



AI FOR PRESCRIPTIVE MAINTENANCE IN DEFENCE FORCES



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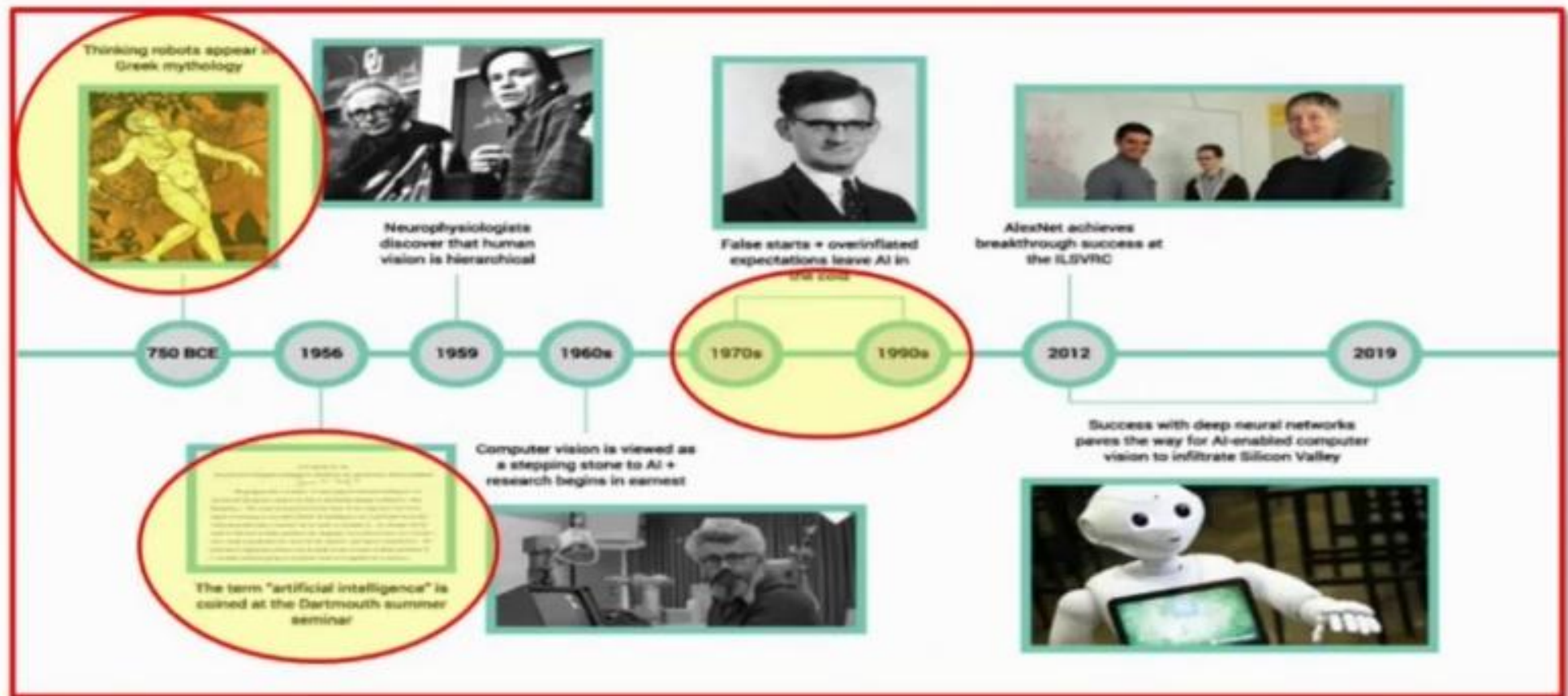
PREVIEW

- Introduction
- **Need for Prescriptive Maintenance(RxM)**
- Technologies for RxM
- **Advantages**
- **Challenges**
- **Model for RxM**



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ARTIFICIAL INTELLIGENCE (AI)



Computer Vision

NLP

Robotics

Expert Systems

Fuzzy

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AI IN DEFENCE



RCV



Predator



Sea Hunter

- Int , Svl and Recce (MAVEN, COMPASS)
- **Autonomous Wpn (ATLAS,RCV)**
- Info Ops(Deep Fakes)
- **Bfd Healthcare (Electronic Med Record Analyzer (EMRA) & Robotic Surgical Sys)**
- Simulation and Trg (AIMS)
- **Lgs and Tn (Uptake, ALIS-F35)**



COMPASS (Collection And Monitoring Via Planning For Active Situational Scenarios)

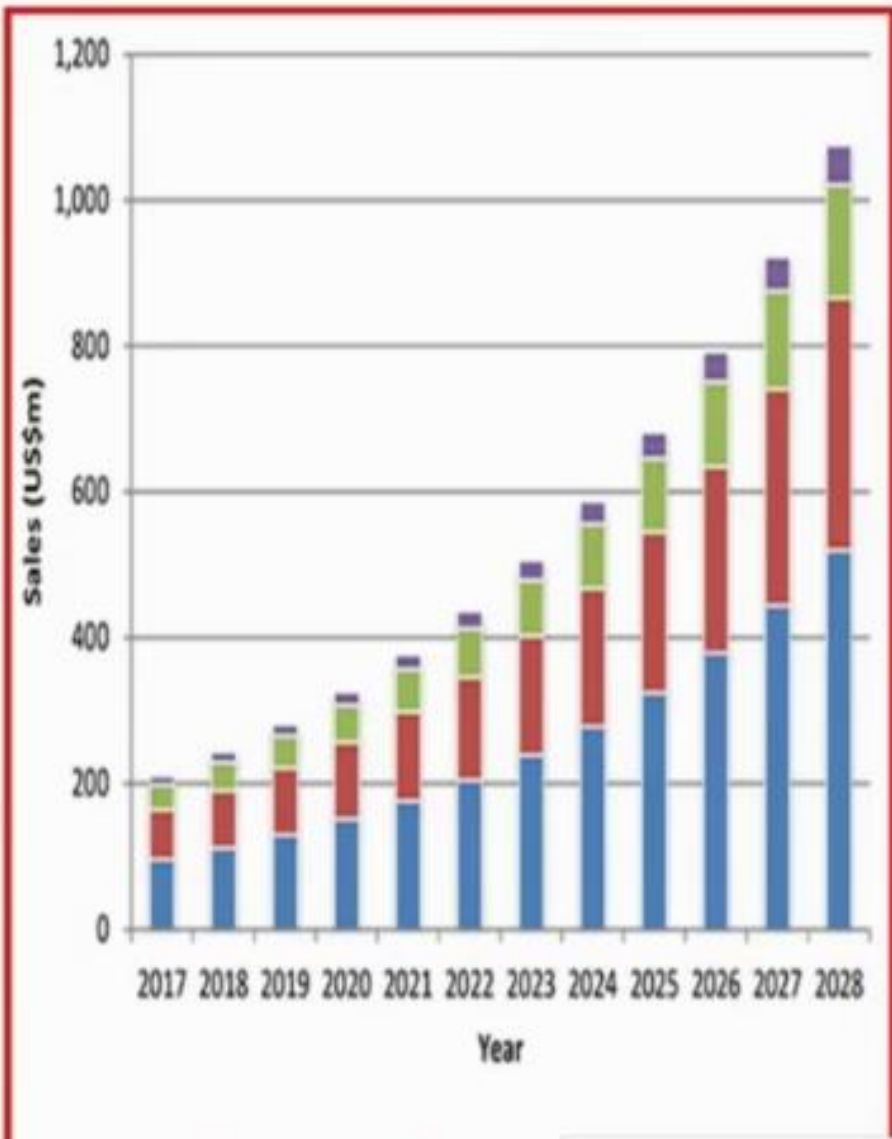


SMET (Squad Multipurpose Eqpt Tpt)

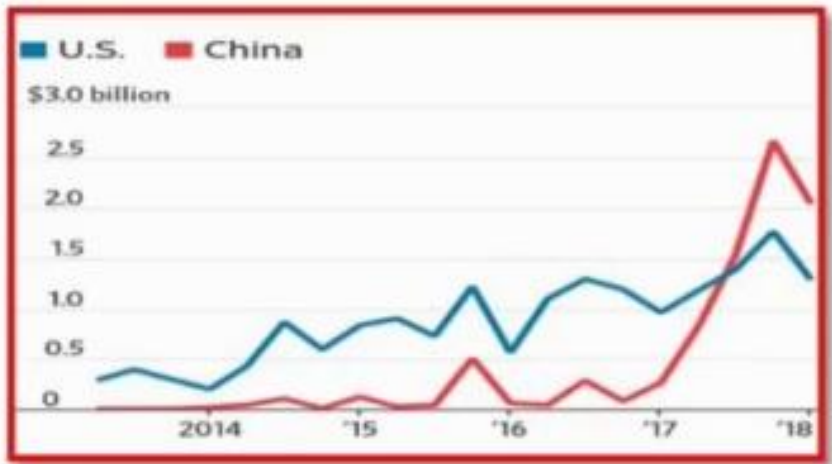


AIMS (AI For Mil Sml)

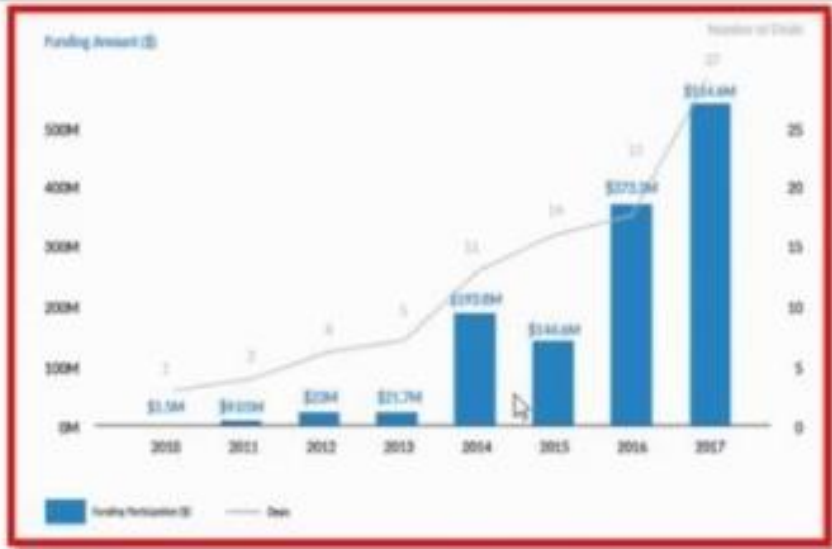
FIGHT FOR AI SUPREMACY



■ Land based ■ Airborne



CHINA SURPASSES US IN FUNDING IN AI



BY CHINA IN AI COYS OF US

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FIGHT FOR AI SUPREMACY IN MIL

China develops world's first armed amphibious drone boat: Report

The drone ship, named Marine Lizard, successfully passed delivery checks and left the factory on April 8 in Wuhan.

