



**15th INTERNATIONAL OPERATIONS & MAINTENANCE CONFERENCE** IN THE ARAB COUNTRIES  
UNDER THE THEME: “**SMART MAINTENANCE**” CONICIDE WITH THE 15<sup>TH</sup> ARAB MAINTENANCE EXHIBITION

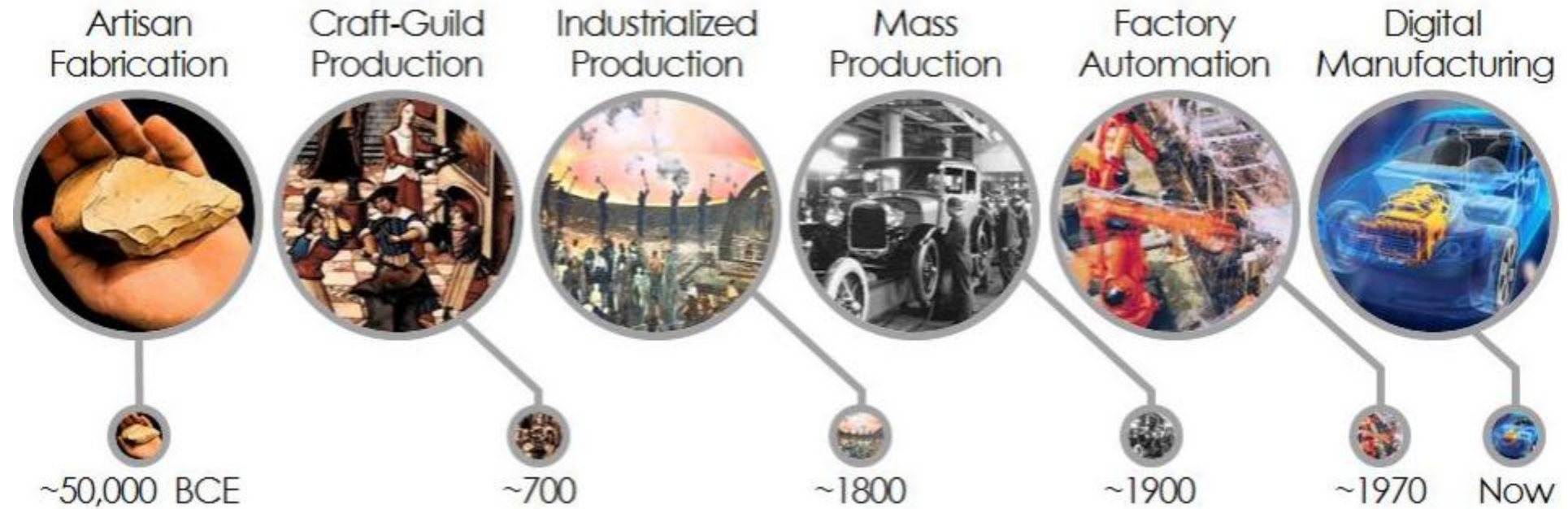
# SMART MAINTENANCE TO ENHANCE RELIABILITY

**TRINATH SAHOO**

**Indian Oil Corporation Ltd**



# Manufacturing Paradigm change





# Manufacturing Paradigm change

Tomorrow's manufacturing will be-

- ❖ Smart, Digital manufacturing
- ❖ Big data
- ❖ Predictive analysis
- ❖ Virtualized processes.
- ❖ Modeling and simulation
- ❖ High performance computing
- ❖ Robotics

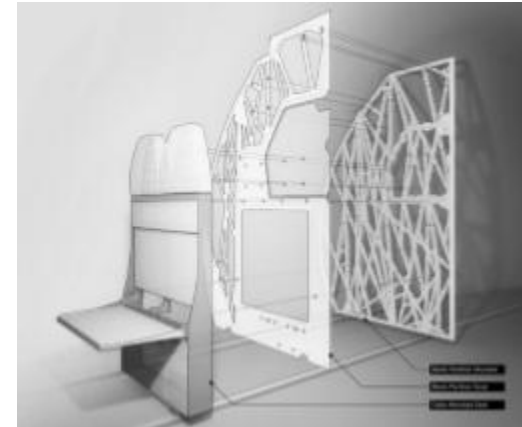


# Smart Manufacturing & Smart Design

Engineering processes like design, testing, and optimization can only go so fast in the physical world.

❖Autodesk's Project Dream catcher: "Algorithmically generated" design software allows designers to generate designs based on a list of material and performance requirements.

