



Data Analytics in Automation System

Predictive Maintenance

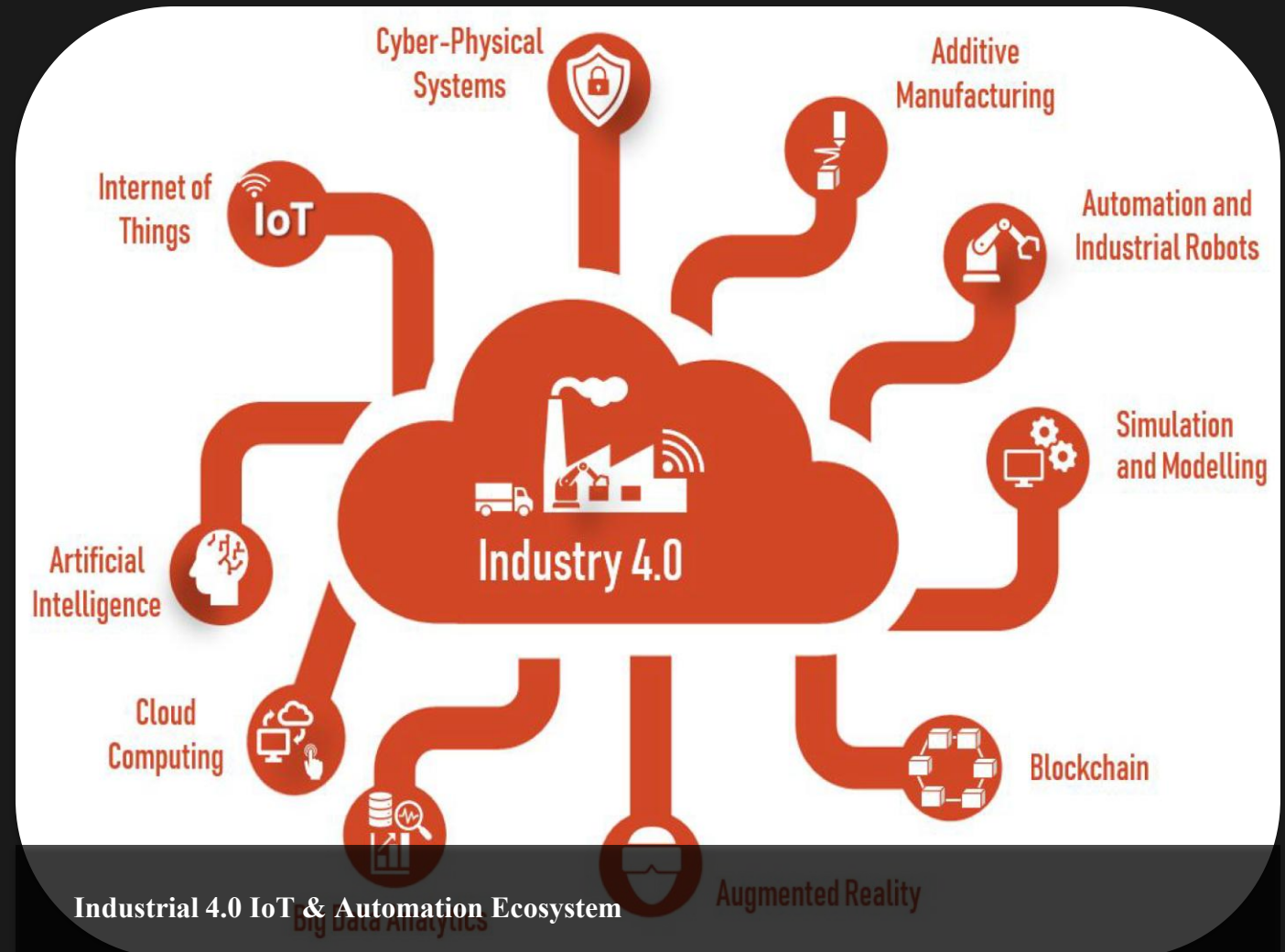
Course: 23MCT305 - Data Analytics in Automation System

Definition

Systematic analysis of operational data to enhance performance and decision-making

Key Concepts

- Real-time monitoring
- Performance optimization
- Fault detection
- Process automation