PHOTO: April 15, 2019, 05:54 PM (UTC+8)



BEIJING: China has successfully tested the world's first armed amphibious drone boat which the Chinese military analysts claimed could be used in land assault operations and is capable of forming a combat triad with aerial drones and other drone ships, according to a media report.

Built by Wuchang Shipbuilding Industry Group under China Shipbuilding Industry Corporation (CSIC), the drone ship, named Marine Lizard, successfully passed delivery checks and left factories on April 8 in Wuhan.

Having a maximum operation range of 1,200 km, the Marine Lizard can be remotely controlled via satellite, an official said.



Proposed Guizhou Soar Dragon high-altitude, long range UAV

China aims to be an AI superpower in 12 years

Article First Published April 20, 2019, 12:00 AM (UTC+8)



China has unveiled a roadmap to help it emerge as a contender in artificial intelligence technology.

Chinese organizations make up 17 of the top 20 academic players in AI patenting as well as 10 of the top 20 in AI-related scientific publications.



National plan -1 trillion meetinglab.zoho.in is sharing your screen. Stop sharing Hide core industry by 2030

OP CHALLENGES

On my last deployment in 2014, my unit was *hastily deployed to the Middle East to fight ISIS*, the expanding insurgent Islamic State. Weeks after our arrival, we *inherited decade-old tiltrotor MV-22s* and immediately began *flying combat missions*. Unfortunately, the aircraft had endured *years of compounding mechanical wear and tear*; it was *not uncommon* to hear stories in the ready room of our peers *facing system failures during their missions*. During one particularly harrowing flight, Captain Steven Herrera was faced with *fluctuating gearbox oil pressure while flying in Iraqi airspace*, followed by a “*gearbox oil pressure low*” warning, and then a subsequent “*complete loss of oil pressure*” indication.

China, where **3,000 people are killed every year in mines** and **80% of these deaths were caused by equipment failure**

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USA & RxM



DIU - US \$ 95 Million to C3.AI to boost aircraft readiness



US \$ 1 Million to Uptake- 1.2 Billion hrs of op data



Stryker fleet 2019 to IBM - US \$135 million -70 % of breakdowns & reduce downtime by 50 %



4 Million transactions per day

5 Billion data pts on IoT sensors sp to US

- 4 yrs – US \$ 15 Million savings in op costs using cloud

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- US \$ 80 Million per F35 Ac & US \$ 292 Billion op & maint costs- 8000 ac



PRESENT MAINTENANCE PARADIGMS & DRAWBACKS

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MAINT PARADIGMS

REACTIVE



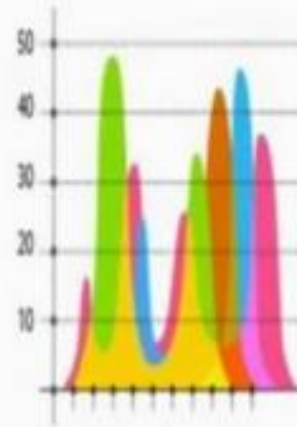
FIX IT WHEN IT BREAKS!

PREVENTIVE



MAINTAIN IT AT REGULAR INTERVALS SO IT DOESN'T BREAK!

PREDICTIVE



PREDICT EXACTLY WHEN IT WILL BREAK AND MAINTAIN IT ACCORDINGLY!

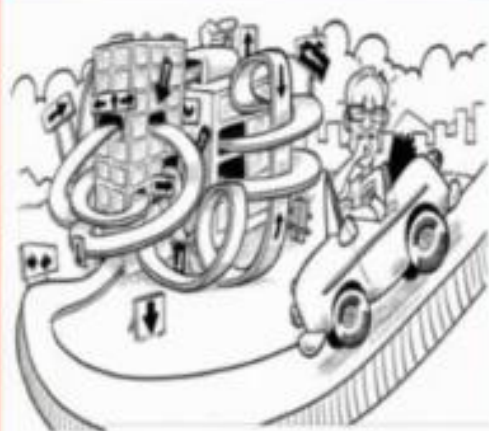
PRESCRIPTIVE



LET THE MACHINES HELP YOU DECIDE HOW TO AVOID PREDICTED FAILURES!

DRAWBACKS : PRESENT MAINT STRAT

- **Inventory**
- **Time & Cumbersome**
- **Availability**
- **Reliability**
- **Reduced Life**

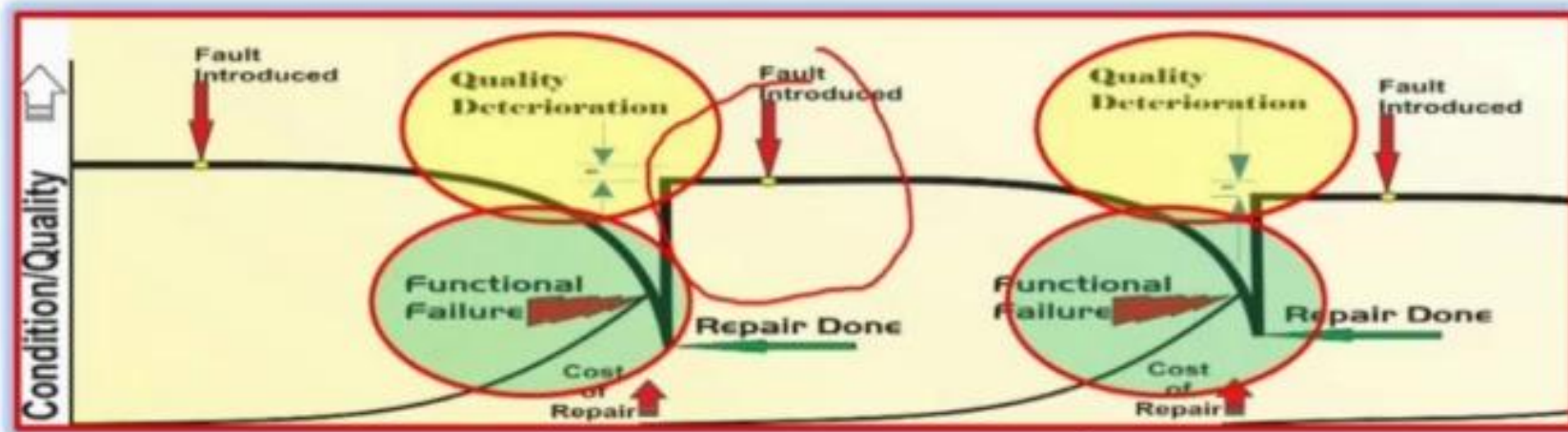


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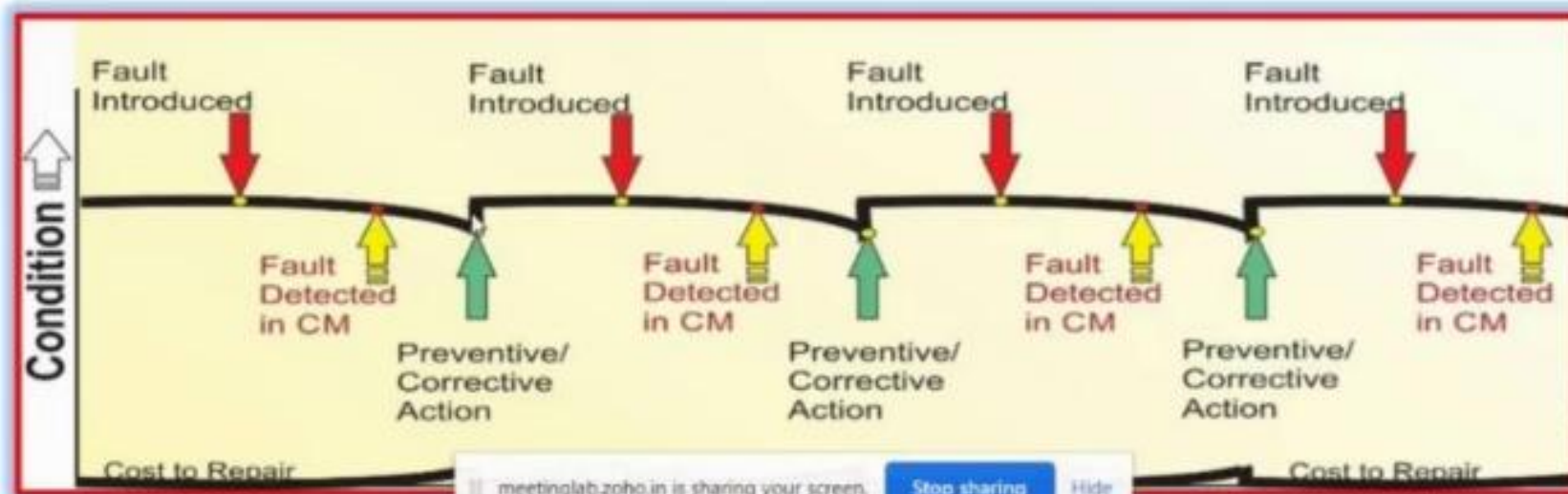
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RELIABILITY DEGRADATION & COST ESCALATION