❖Airbus and Boeing use such "generative design" modelling and simulation tools.

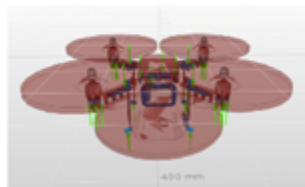


# Smart Manufacturing & Smart Design

❖ The Dreamcatcher system allows designers to input specific design objectives, including functional requirements, material type, manufacturing method, performance criteria, and cost restrictions.

❖ Loaded with design requirements, the system then searches a procedurally synthesized design space to evaluate a vast number of generated designs for satisfying the design requirements

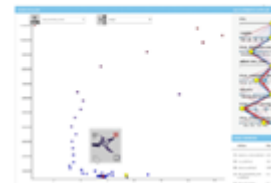
Define



Generate



Explore



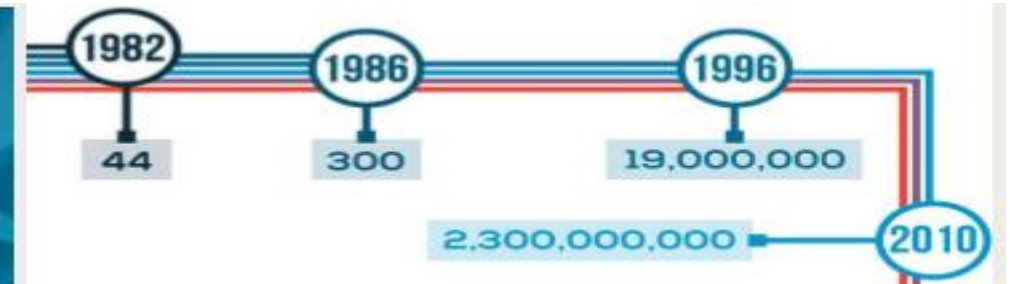
Fabricate





**By 2020, somewhere from 26 to 50 billion “things” connected to the Internet.**

❖ In the past three years, the number of sensors shipped has increased more than five times from 4.2 billion in 2012 to 23.6 billion in 2014.



# The Internet of Things (IoT)

## What is the Internet of Things

Devices with electronics and sensors connected to the public telecom network and the internet.

## Big Data

Large data sets that may be analyzed computationally to reveal patterns, trends, and associations, especially relating to human behavior and interactions.

The size of the data is not important • Ability to analyze the data, make informed decisions and take action .

## The Industrial Internet of Things

**IoT + Big Data = Industrial Internet**

# The Internet of Things Where-We Are Today

## First step on the IIoT Journey

- Focus on operational efficiency
- Utilization
- Productivity

## What is different now?



**Cheap hardware.**



**Unlimited computing power**



**Internet access almost everywhere**



# Mfg. Poised to See Biggest Gains from IoT



**Office – organisational redesign and worker monitoring, augmented reality for training, energy monitoring, building security.**



**Factories- operations optimisation, predictive maintenance, inventory optimisation , health and safety**



**Work sites- operation optimisation , equipment maintenance, health and safety ,IOT enabled R&D**

# The Internet of Things & Manufacturing

- ❖ IoT applications in mfg. and factory settings expected to generate \$1.2 to \$3.7 trillion of economic value annually by 2025.
- ❖ IoT will revolutionize manufacturing processes.
- ❖ IoT will revolutionize manufactured products and product systems.

## IoT and Manufacturing Processes

**IoT will generate 4 primary forms of value in terms of manufacturing processes:**

- ❖ **Operating Efficiency;**
- ❖ **Predictive Maintenance;**
- ❖ **Supply Chain Management;**
- ❖ **Inventory Optimization.**





## IoT and Manufacturing Operating Efficiency

- ❖ IoT provides manufacturers a comprehensive view of what's occurring at every point in the production process and helps make real-time adjustments.
- ❖ Will increase manufacturing productivity by 10-25%.
- ❖ Producing up to \$1.8 trillion in global economic value by 2025.