Definition

Proactive maintenance based on data analysis to predict equipment failure

Why Important

- Reduces downtime
- Lowers costs
- Extends life
- Improves safety

Maintenance Comparison

Reactive

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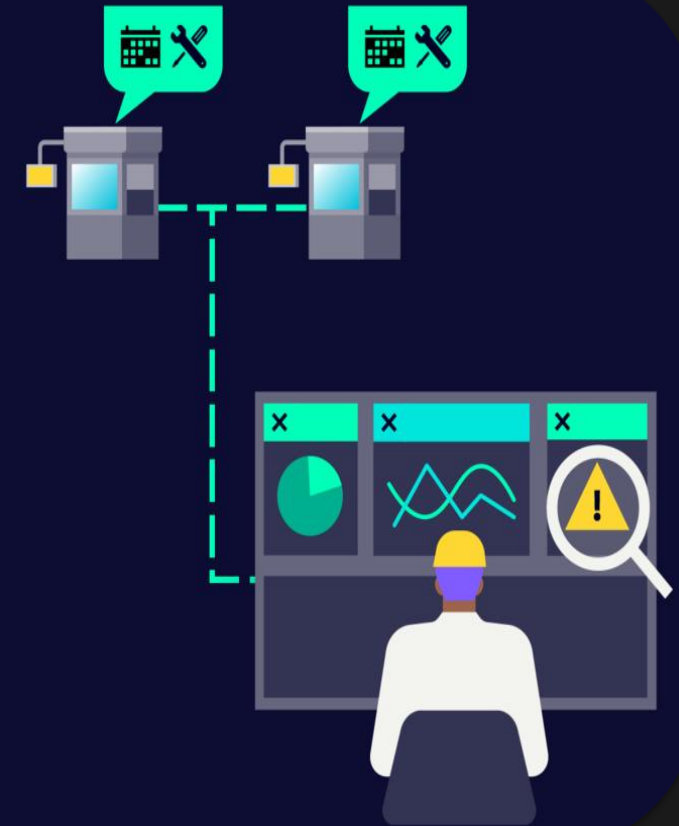
Preventive

•

Predictive

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Predictive Maintenance



Predictive Maintenance Warning System

IoT Sensors

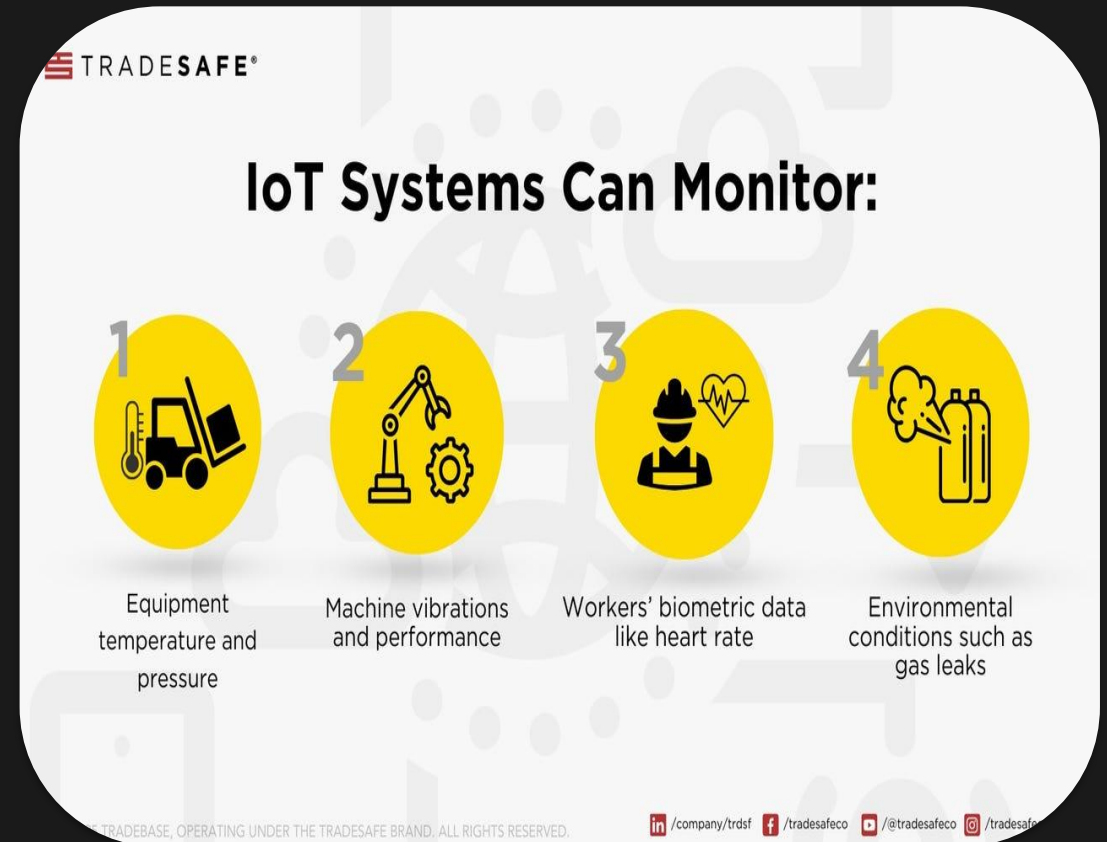
- Temperature
- Vibration
- Pressure
- Flow

