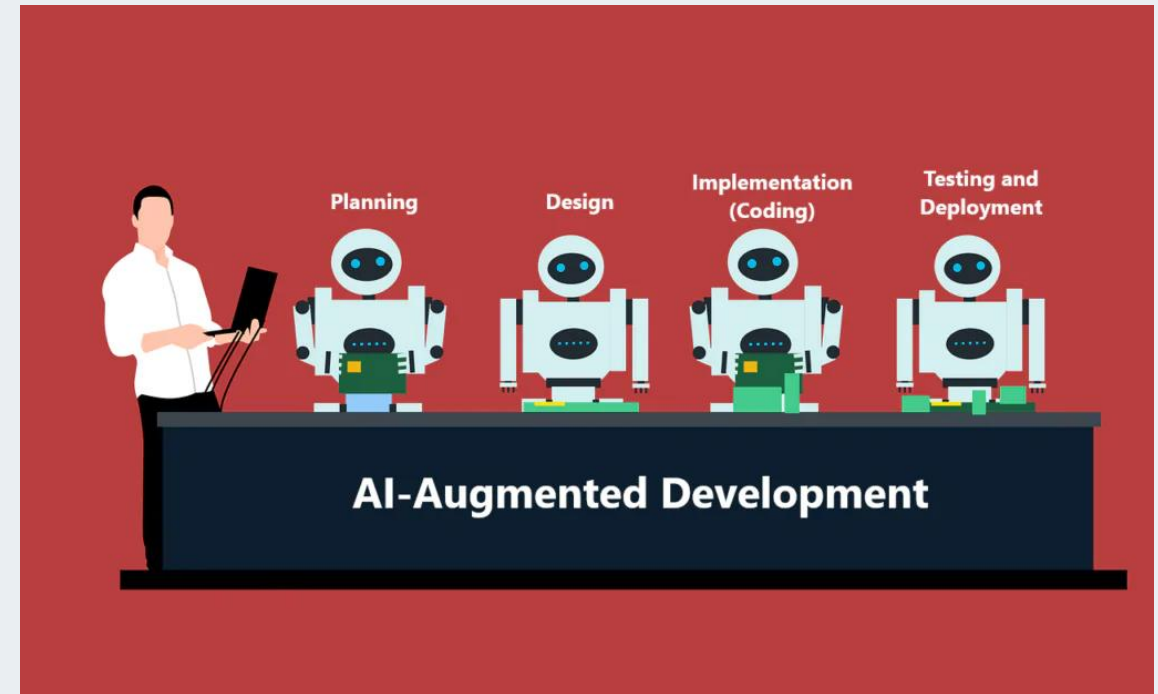
- Pure AI is powerful
- Pure engineering models are reliable
- Modern systems combine both
- **Hybrid AI**
- Physical models + machine learning
- Motor fault diagnosis + vibration ML
- Robot navigation + sensor fusion
- Power systems + predictive analytics
- Best outcome
- Accuracy + reliability + explainability



Source: [<https://journals.ametsoc.org/view/journals/aies/2/1/AIES-D-22-0023.1.xml>]

AI Copilots for Engineers

- AI is becoming an engineering assistant.
 - Design support.
 - Troubleshooting assistance.
 - Report generation.
 - Code and PLC logic suggestions.
 - Maintenance recommendations.
 - Engineers remain the decision-makers.
 - AI improves speed, not professional responsibility.
 - Future trend:
 - AI-augmented engineers, not AI replacement.



Source: [<https://knowledgegenorthstar.com/ai-augmented-development-is-the-future/>]