Corrective Maintenance



Predictive Maintenance

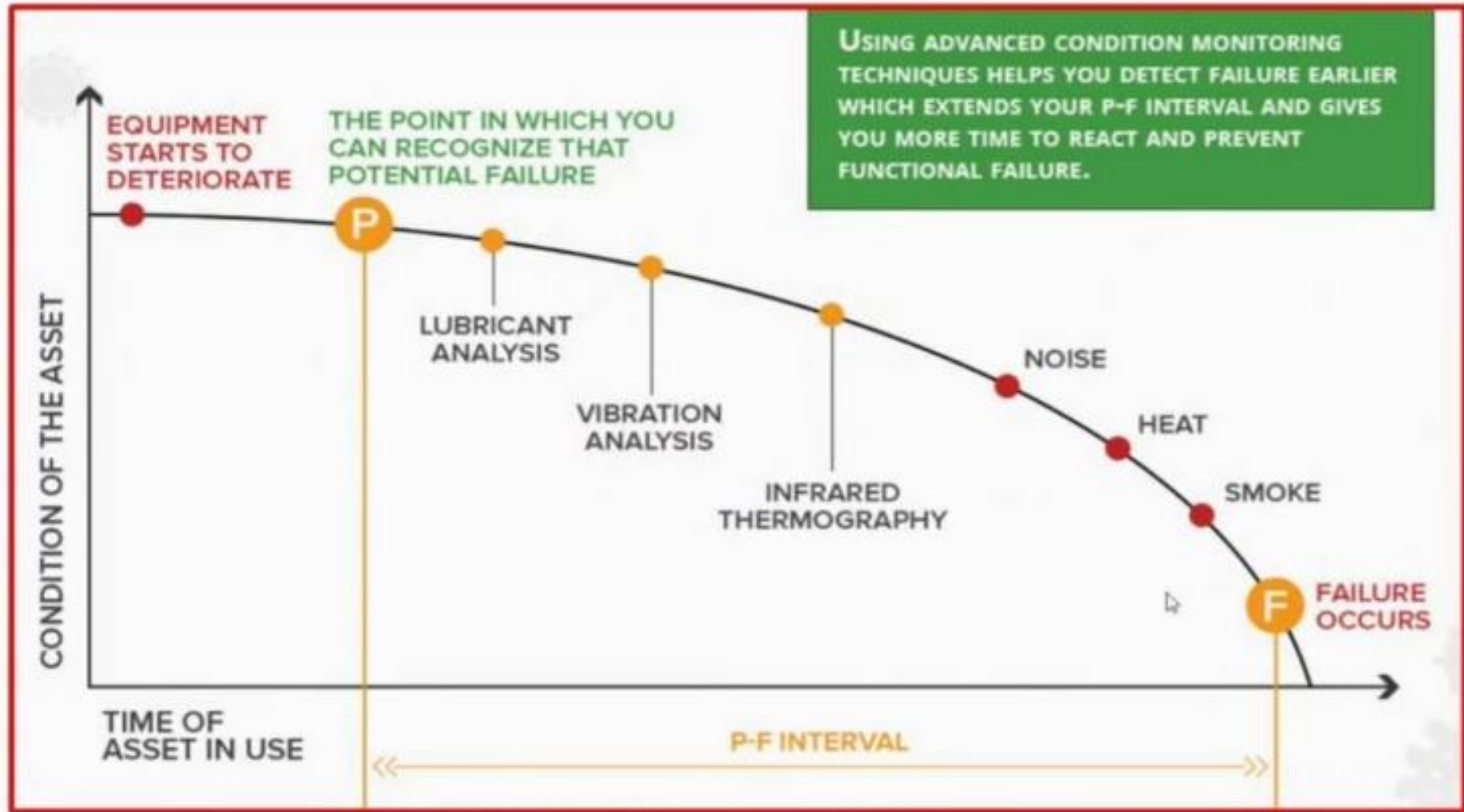
DRAWBACKS : PRESENT MAINT STRAT

- **Costs**

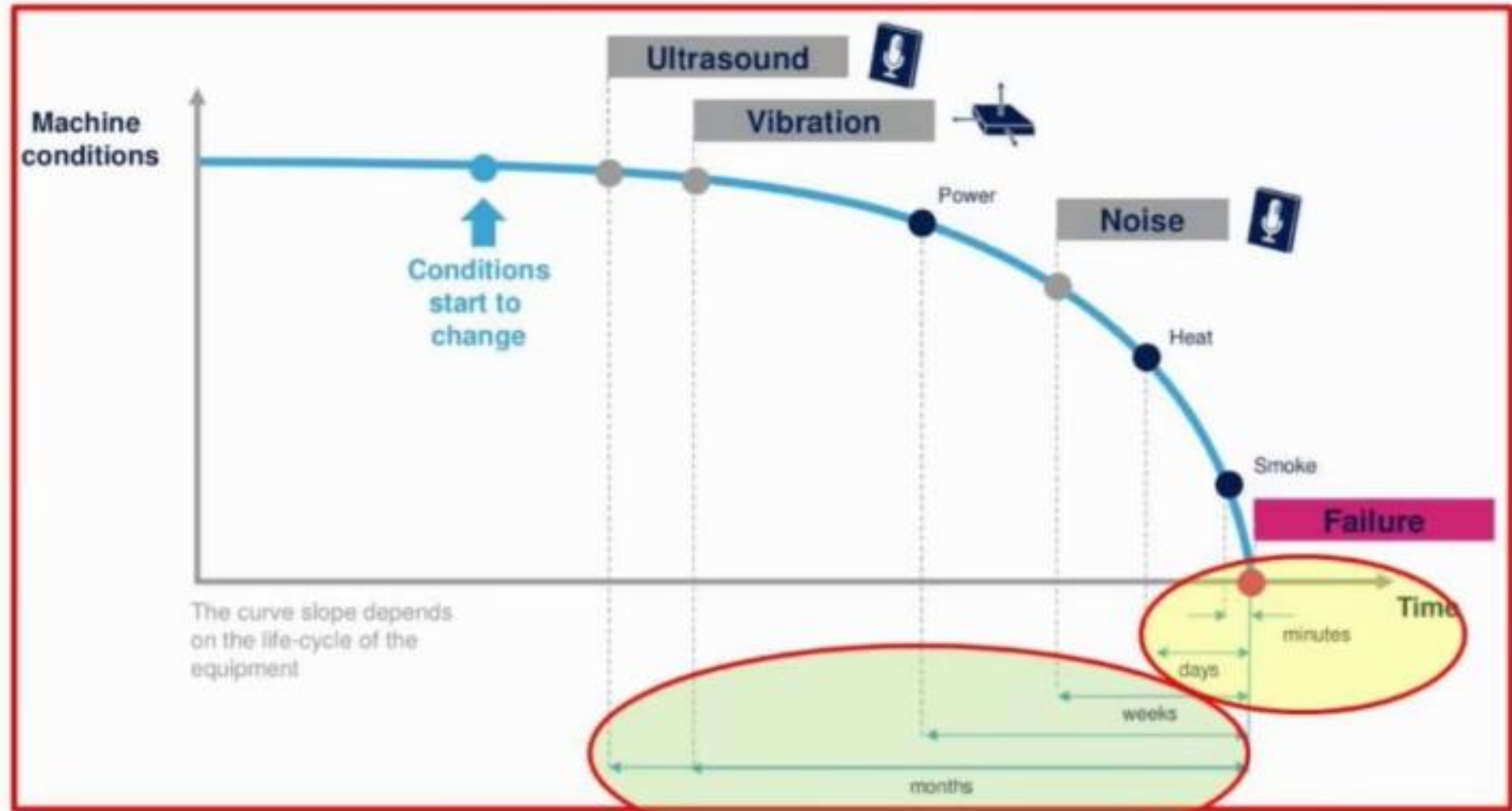
- **Direct Costs – Inventory**
- **Hidden Costs - Time ,
Manpower**
- **Replacements**