Monitoring Equipment

- PLC systems
- SCADA
- Industrial controllers





Data Sources

- Machine logs
- Sensor networks
- Manual inspections
- Historical data



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IoT Systems Can Monitor:

- 1  Equipment temperature and pressure
- 2  Machine vibrations and performance
- 3  Workers' biometric data like heart rate
- 4  Environmental conditions such as gas leaks

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IoT Sensors & Monitoring Infrastructure

Analytics Techniques for Predictive Maintenance

Machine Learning

- Supervised learning
- Unsupervised learning
- Neural networks
- Regression analysis

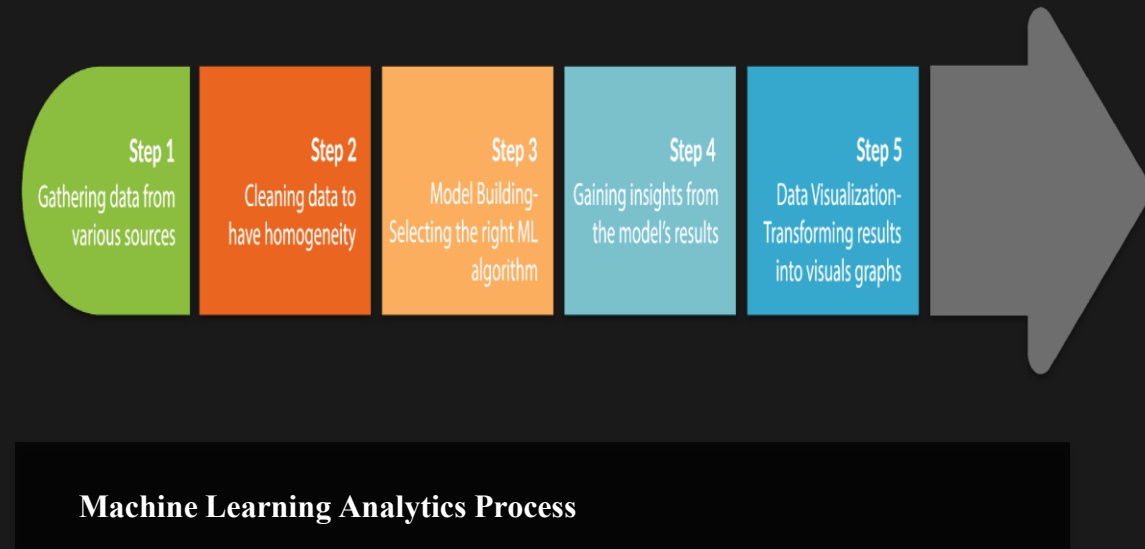
Statistical Methods

- Time series analysis
- Anomaly detection
- Pattern recognition

Data Visualization

- Dashboards
- Charts
- Real-time monitoring

The Machine Learning Process



1

Data Collection

From sensors and systems

2

Data Integration

Preprocessing and cleaning

3

Analysis & Training

Model development

4

Prediction

Alert generation

5

Maintenance Scheduling

Action and execution

2. Data Acquisition

- Gathering Data from internal and external sources
- Combine technical and business expertise to unlock the value of big data
- Enhance data by filtering out unproductive information

4. Modelling Insights

Generating actionable insights to improve the customer acquisition, retention and efficiency

6. Outcomes

- Operational excellence
- Increased security
- Enhanced customer retention
- Expanding market share



1. Understanding Requirements

- Articulating business needs and estimated impact
- Creating a base with a vision of how the solution will be beneficial for business

3. Data Engineering

Deriving analytics through right combination of quantitative techniques and cutting edge technologies

5. Workflow Integration

- Integrating insights into decision making to automate processes
- Deploying latest tools for converting insights into actions to drive outcomes

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End-to-End Predictive Maintenance Workflow

✓ Key Benefits

- Increased equipment reliability
- Reduced maintenance costs
- Minimized downtime
- Enhanced safety
- Extended asset life

⚠ Challenges

- Data quality issues
- Initial investment costs
- Technical expertise requirements
- Integration complexity



