

IT-OT MARRIAGE IN THE POWER DRONES DEPLOYMENT-AN OUTLOOK

By DBA Student

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Mentored by

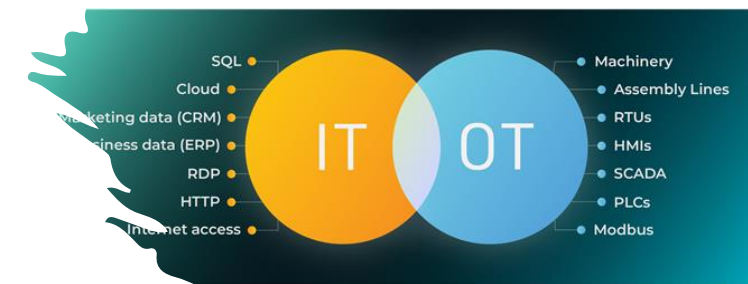
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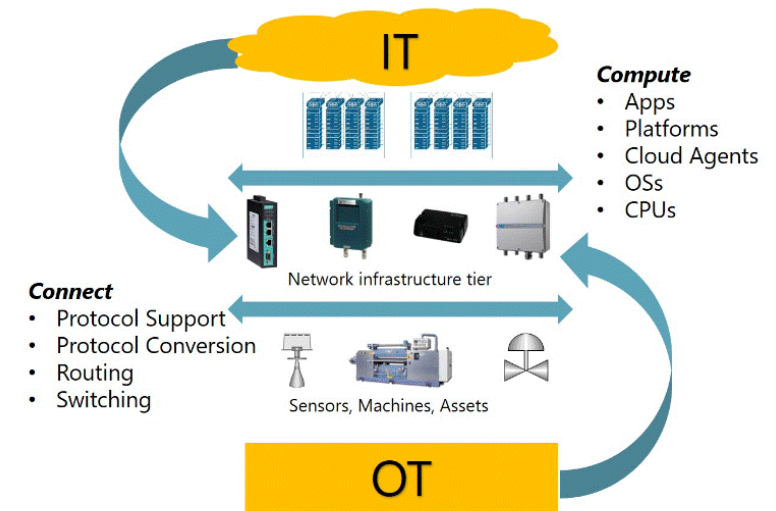
Agenda

- **BACKGROUND**
- **FIELD TO BOARD ROOM**
- **USE CASES –DIGITALISATION**
- **USE CASES-DRONES**
- **WAY FORWARD**
- **REFERENCES**



Background

- An effective marriage between IT and OT integrating the functional siloes is the need of the hour for improving the business strategy and achieving operational excellence.
- It helps in drawing actionable insights and business intelligence using a set of tools on available data.
- This yields not only business competitiveness, but also safety, reliability, sustainability, and transparency .
- According to Livia Wiley, 2020, “using digital technologies, a power plant could expect to significantly reduce its major costs
 - fuel costs by 28%,
 - maintenance costs by 20%, and
 - operations costs by 19.5%.
- Despite such a plethora of benefits, the marriage between IT and OT has not been popular to the extent possible in power sector, especially in India.



Field to Boardroom : IT-OT Integration.

Ground connected board enabled with analytical acumen

ERP , enterprise data systems, dash boards, PI analytics, KPI and balance score cards, budgeting

Business Planning

Operations Management

Operations excellence

IT

OT

Supervisory Control Applications

DCS, SCADA, HMI, industrial control systems

Process Control Network

Automation network, permissive/protections. Interlocks

Production Process/ Field operations

I/O, Sensors, actuators, field devices, wiring, mechanical/chemical/electrical process

Use Cases 1/3



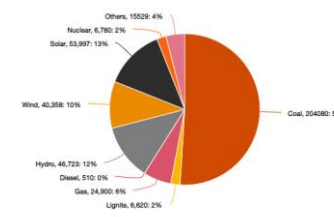
1. Control

Maintain set values, Protections, interlocks, permissive



2. Optimization

- i. Output
- ii. Resources
- iii. Risk



3. Visualization

- a. Dashboards
- b. MIS



4. Automation

Reduce human intervention in processes, mainly by predetermining decision criteria
E.g. CMC, m/c autoloops

The SORTIE framework helped to foster faster, better, and robust digital use cases in power sector.