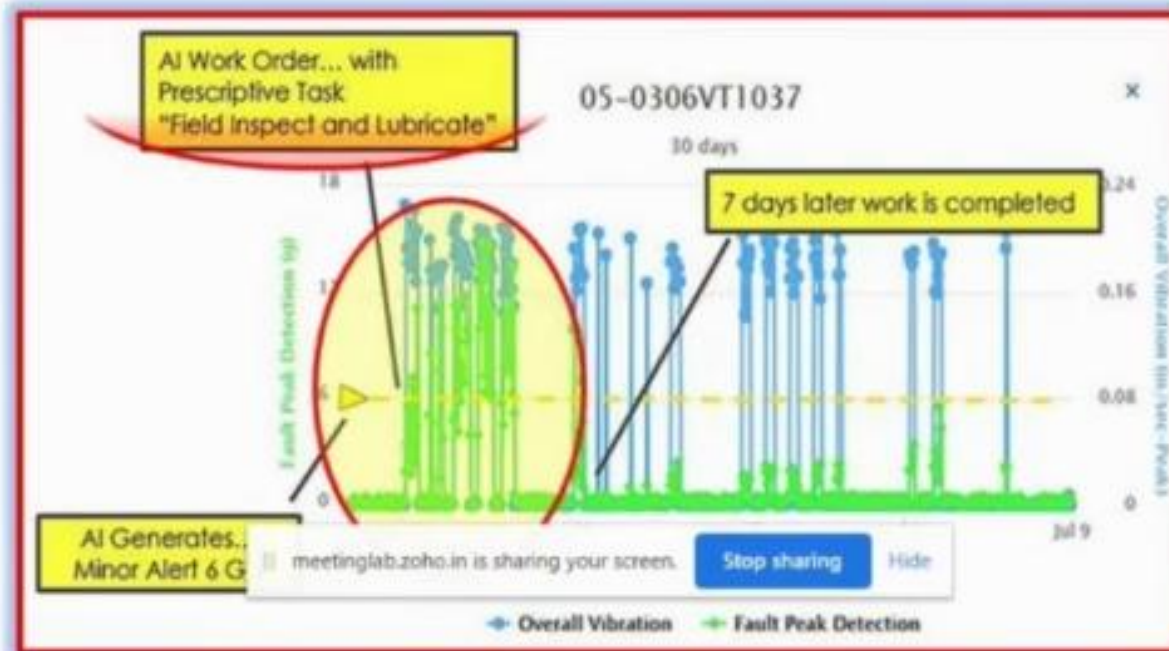
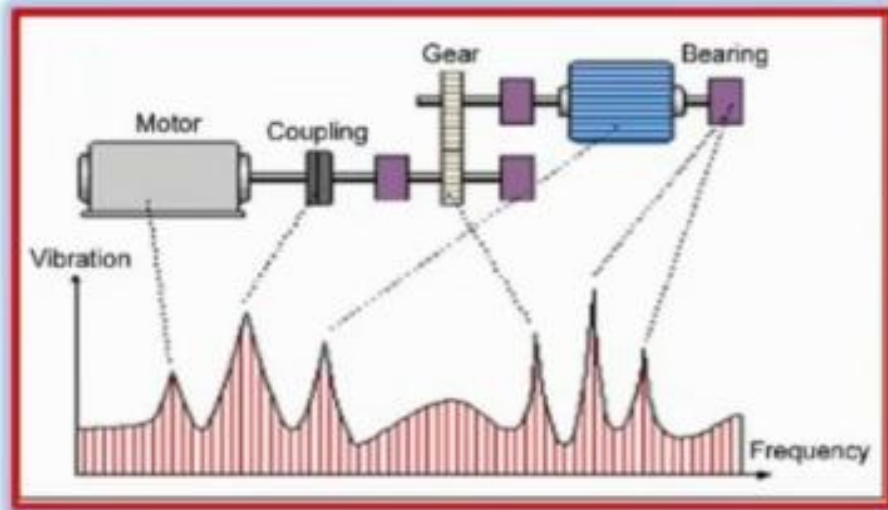
AI BASED RxM



AI BASED RxM



RxM : VIBRATION ANALYSIS





TECHNOLOGIES FOR EFFECTIVE AI BASED RxM

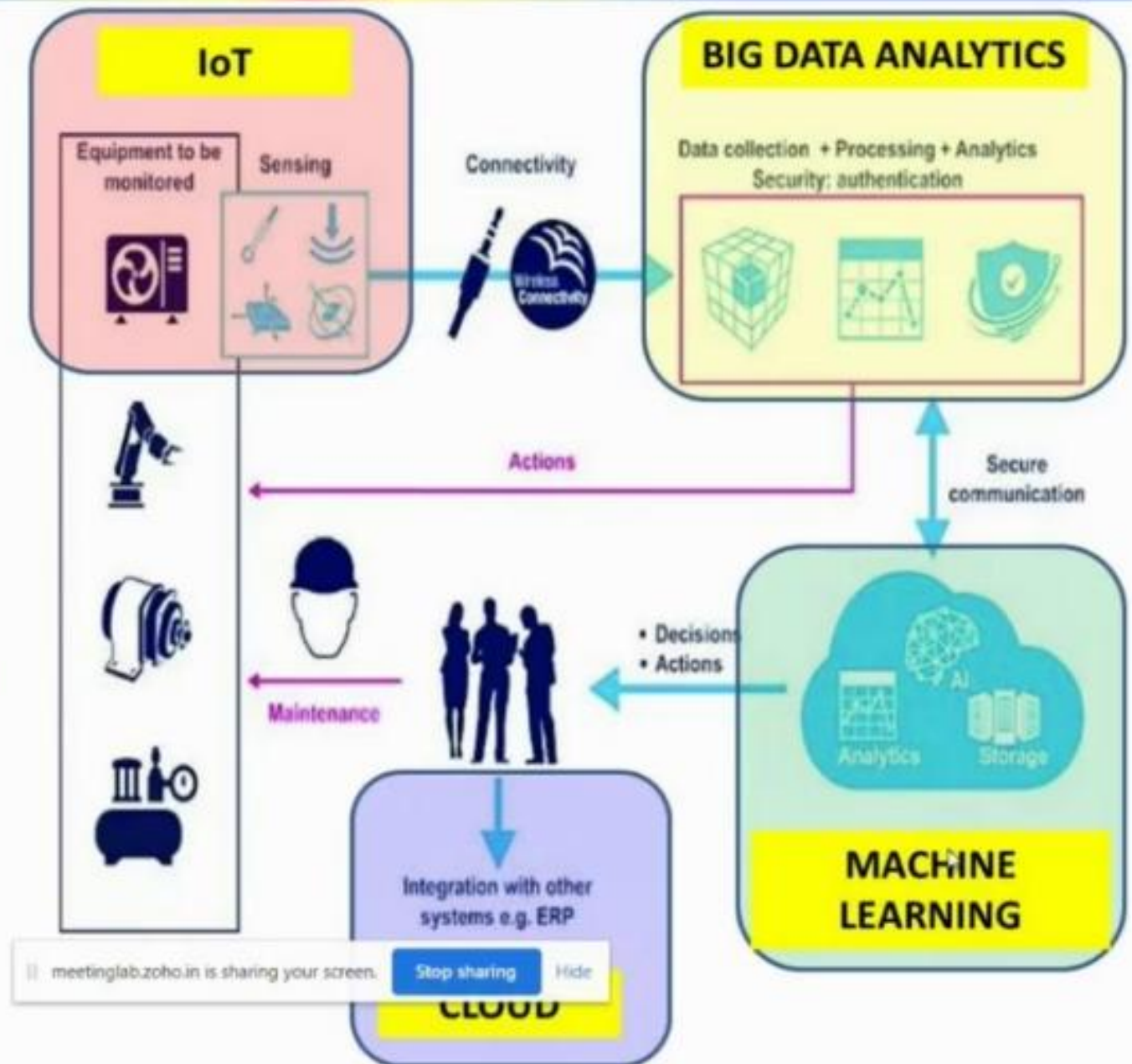
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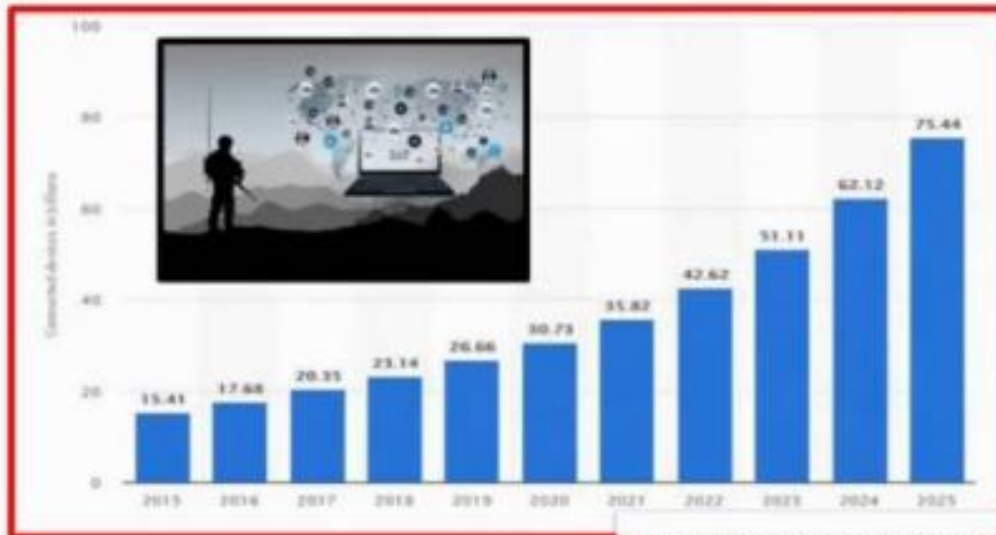
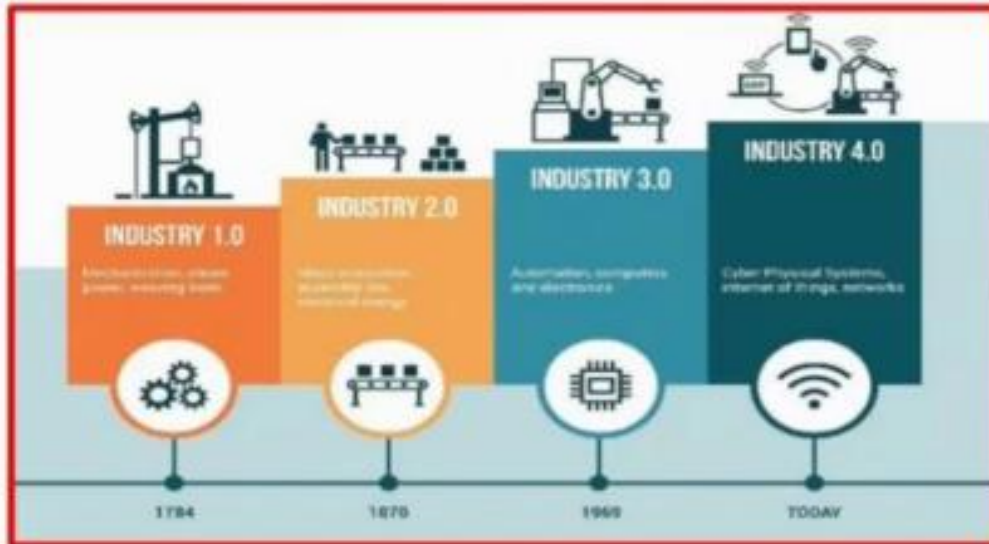
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TECHNOLOGIES FOR AI BASED RxM