COMPARISON

Predictive Maintenance vs. Traditional Maintenance

1. Predictive maintenance is performed based on actual equipment performance data.	1. Traditional maintenance methods, such as preventive and run-to-failure maintenance, are typically performed at predetermined intervals.
2. It can be more cost-effective than traditional maintenance methods, as it reduces downtime and increases equipment efficiency.	2. Traditional maintenance methods can be more expensive due to the high frequency of maintenance activities.
3. Predictive maintenance can help to reduce downtime by predicting and preventing equipment failures	3. Traditional maintenance methods can result in more downtime due to the need for regular maintenance activities.
4. Predictive maintenance is data-driven and relies on real-time data from sensors, machine logs, and other sources to predict maintenance requirements	4. Traditional maintenance methods are often based on a set schedule or run-to-failure approach.
5. Predictive maintenance is proactive, addressing potential issues before they become problems	5. Traditional maintenance methods are reactive, waiting for equipment to fail before taking action.

Predictive vs Traditional Maintenance Comparison

Manufacturing

- Reduced downtime 35%
- \$2M annual savings

Automotive

- Predicted bearing failures 92% accuracy

Aerospace

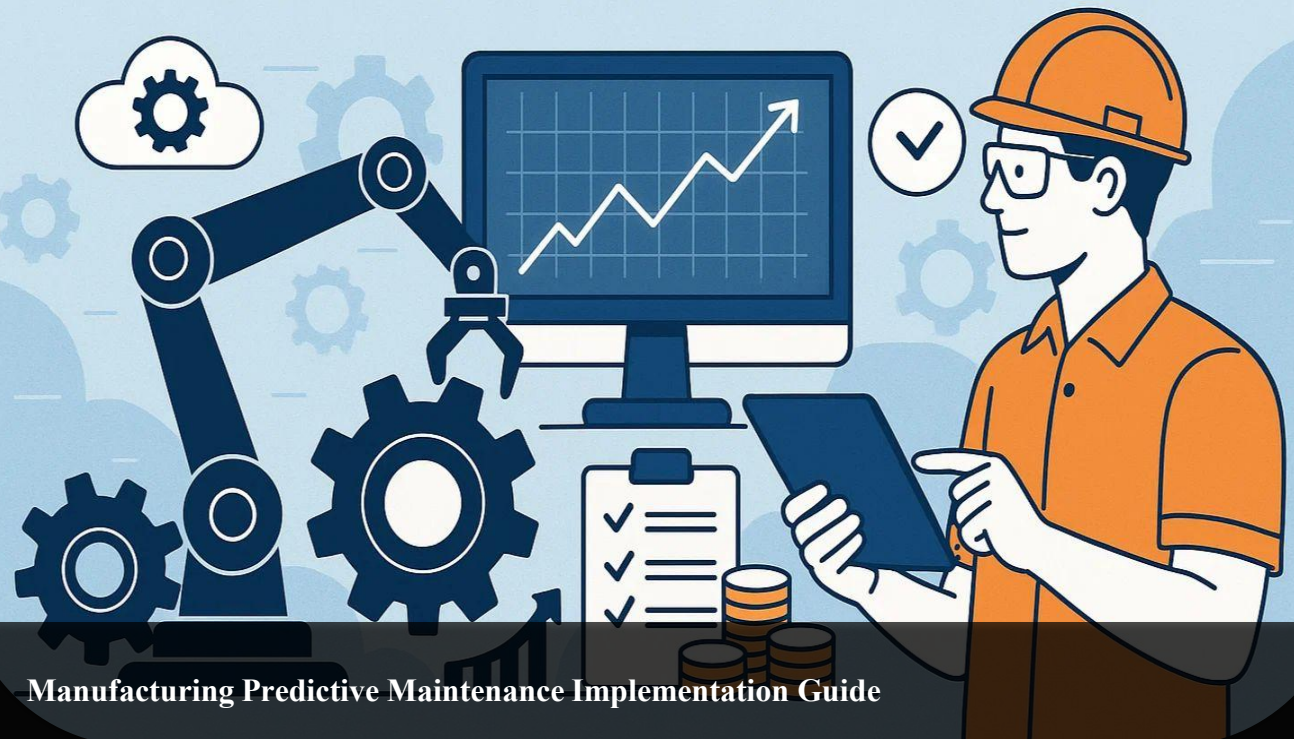
- Enhanced safety
- Lower inspection frequency