Smart Sensors Revisited

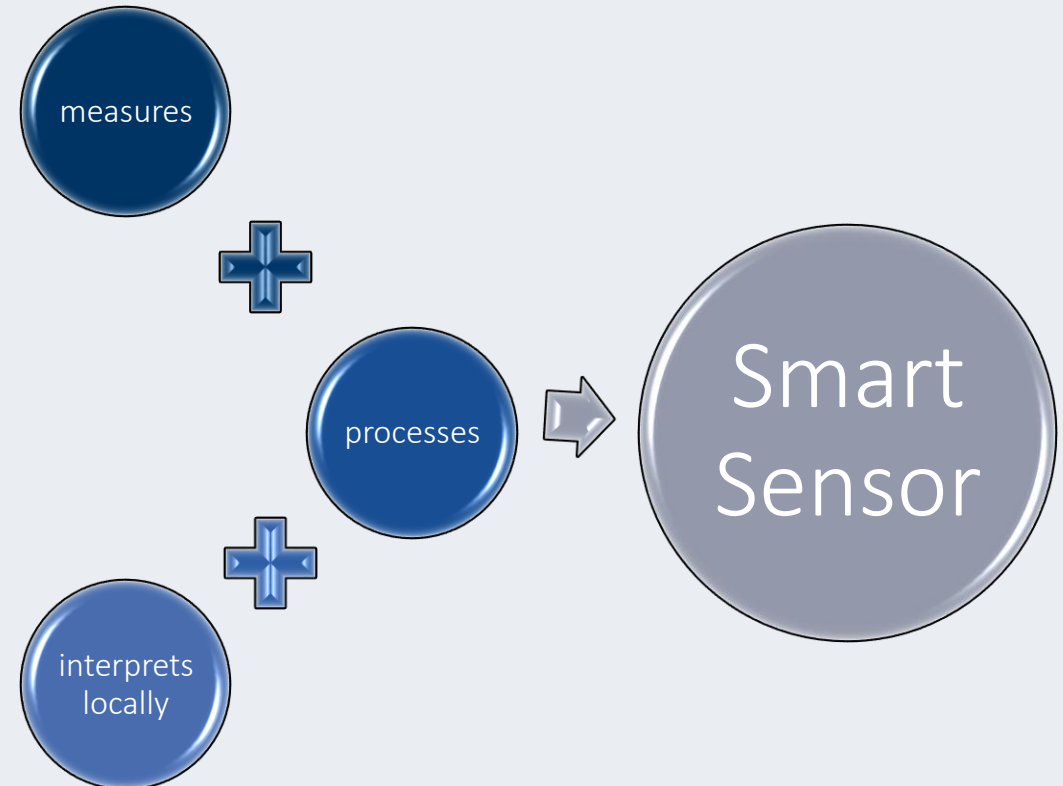
- Sensors are no longer passive measurement devices.

Traditional Sensor

- Measures and sends raw data.

Smart Sensor

- Capabilities:
 - Filtering.
 - Anomaly detection.
 - Self-diagnostics.
 - Local decision support.
- Smart sensors reduce latency and improve reliability.



Edge AI + TinyML

- Edge AI
- AI running locally on devices
- TinyML
- Machine learning on microcontrollers and low-power hardware

Benefits



- Lower latency
- Improved cybersecurity
- Reduced cloud dependency
- Lower operational cost

Applications



- Smart sensors
- Predictive maintenance
- Embedded diagnostics
- Autonomous controllers

AI Embedded in PLCs and Industrial Controllers

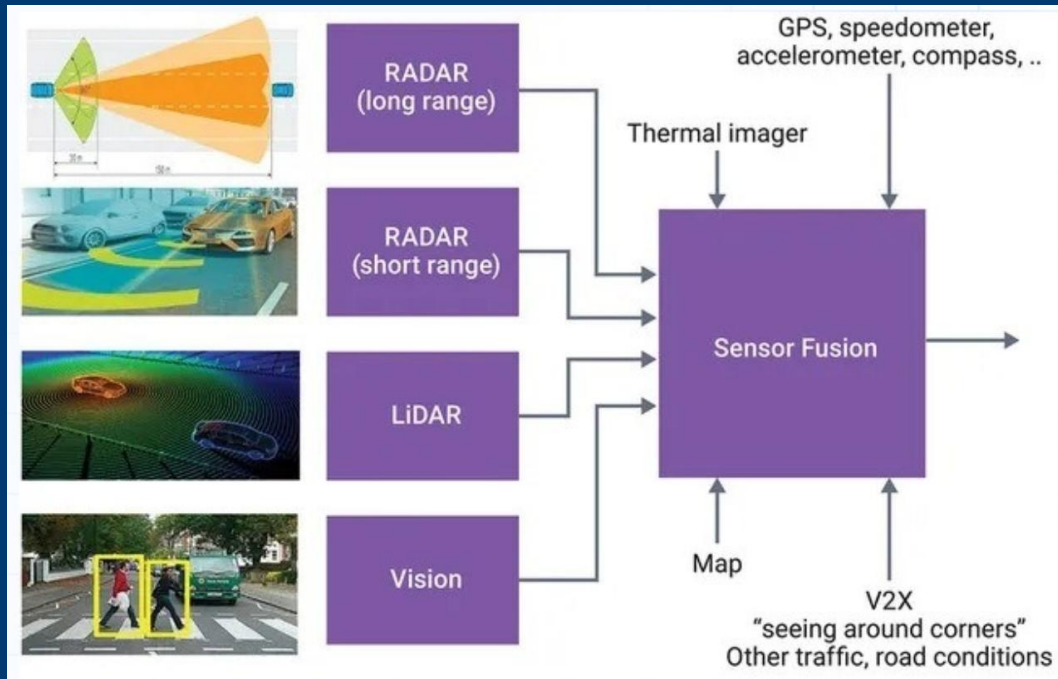
- PLCs are evolving from fixed logic to intelligent control.
- **Traditional PLC.**
- Rule-based control only.
- **Modern Intelligent PLC Systems.**
- Data-driven optimisation.
- Anomaly detection.
- Adaptive process tuning .
- Predictive maintenance support.
- AI improves decisions without replacing core control logic.