Wheel of Use Cases 2/3

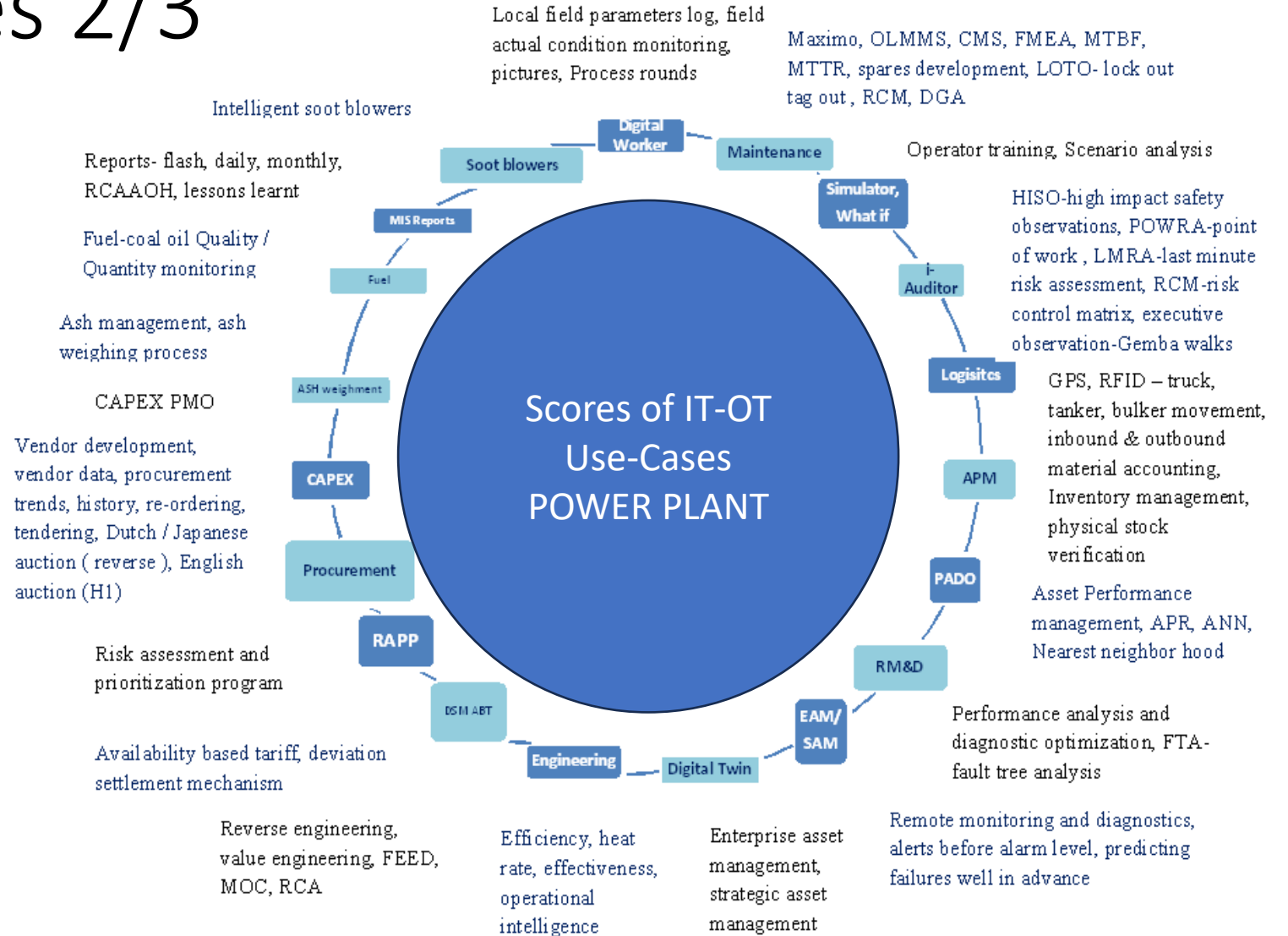
Application programming interface (API)