Average ROI

Within 18 months

PREDICTIVE MAINTENANCE IN MANUFACTURING

ROI GUIDE & IMPLEMENTATION STEPS



Manufacturing Predictive Maintenance Implementation Guide

Mind Map: GenAI-Generated Concept Overview

- **Data Collection**

- Sensors • IoT • PLC

- **Analytics**

- ML • Statistics • AI

- **Implementation**

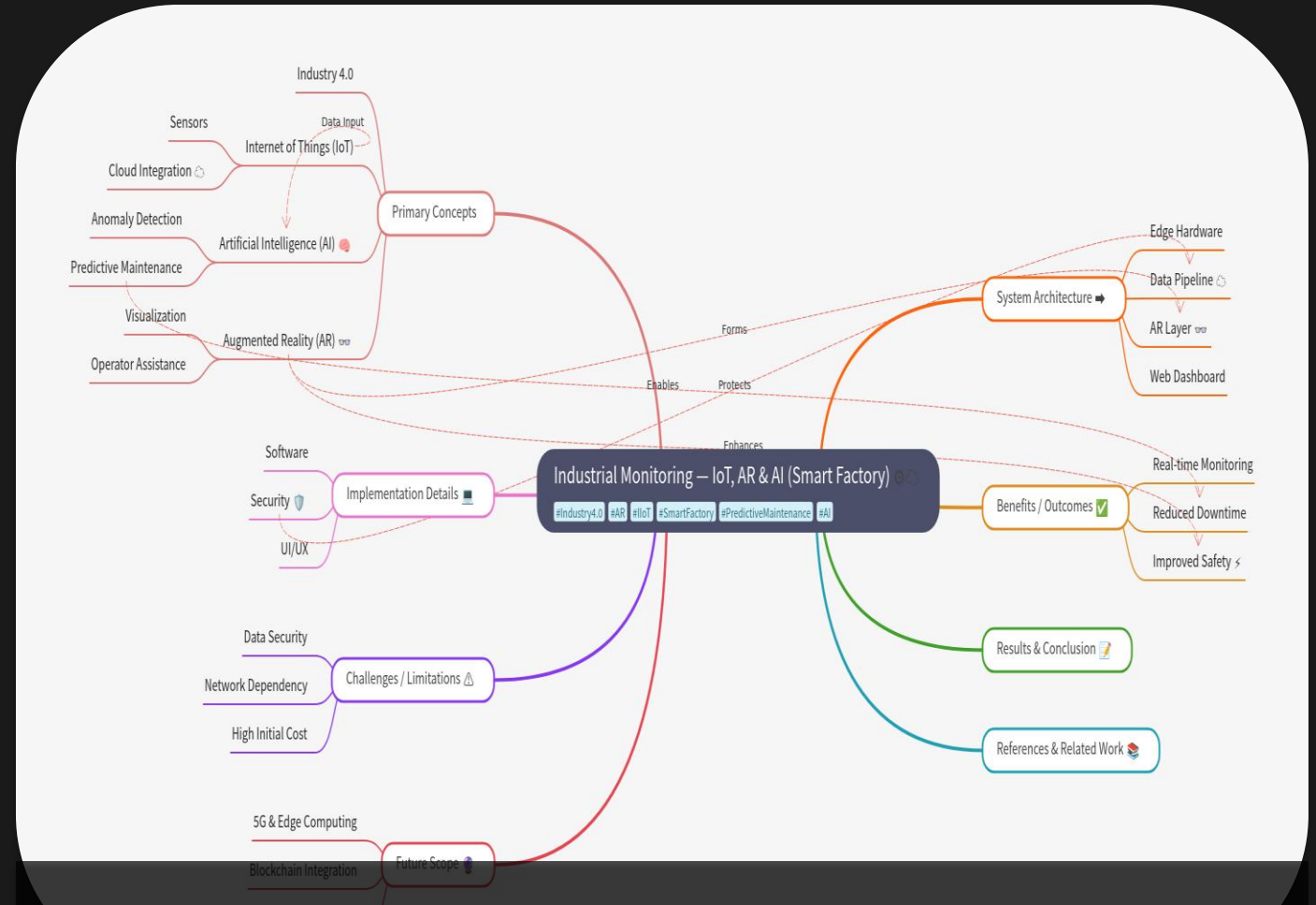
- Workflow • Integration • Training

- **Benefits**

- Cost • Reliability • Safety

- **Applications**

- Manufacturing • Automotive • Aerospace



Comprehensive Predictive Maintenance Mind Map

Summary and Recap

Key Takeaways

- Predictive maintenance uses data analytics to forecast equipment failures
- Implementation involves data collection, analysis, and action
- Benefits include reduced costs and improved reliability
- Real applications show significant ROI across industries

Conclusion

Data analytics transforms maintenance from reactive to proactive, enabling smarter decisions and better outcomes.