- IoT
- Big Data Analytics
- Machine Learning
- Cloud
- Simulation and Modeling (Digital Twins)



IOT



5 times Incr by 2025

Type of Sensors	Parameter
Temp sensor	Oil temp, Coolant temp
Pressure sensor	Oil pressure
Accelerometer	Motion
Ultrasonic sensor	Distance between couplings, objects etc.
Torque sensor	Power transfer between couplings and shafts
Exhaust sensor	Composition of exhaust of engine
Oil Condition sensor	impurities & wear pattern
Acoustic sensor	Identification of various noises
Vibration sensor	Torsional or linear vibrations in shafts and bearings
Thermal Sensor	Thermography

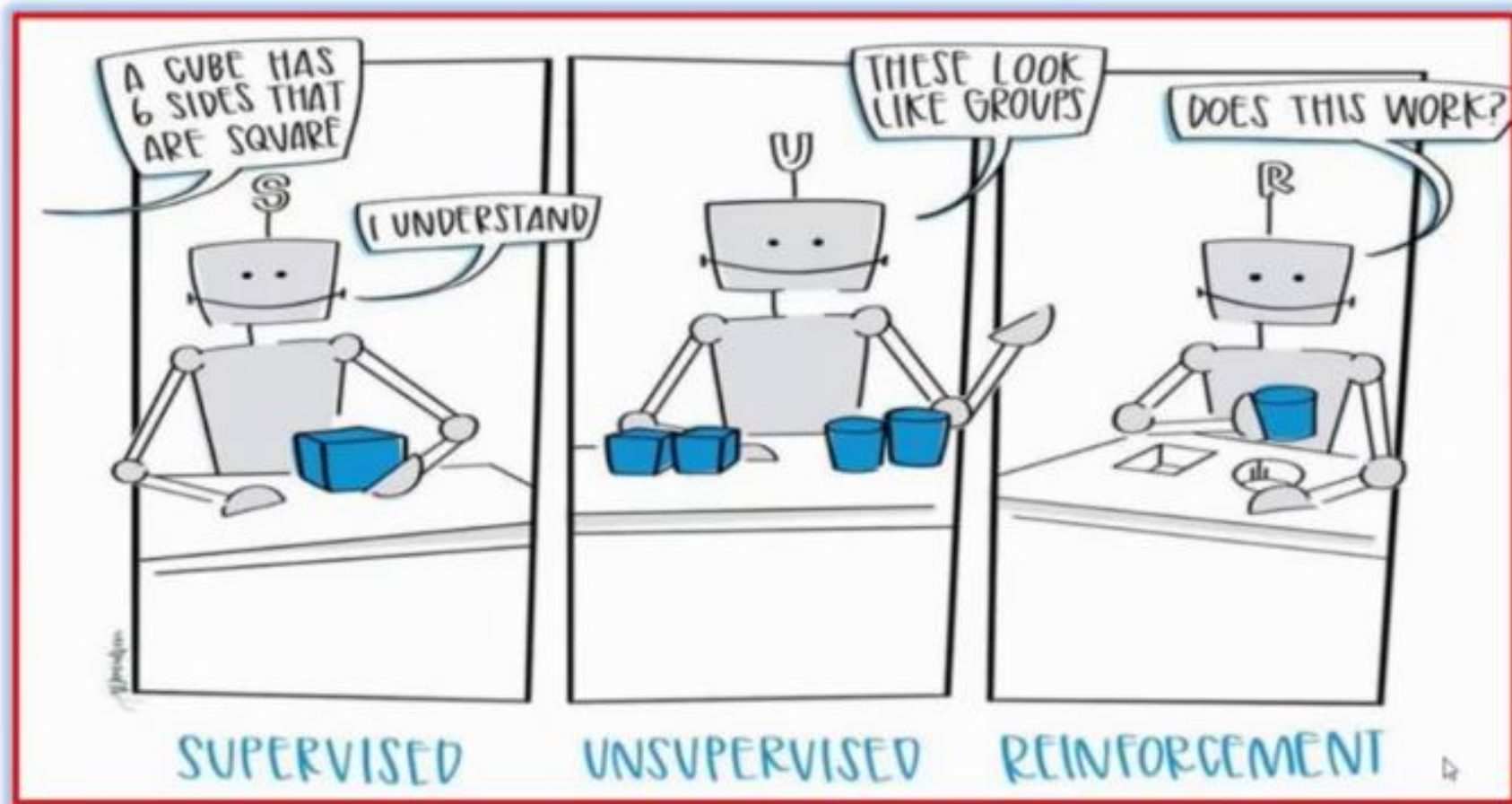
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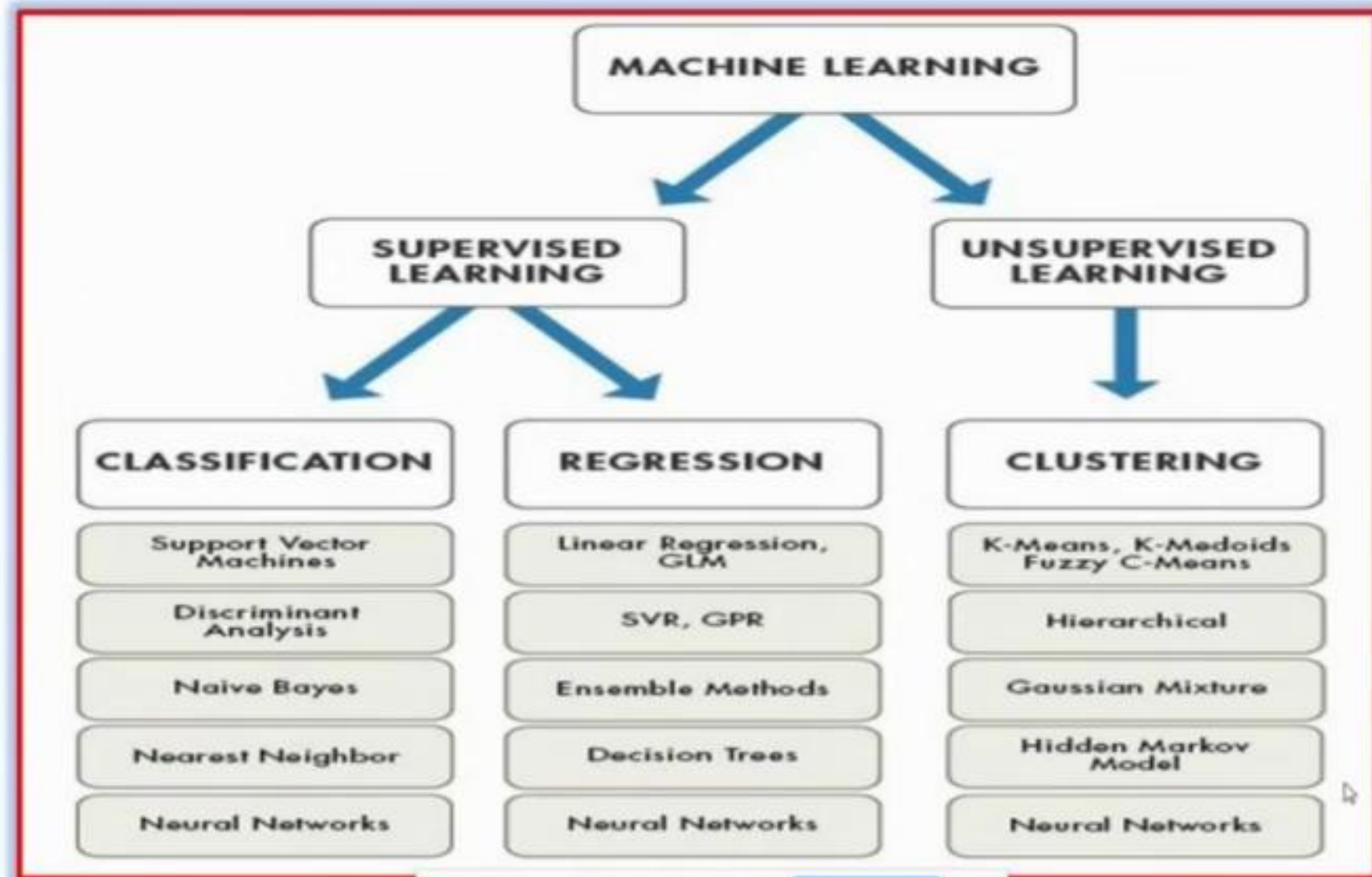
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Parameters