a set of rules to enable apps/programs to communicate with each other,

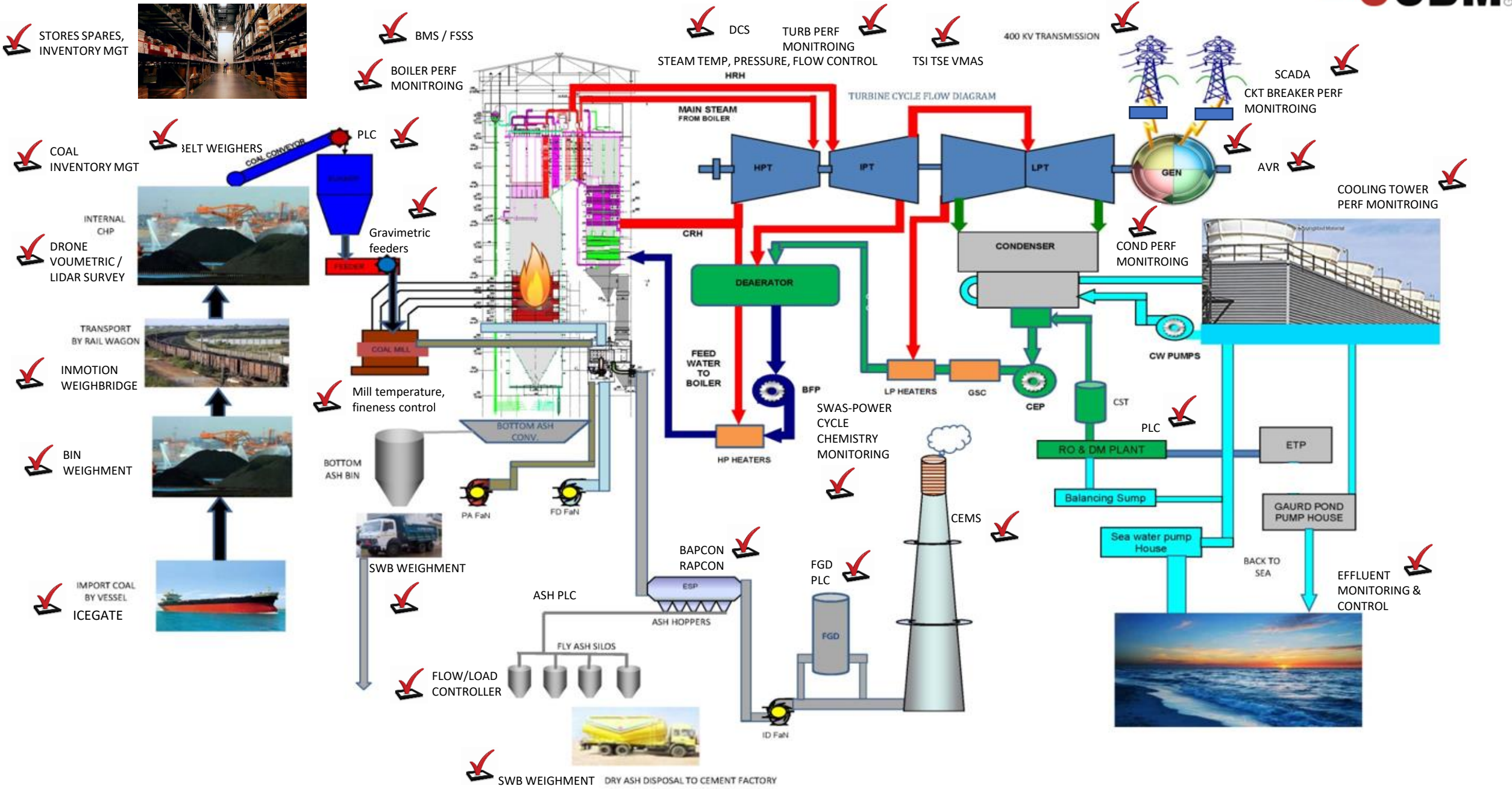
Open Platform Communications (OPC) is a series of standards/specifications for industrial telecommunication, based on Object Linking and Embedding (OLE) for process control.

OPCUA-

unified architecture is a m2m communication protocol



Use Cases 3/3



Drones Uses Cases 1/8

SAFETY

- Assures effective usage of PPEs and other safety appliances at heights and inaccessible areas of space - Drone inspecting safety aspects



SECURITY

- Effective in in-accessible areas .
- Monitor activities and provide law enforcement with real-time information to help them deal with potential threats.
- Capture still images and video from a distance or at a high altitude to gather information about specific targets.
- Can withstand harsh environments and reach objects that are out of reach .
- Can be laden with live video cameras, infrared cameras, thermal sensors, and LiDAR to affect effective surveillance.
- Human security guards are prone to fatigue and errors, can lose concentration and miss threats. Whereas drones alleviate these challenges and can provide autonomous threat response.
- Drones are cheaper & quicker than a patrol vehicle and can reach the incident location faster and provide an opportunity for rapid remedial response.