Multi-sensor fusion dynamic odometry calculation framework diagram [7].

Sensor Fusion = Reliable Systems

No single sensor is perfect.



Cameras: strong semantics, weak in poor lighting

IMU / GNSS
motion + global positioning

LiDAR / Radar

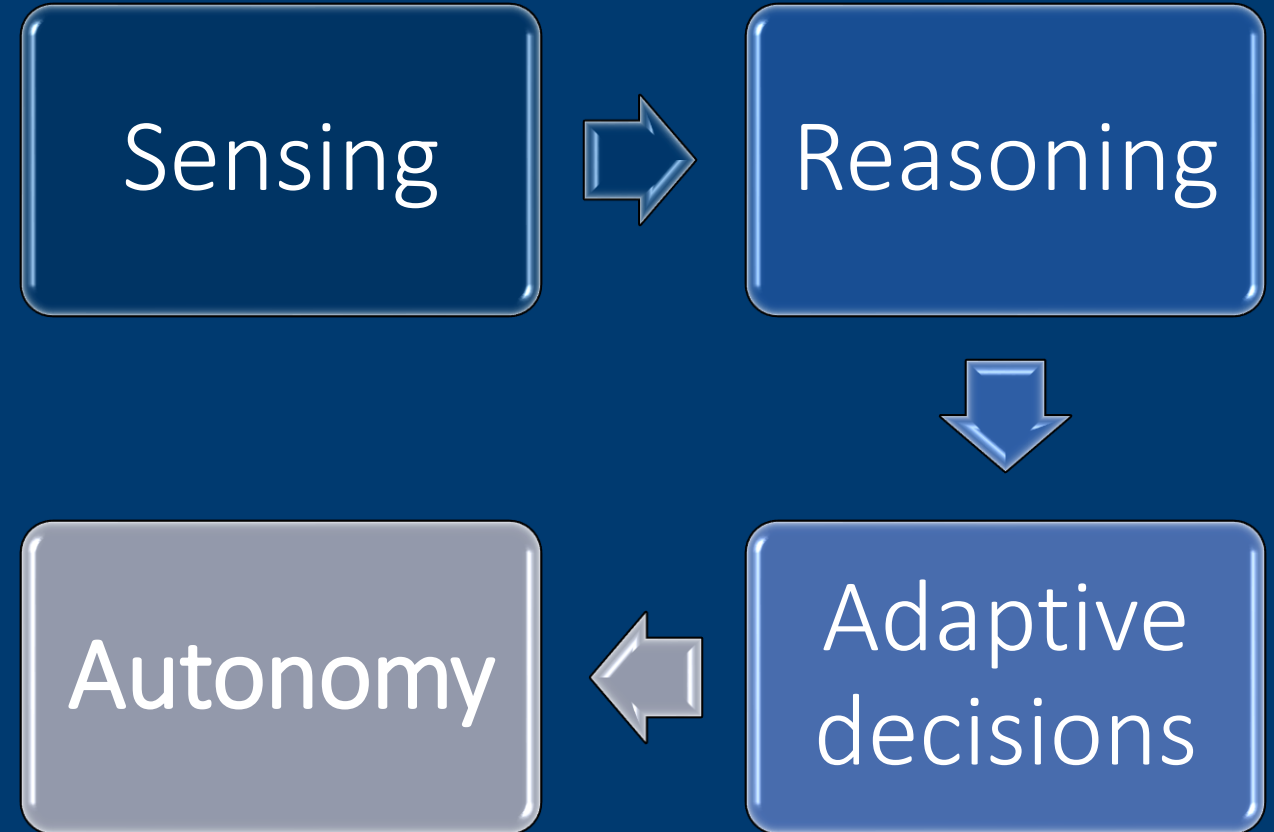
strong geometry, harsh environment capability