MACHINE LEARNING



MACHINE LEARNING

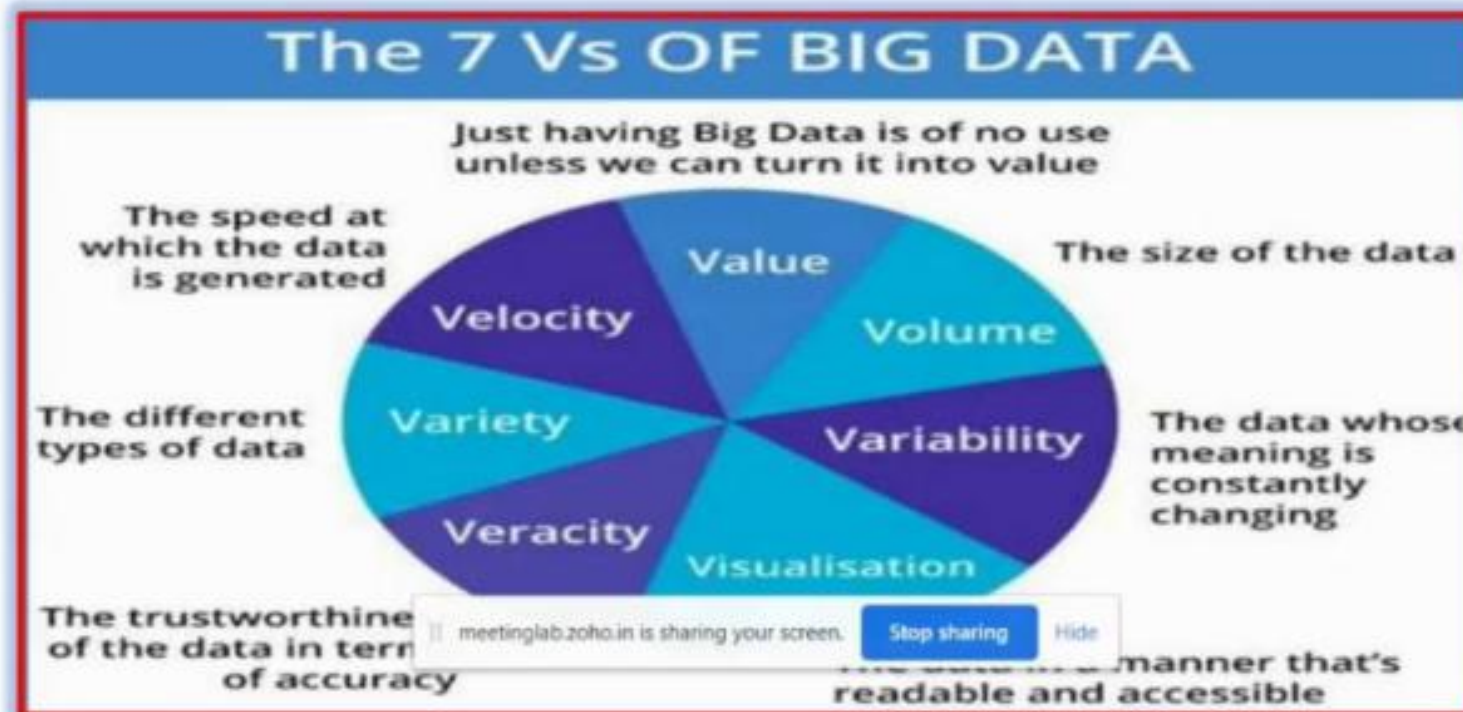


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Anomaly Detection

Anomaly Detection

BIG DATA



BIG DATA ANALYTICS

A central banner for the Logistics Data Analysis Center (LDAC). It features a dark blue background with a network of glowing blue nodes and lines. On the left, there are three logos: the U.S. Army star, a shield with red, white, and blue, and a small LDAC globe logo. The text "LDAC Logistics Data Analysis Center" is prominently displayed. Below this, the heading "LDAC's Mission" is followed by a paragraph: "AMC's Logistics Data Analysis Center provides sustainment data, information technology and decision support to improve readiness and enable effective Army Senior Leader decision-making from the Strategic Support Area to the tactical point of need." A small LDAC globe logo is also present in the top right corner of the banner.

LDAC Logistics Data Analysis Center

LDAC's Mission

AMC's Logistics Data Analysis Center provides sustainment data, information technology and decision support to improve readiness and enable effective Army Senior Leader decision-making from the Strategic Support Area to the tactical point of need.



US NAVY CLOUD

Naval Tactical Cloud (NTC)



Purpose: Improve warfighting effectiveness while operating inside adversary kill chains

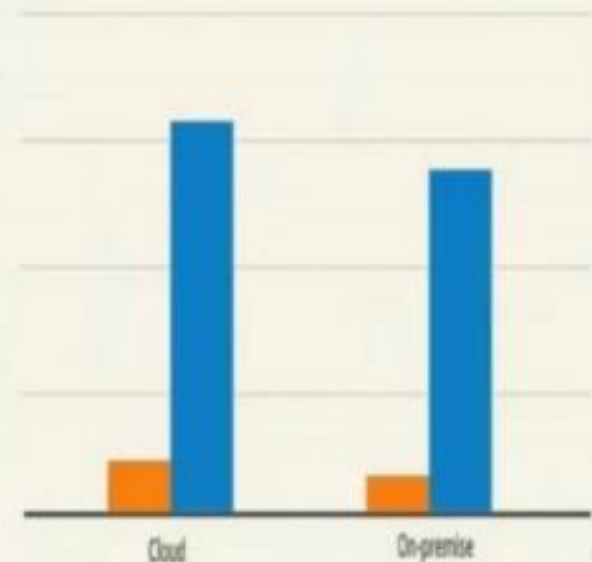
- Cloud located at the tactical edge supporting real-time mission planning and execution
- Applications automate diverse sensor and data assimilation
- Operates on tactical RF networks

Tactical Clouds are emerging and have the potential to radically improve Navy combat effectiveness

GLOBAL PREDICTIVE MAINTENANCE MARKET

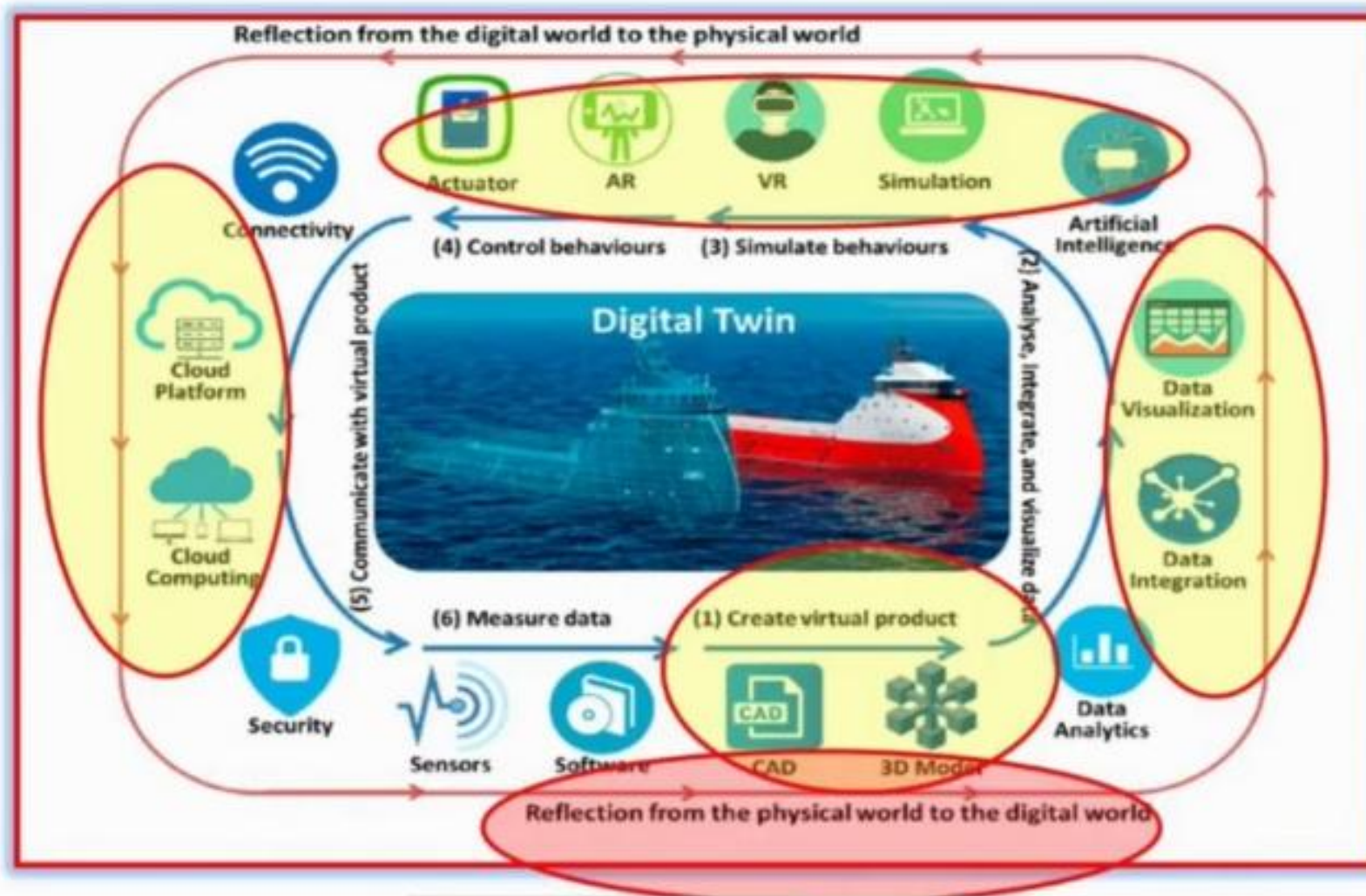
BY DEPLOYMENT

2018 2026



CLOUD segment is projected to show highest growth during the forecasted period.