Drones Uses Cases 2/8

CHIMNEY / NATURAL DRAFT COOLING TOWER HEALTH MONITRING

- Tall concrete structures like chimneys, stacks, natural draft cooling towers etc. can be surveyed and inspected using drones. Nondestructive testing like ultrasonic thickness survey, thermal imaging, can be carried out using drones.
- Additionally, they can monitor the healthiness of earthing strips, lightning arrestor strips from top to bottom. Drones avoid elaborate scaffolding needs and can carry out the inspections in a quicker and more accurate manner.

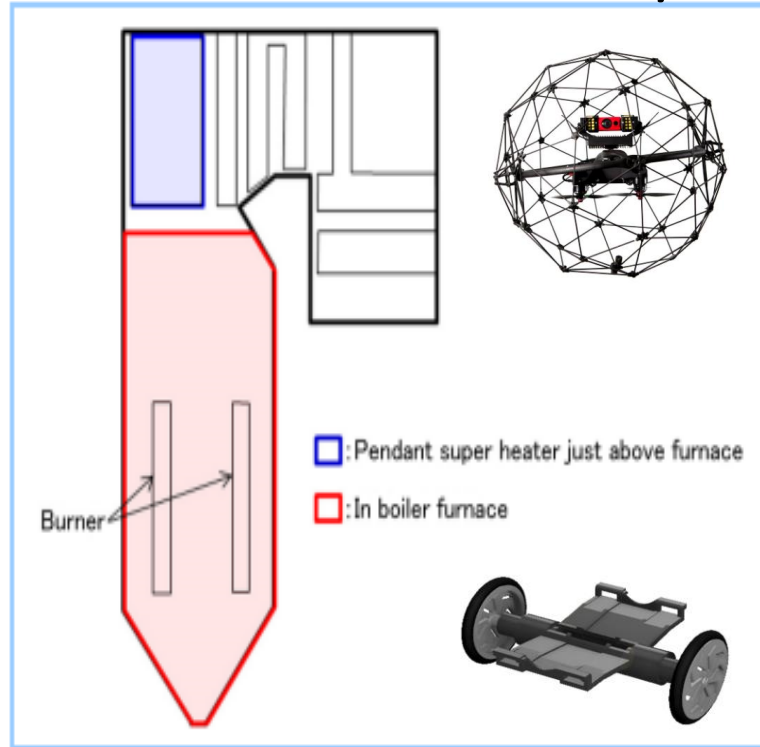
Uses Cases 3/8

BOILER INSPECTION

During annual overhauls, to check furnace cleanliness and carry out inspections for corrosion, erosion, cracks, bulges, dents, misalignments, performing insulation survey etc. eliminating the need for sky climbers or time consuming and cumbersome scaffolding.

This prevents people climbing through a small hole and crawling over tubes for inspection which is uncomfortable, tiring, and even dangerous.

Drones as shown in figure 10 below surrounded with a carbon fiber cage, which makes it collision-tolerant on impact by up to 15 m/s are deployed to carry out the inspections, d-metering (thickness survey) etc.



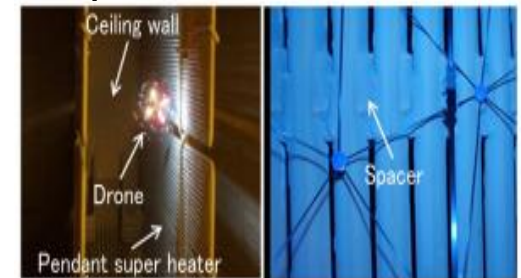
Wall blower opening area inspection by Magnetobot drone



Spherical cage mounted drone



Pendent super heater inspection



Burner section inspection



Drones Uses Cases 4/8

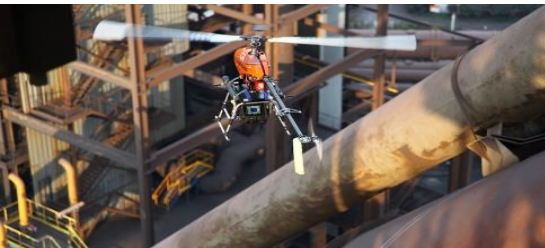
WAREHOUSE MANAGEMENT



- Warehouses inventory management, intra-logistics of items, inspection and surveillance
- New scanning technologies, bar codes, QR codes, radio frequency identification (RFID) technologies and artificial intelligence (AI) enable drone-driven automations in warehouses.