Fusion combines strengths and reduces weaknesses

Result
higher reliability
better localisation
safer autonomous systems

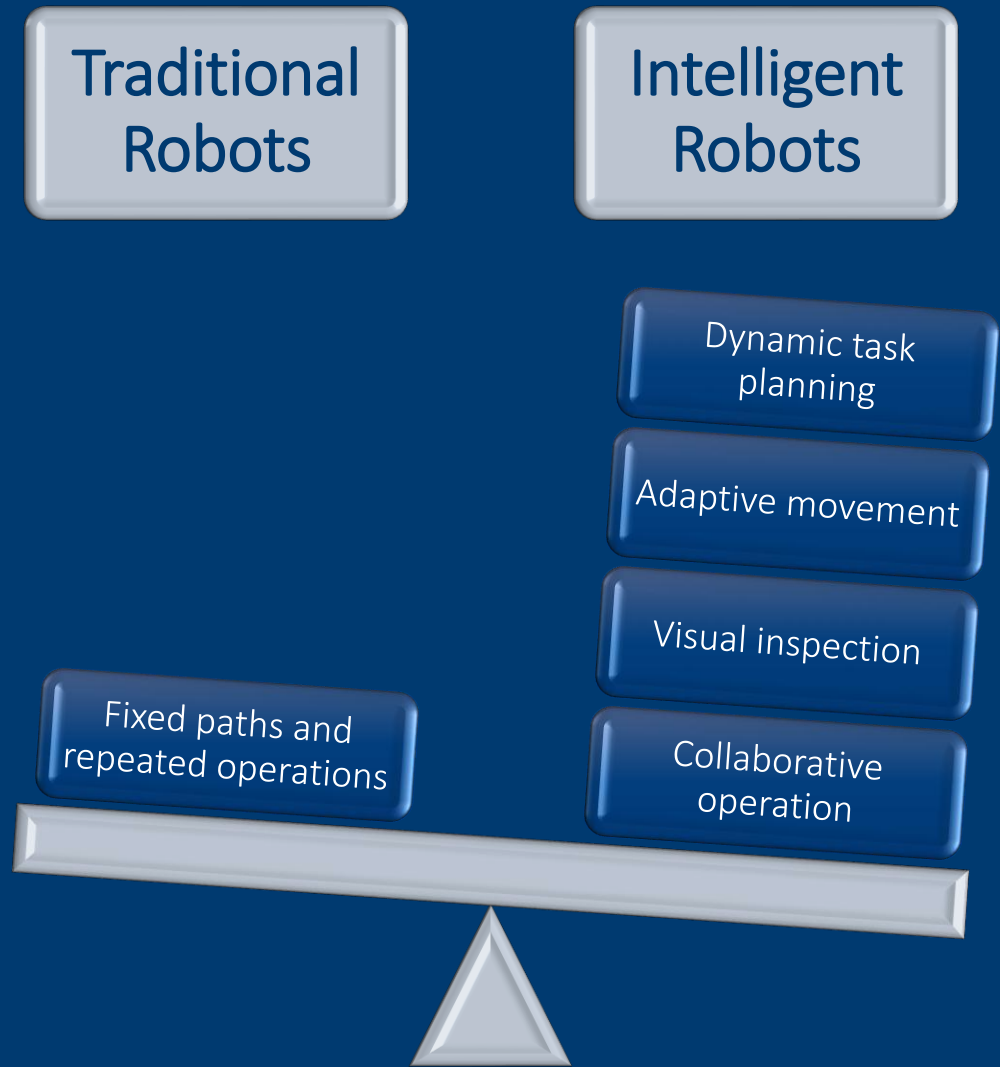
AI and Fusion: A Plan for Optimisation

- From Automation to Autonomy.
- Traditional automation follows fixed rules.
- Automation
 - Predefined responses.
- Autonomy
 - Detect unexpected situations.
 - Adjust behaviour.
 - Optimise performance in real time.
- Intelligent systems can:
 - Detect unexpected situations.
 - Adjust behaviour.
 - Optimise performance in real time.
- Shift from “control” → “intelligent decision-making”