DIGITAL TWINS



ADVANTAGES

- **Cost of Repair**
- **Inventory costs**
- **Efficient Manpower Utilisation**
- **Higher Availability**
- **Proactive & Responsive SCM**
- **Safety**
- **Enhanced Life**
- **Knowledge Management**

SAVINGS IN THE LONG RUN



OP RELIA

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CHALLENGES

- **People**

- Trg
- Leadership

- **Process**

- Data Availability - Historical
- Data Integrity
- Capital Cost
- Warranty
- Cyber Security

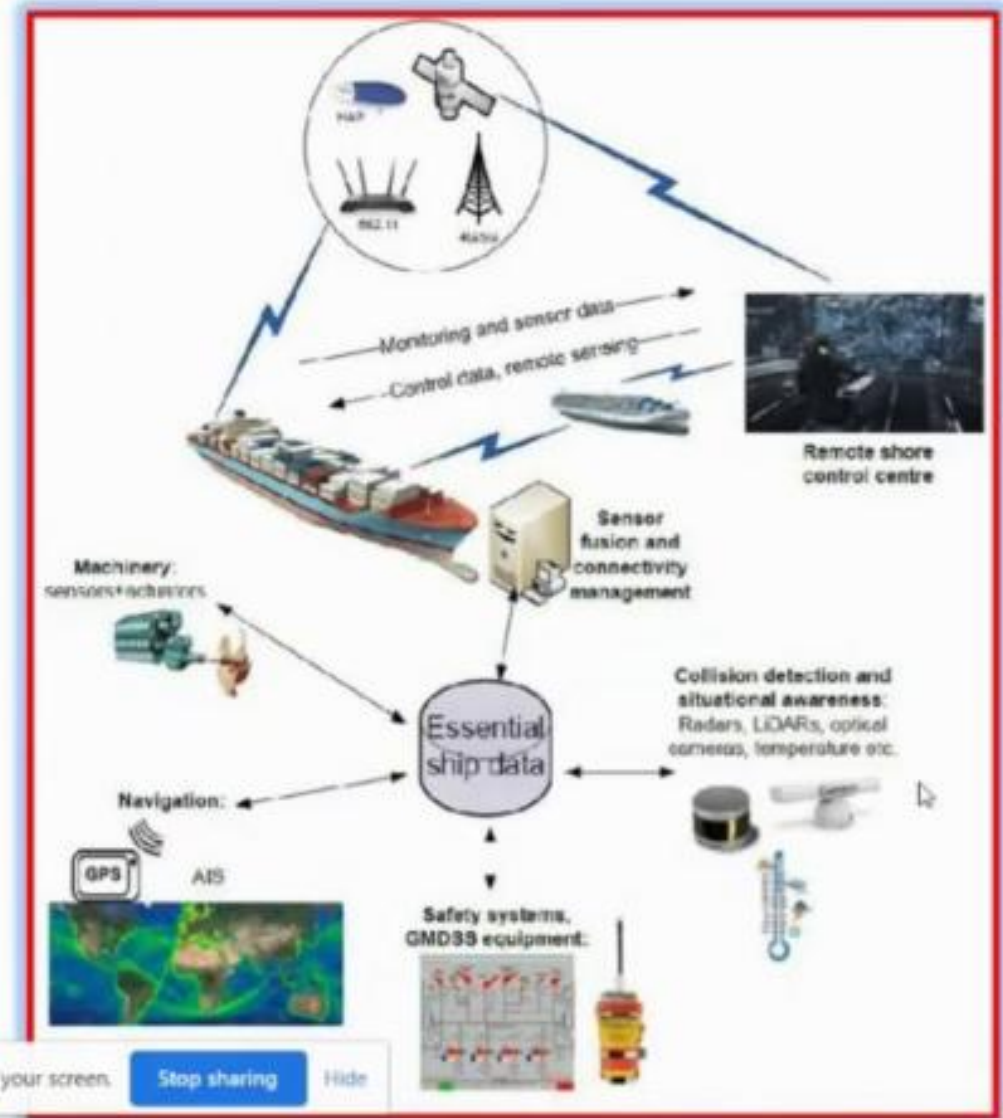
- **Technology**

- Vintage Eqpt- N

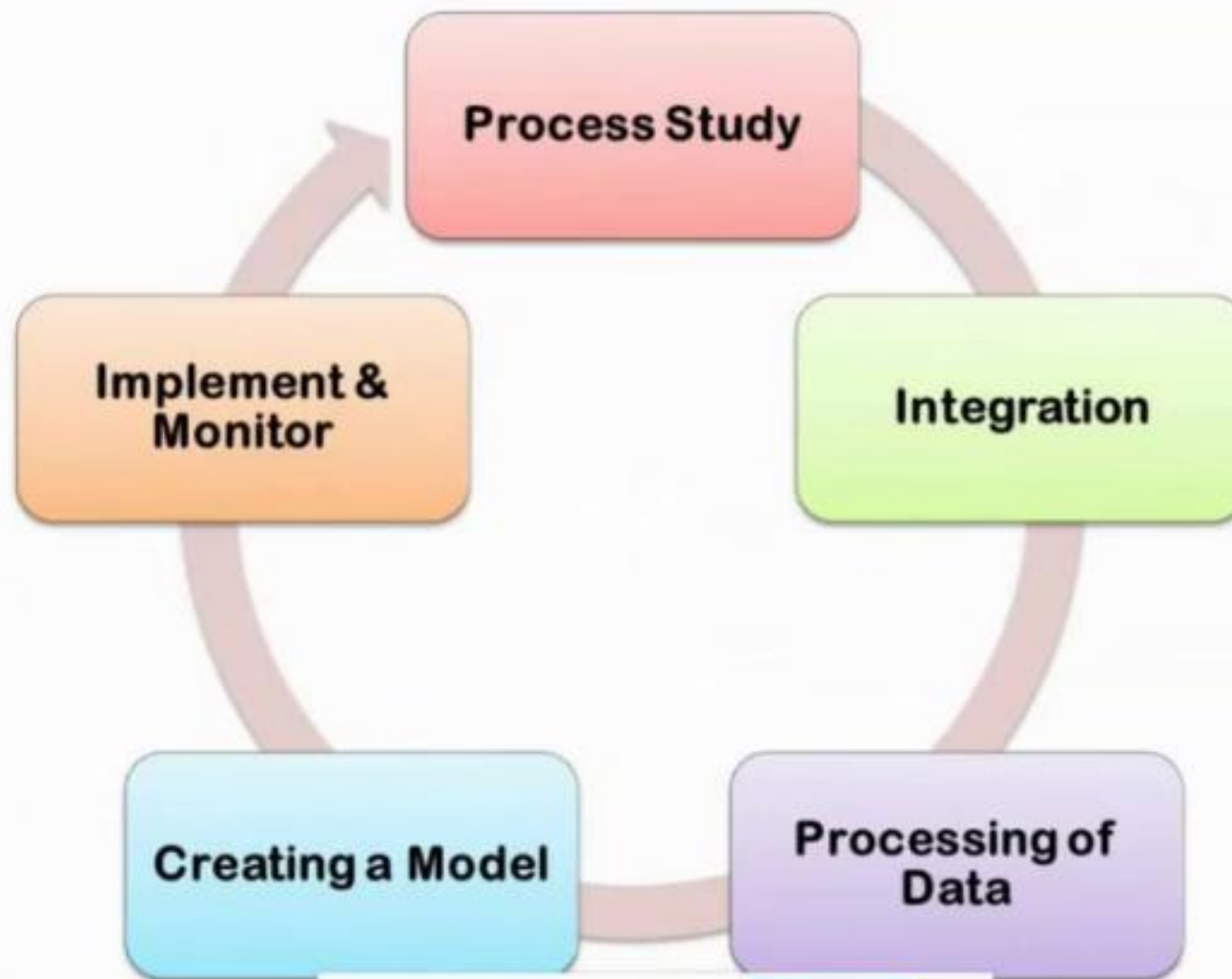


CHALLENGES IN MARITIME DOMAIN

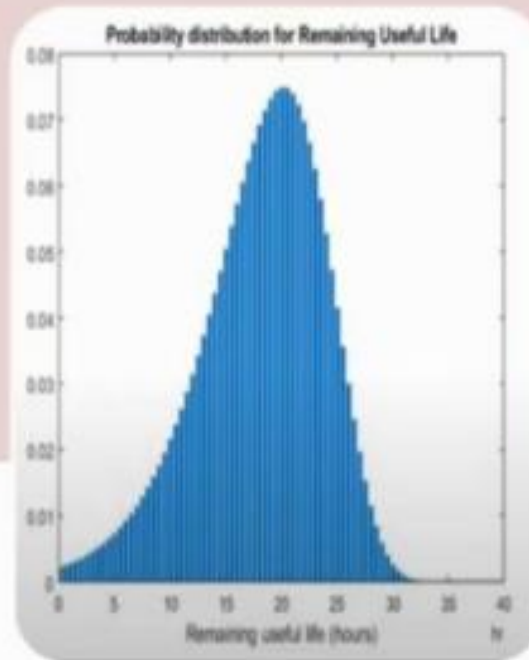
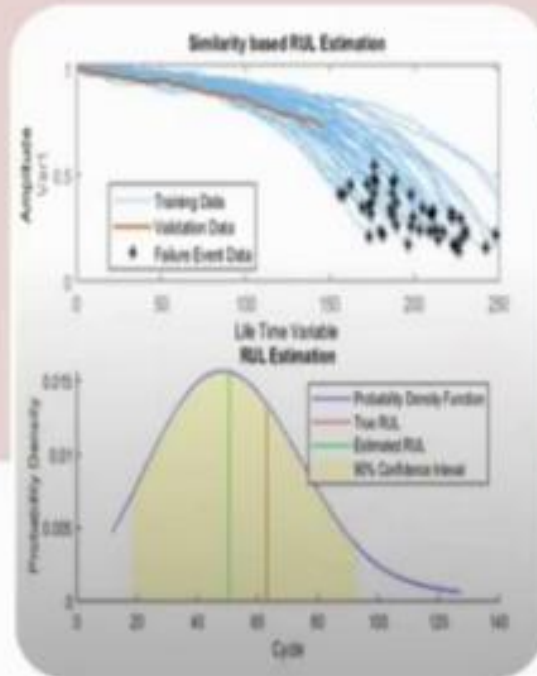
- Limited Connectivity
- Data Volume & Variety
- Dply - offline
- Ruggedised and endurance
- Security



MODEL FOR RxM



REMAINING USEFUL LIFE MODELS



Similarity Method
(Run to failure
data)

Survival Method
(Failure Data)