INSPECTION OF CROSS-COUNTRY PIPELINES / CONVEYORS

- Inspection and upkeep of long conveyors and pipelines pose a greater challenge to the maintenance engineers
- Drones facilitate quicker and effective inspections
- Drones on conveyor, pipelines



FIRE FIGHTING

- Drones, equipped with a thermal camera, are deployed to identify hotspots, and search the unsafe spots after the fire is extinguished.



PHYSICAL STOCK VERIFICATION

Accuracies are within 1-2% compared to traditional ground-based laser or total station measurements.



Use Cases 5/8



Drones Uses Cases 6/8

Environment

- **CEMS:** Continuous emission monitoring systems. This system monitors real time emissions like Sox, NOx, SPM etc. being discharged through chimney. As part of compliance these values are directly connected through the web to the pollution control boards.
- **AAQMS:** Ambient air quality monitoring systems. A minimum of three AAQMS are installed around the periphery of the plant 120 degrees apart from each other, to monitor the ground level concentrations of pollutants.
- **Auto gas leak and communication:** As soon as the sensor detects a gas leak, an SMS is sent to ERT team in addition to triggering hooter/ alarm .
- **PLC based inspection:** In some plants where the routine inspections are mundane and boring in nature the PLC controlled buttons with interlocks, ensure non-skipping of procedures.
- **NFC based equipment local visits/inspections:** Using this feature, the operator must go near the equipment and scan the ‘near frequency code ‘ (NFC) to enable the relevant form pertaining to that equipment open, before logging in parameters.
- **RFID:** Can be used to track manpower , especially when entering a confined space.
- **Drone applications:**
 - LIDAR analysis for forestry and green plantation, CRZ coastal regulated zone monitoring
 - Environmental impact assessment (EIA)
 - Mapping and topographical survey
 - Structural damage assessment
 - Thermography

Health

Artificial Intelligence (AI):

Dangerous work can be automated. Enables continuous monitoring of workplace deviation as well as individual behavior.

Virtual Reality (VR) based training:

VR Training is an advanced method to provide the trainee within real scenario & situations, creating a more realistic feel of what if scenarios.

Lifesaving apparatus

monitoring and usage training like automated external defibrillators (AEDs) , self-contained breathing apparatus (SCBA) etc

Drones are being deployed to reduce human exposure to hazardous conditions or to access dangerous and hard-to-reach locations , sanitization etc.

Realtime monitoring of ergonomics: By apt ergonomics 59% musculoskeletal disorders can be reduced. As high as 75% reduction in lost workdays is feasible. It is reported that employee absenteeism can be brought down by a 58% reduction.