AI in Industrial Robots

Robots are moving beyond repetitive tasks



AGVs, AMRs and Autonomous Systems



AGV (Automated Guided Vehicle)
Fixed routes and predefined paths



AMR (Autonomous Mobile Robot)
Dynamic navigation and decision-making

- Applications
- Warehouses
 - Hospitals
 - Logistics centres
 - Manufacturing plants



- AI enables**
- Obstacle avoidance
 - Route optimisation
 - Real-time adaptation

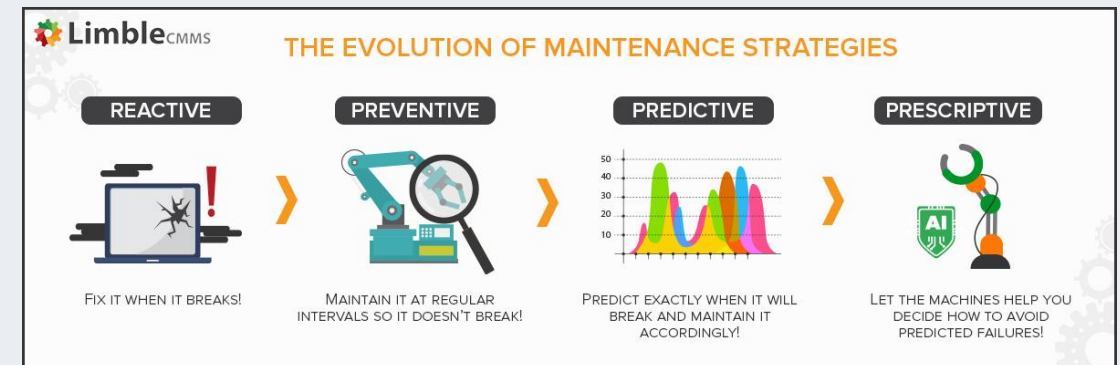


Predictive → Prescriptive Maintenance

- Predictive maintenance asks:
 - “What may fail?”
- Prescriptive maintenance asks:
 - “What should we do now?”
- AI moves maintenance from detection to action

Examples

- Scheduling maintenance automatically.
- Recommending spare parts.
- Prioritising urgent interventions.
- Higher uptime + lower operational cost.



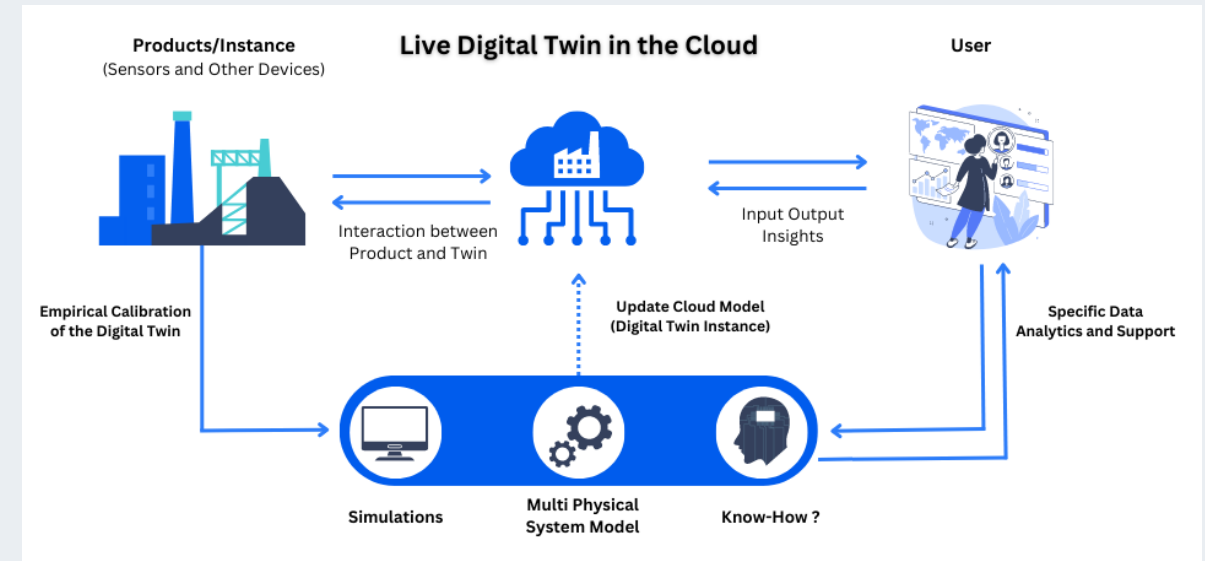
Source: [<https://factech.ai/blog/machine-learning-in-prescriptive-maintenance/>]