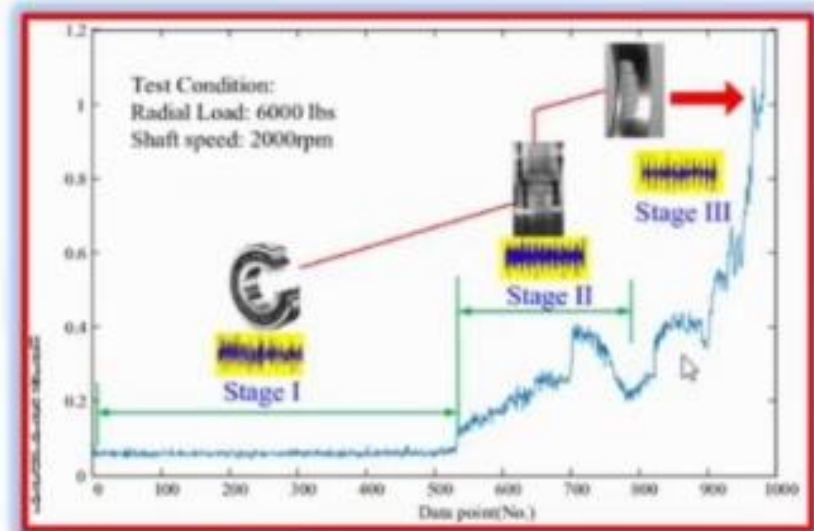
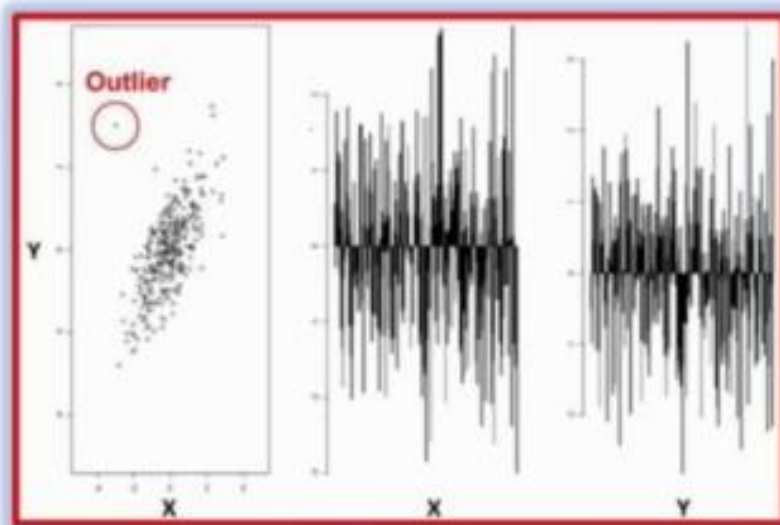
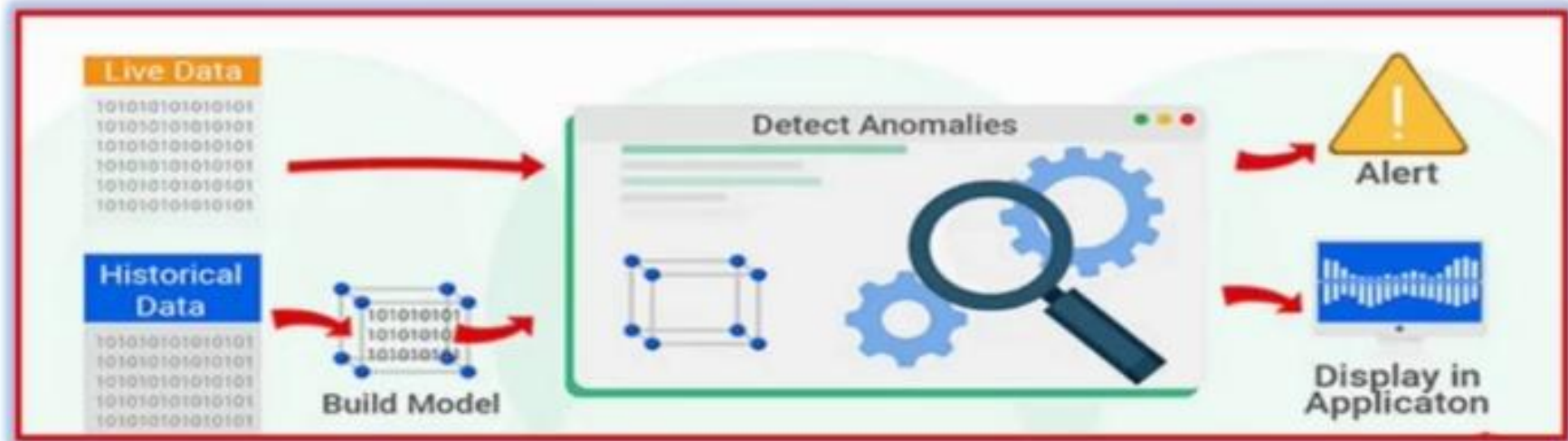
Trend Based
Methods
(Known failure
threshold)

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ANOMALY DETECTION

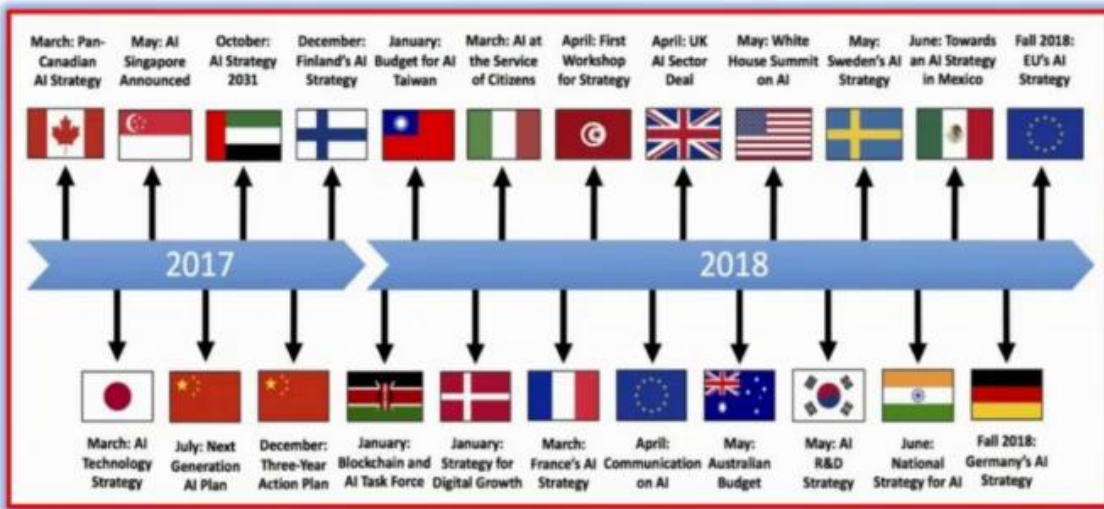


Detect Outliers - classification

Study of Patterns

Col Kuldeep Yadav is speaking now!

GLOBAL AI STRATEGIES



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Attendees

Q&A

Polls

Raise Hand

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More

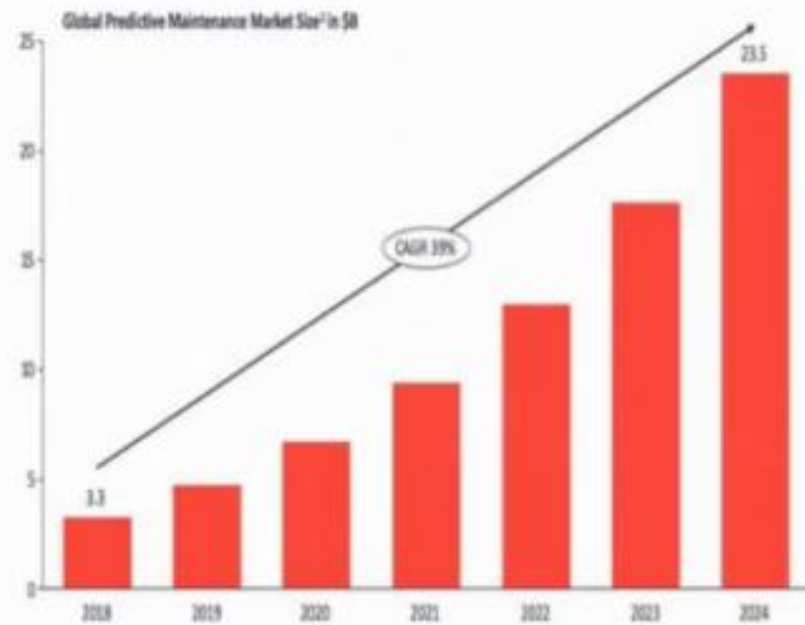
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DEVELOPMENTS IN RXM

Global Predictive Maintenance Market

Predictive Maintenance a \$3.38 Market in 2018, Expected to Grow to \$23.58 by 2024

Global Predictive Maintenance Market Development



1 Market size defined as either "Global Predictive Maintenance technology spend" by companies implementing Predictive Maintenance solutions or IOP

Source: IOT Analytics 2023 Predictive Maintenance Market Report 2019-2024

180+ Companies operating in Predictive Maintenance Market



Note: Companies are categorized according to their main field of activity, e.g. Industrial Automation. Only companies considered that have a visible use case in PDM. Companies are not mentioned here that work in PDM without any visible use of the product or hardware here. Details of the use case can be found on our website or by email request. Some of the logos are not visible.

*“What keeps me awake at night is,
are **we** going to **miss the next big technological advance?**
And perhaps our **enemy will have that**”*

‘Margaret Kosal’

JAI HIND

*“A **good battle plan** that you **act on today** can be
better than a perfect one tomorrow.”*

‘Gen George S. Patton’