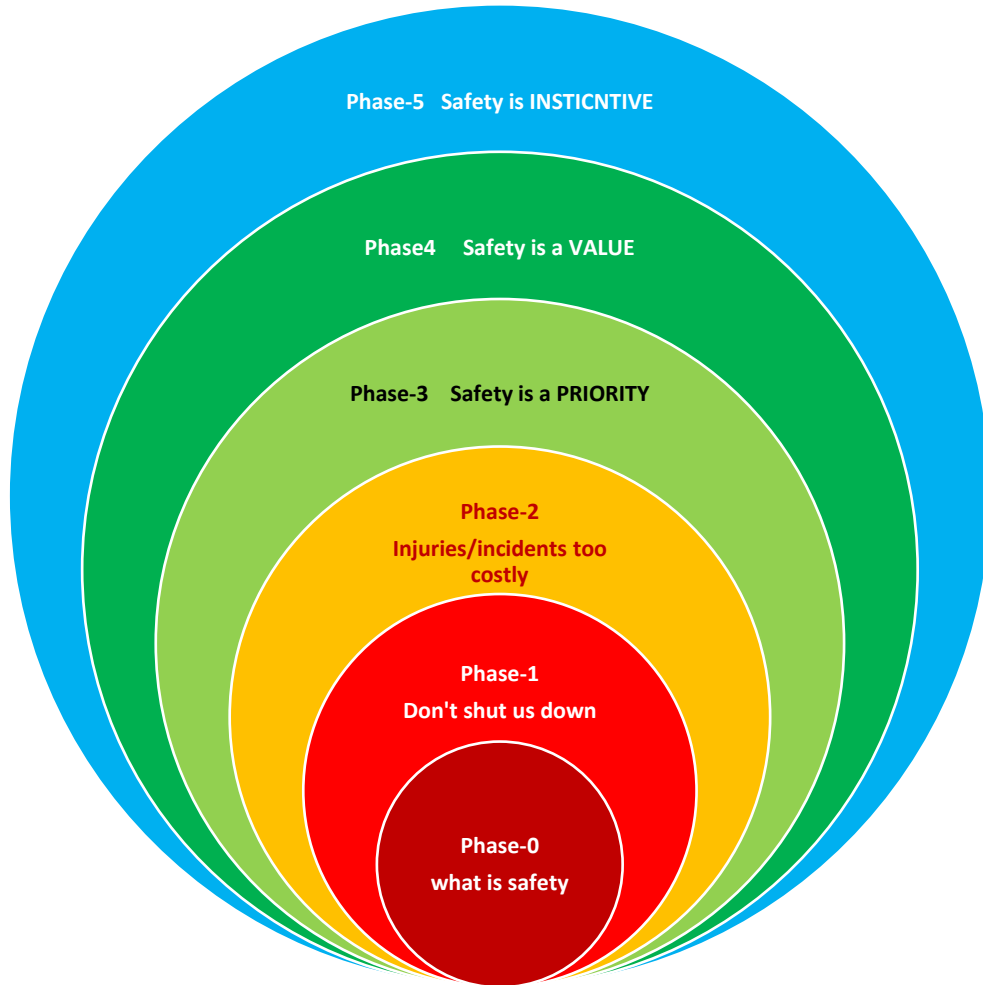
RDT-real digital twin: A virtual version of a physical object is called a digital twin. Enables real-time remote monitoring for process & hazardous Industries.

Facility mobile management system (FMMS) eliminates scope for fake inspection reports, housekeeping reports, hygiene related inspections in a paperless way.

SOS wristwatch: Provides a beep sound or alerts through vibrations when a person enters unintentionally a prohibited area.

Safety and Security

The safety maturity model
continuity framework -6 phases



i-care,
applications

They are very useful in carrying our local walk-down checks, Gemba walks, safety walks, executive walks, executive observations etc.

AI based Interactive
toolbox talks:

Providing a 360 degrees perspective of the hazard in a job, job safety analysis, point of work risk assessment, last minute risk assessment.

i-auditor

CCTV Analytics

Regular CCTV camera can be turned into a AI Smart camera to monitor man, machine, material, method (SOP) to ensure safety adherence with automated real-time detection & response system

Drone applications:

Inspections/ security surveillance in in-accessible areas.

Digital security tools enhance plant physical and cyber security.

Way forward

- Drones are becoming omnipresent and omnipotent when it comes to their deployment in power plants for various functions taking care of people, plant equipment and planet.
- In addition to such numerous advantages, they provide a 2.4 GHz live video feedback that can also be stored on the onboard secure digital card. This enables the pilot to receive live visuals when flying the drone, for team to participate in inspections and analyze and for specialists to view the footage at a later stage when maintenance or corrective actions needs to be carried out.
- Further to expand the study in future AI, ML, AR and VR can be added in OT.
- End to end outsourced service model can also be studied.

References

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- Greg Bean, Connor Davies (2020) 'Digitization of the Energy Industry'
- Dr Rajmohan Palanivelu (2023) 'Use of technology in capacity development,
- Agnishwar Jayaprakash (2023) 'Real AI-powered smart factory solutions: Computer vision transcending possibilities of Industry 4.0'
- Garuda drone services, presentation at EHS conclave , Tiruchy, 15 May 2023.

An aerial photograph of a multi-lane highway bridge spanning across a vast expanse of turquoise water. The bridge has several lanes in each direction, with white lane markings and a central divider. Several vehicles, including cars and trucks, are visible on the bridge. The water has a textured, rippled surface.

digital journey in the ocean of data

THANK YOU

Dr PK Rao