Live Digital Twins

- Traditional digital twins are static models.

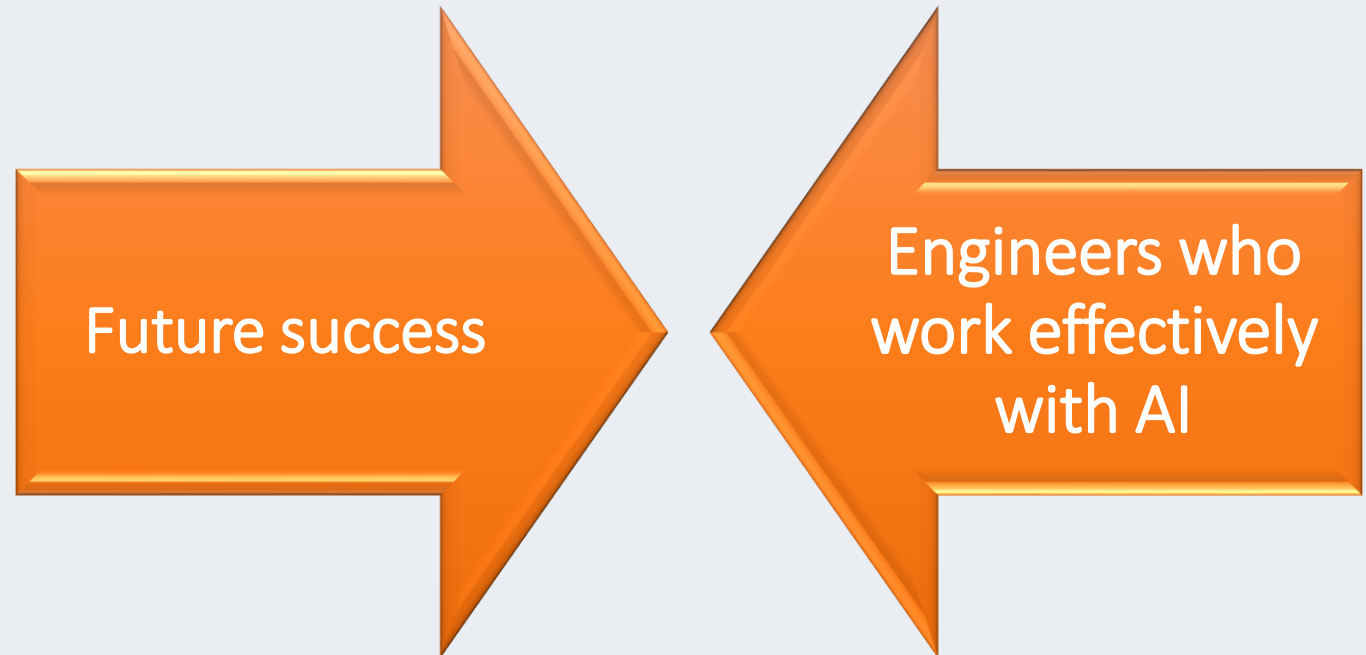
Live Digital Twins

- Continuously updated using real sensor data.
- AI improves the twin by:
 - Predicting behaviour.
 - Detecting abnormal conditions.
 - Simulating future scenarios.
 - Optimising operational decisions.
- Real-time engineering decision support.



AI-Augmented Engineers


- AI is not replacing engineers.
- AI supports engineers by improving:
 - Speed
 - Analysis
 - Diagnostics
 - Decision quality
- Human engineers remain essential for:
 - Judgment
 - Ethics
 - Responsibility
 - Safety decisions



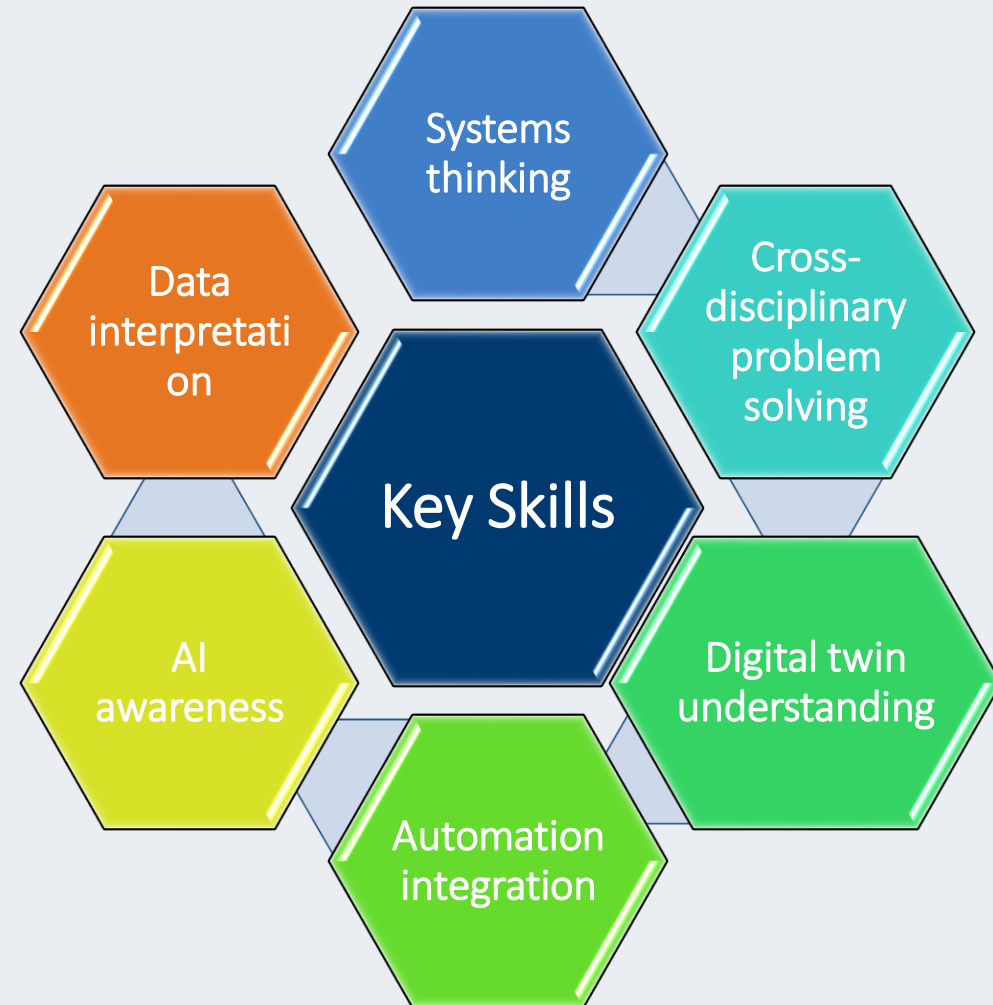
Skills Engineers Need Next



Future engineers need more than technical knowledge.



Engineering is becoming more connected, intelligent, and data-driven



Case Study 1: AI in Intelligent Warehouses

Amazon Robotics Warehouses

- Thousands of mobile robots operating simultaneously.
- AI-driven routing and task optimisation.
- Smart sensors for localisation and obstacle detection.
- Real-time coordination between robots and humans.
- Predictive and prescriptive maintenance systems.
- Continuous operational optimisation using data analytics.



Source: <https://www.parhlo.com/amazon-robots-warehouse/>

Case Study 1: AI in Intelligent Warehouses

Technologies Used

Computer vision

Sensor fusion

Autonomous mobile robots (AMRs)

Edge computing

AI-based scheduling and optimisation

Engineering Impact

Faster order fulfilment

Reduced operational cost

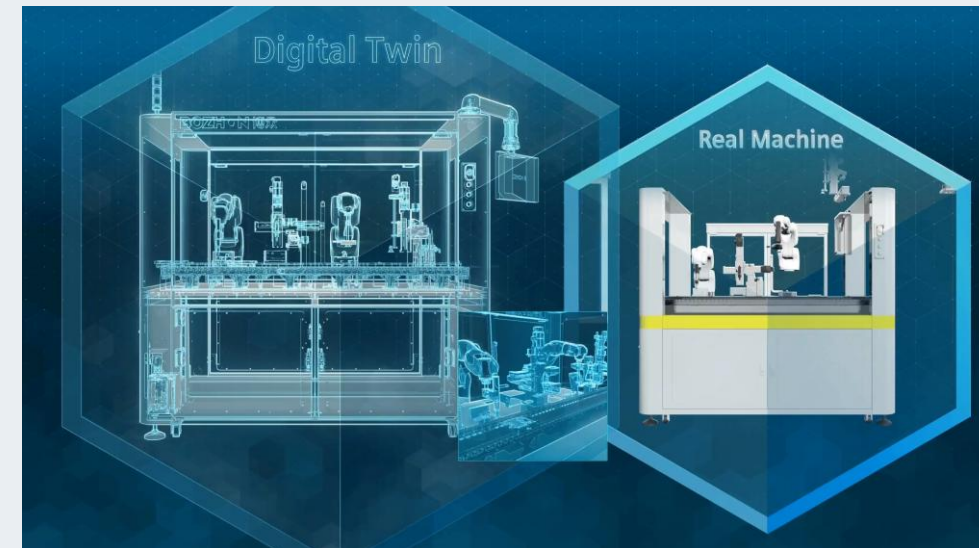
Improved workplace safety

Scalable intelligent automation

Case Study 2: AI-Driven Digital Twins in Industry

Siemens Smart Manufacturing Systems

- Real-time digital twins connected to physical industrial systems.
- Smart sensors continuously update operational data.
- AI used for predictive and prescriptive analytics.
- Simulation of system behaviour before real-world implementation.
- Integration with industrial automation and control platforms.



Source: https://blogs.sw.siemens.com/wp-content/uploads/sites/6/2020/01/Digital_twin_in_manufacturing.png

Case Study 2: AI-Driven Digital Twins in Industry

Technologies Used

Industrial IoT (IIoT)

AI-driven analytics

Edge computing

Smart sensors and sensor fusion

Cloud-connected digital twins

Engineering Impact

Reduced downtime

Improved process optimisation

Faster fault detection

Lower maintenance cost

Better operational decision-making

Conclusion

- AI is already part of modern engineering systems.
- Smart sensors + Edge AI are changing how decisions are made.
- PLCs, robots, and autonomous systems are becoming more intelligent.
- Digital twins are moving from simulation tools to live decision systems.
- The future belongs to engineers who combine domain expertise with AI understanding.
- Engineering is not being replaced by AI; it is being transformed by it.

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AI-Driven Intelligent and
Secure Navigation in Next-Gen
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Guest Editors

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Master of Engineering (Industrial Automation)	29 June 2026
52911WA Graduate Certificate in Internet of Things (IoT) for Engineering (Foundations)	7 July 2026
Undergraduate Certificate in Industrial Automation Engineering	20 July 2026
Bachelor of Science (Industrial Automation Engineering)	20 July 2026
52886WA Advanced Diploma of Industrial Automation Engineering	4 August 2026
Professional Certificate of Competency in Industrial Control Systems Cybersecurity	11 August 2026
52892WA Advanced Diploma of Electrical and Instrumentation (E&I) Engineering in Mining	1 September 2026
Professional Certificate of Competency in Allen Bradley Controllogix / Logix5000 PLC Platforms	8 September 2026
Professional Certificate of Competency in Digital Twins and Simulation Monitoring	13 October 2026
Professional Certificate of Competency in Industrial Data Communications	3 November 2026

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Engineering College of Technology (ECT) <i>UK qualifications</i>	Start Date
Bachelor of Engineering (Honours) in Electrical Engineering	21 September 2026
Bachelor of Engineering (Honours) in Industrial Automation	21 September 2026
Master of Science (Power System Analysis and Renewable Integration)	5 October 2026
Master of Science (Industrial Automation and Instrumentation Control)	5 October 2026

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Bachelor of Engineering Technology in Electrical Engineering	3 August 2026

Q&A



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