# IoT and Manufacturing Operating Efficiency



**Explosion of low-cost sensor technologies has made every manufacturing process and component a potential data source.**

**❖ Ford: Placed sensors on virtually every piece of production equipment at its River Rouge facility.**



**❖ GM: Uses sensors to monitor humidity conditions during vehicle painting; if unfavourable, the work piece is moved elsewhere in plant or ventilation systems adjusted.**



**❖ Raytheon: Keeps track of how many times a screw has been turned in its factories.**



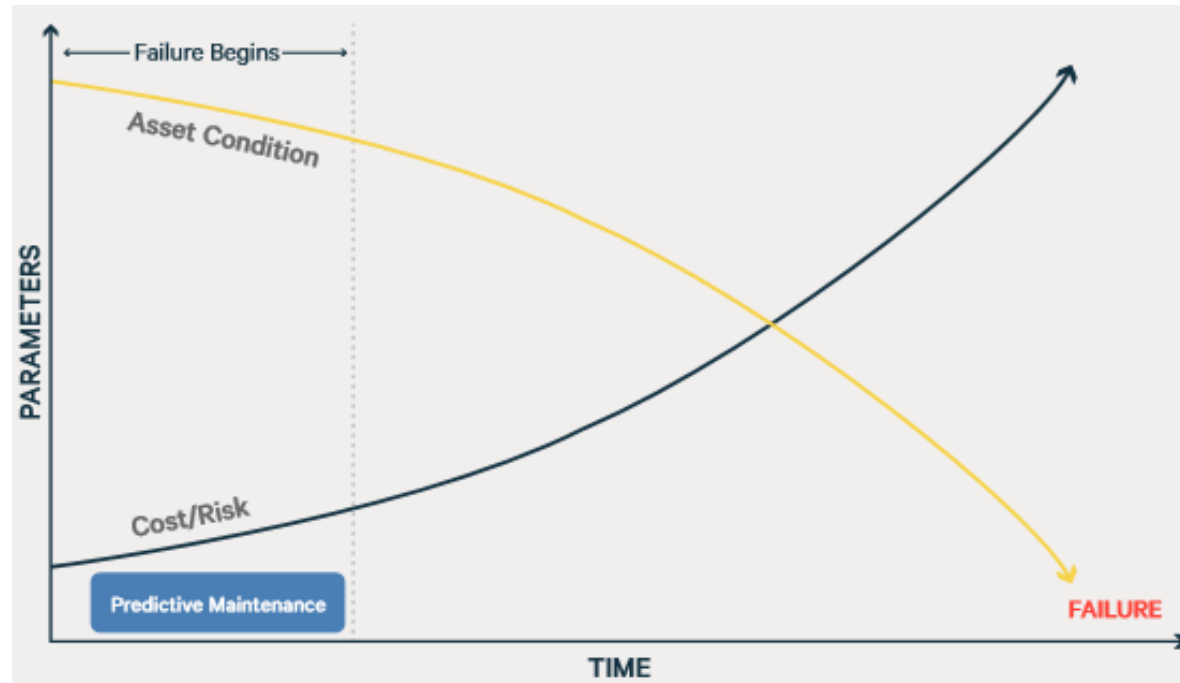
**❖ Merck: Improves vaccines by conducting up to 15 billion calculations to determine what environmental and process factors influence quality of final product**



## IoT and Predictive Maintenance

Today, IoT and connected devices are essentially re-shaping the predictive maintenance landscape.

According to research from McKinsey, implementing predictive maintenance using IoT can reduce equipment downtime by as much as 50 percent and reduce maintenance costs of factory equipment by 10 to 40 percent.





## IoT and Predictive Maintenance

**The connected assets are producing large amounts of information. By tapping into the data streams and connecting them to the cloud and back-end systems, organizations can optimize business processes, make more informed decisions.**

**What used to be a manual, time-intensive procedure can now be dynamic, rapid, and automated. IoT-enabled predictive maintenance solutions take advantage of streaming data from sensors and devices to quickly assess current conditions, recognize warning signs, deliver alerts and automatically trigger appropriate maintenance processes.**

# IoT and Predictive Maintenance

- ❖ **Identify the target outcome**  
Timing, Probability, cause, Risk ranking, Maintenance recommendation.
- ❖ **Inventory data sources**  
operating condition, Failure detail, Repair history.
- ❖ **Capture and combine data**  
Connecting data, Normalising data.
- ❖ **Model, test, and iterate**  
Analyzing data to identify meaningful patterns, stack-rank the model.
- ❖ **Validate model in a live operational setting**  
Monitoring connected equipment, Pilot planning .

## IoT and Predictive Maintenance

- ❖ IoT expected to reduce factory equipment maintenance costs by up to 40%.
- ❖ Expected to reduce equipment downtime by up to 50% and is expected to reduce capital equipment investment costs 5%.
- ❖ Generating economic value of \$630B annually by 2025





# IoT and Predictive Maintenance

**Monitor the status of production equipment in real-time.**

□ **Intel:** Uses predictive modeling to anticipate failures, prioritize inspections, and cut monitoring costs, save \$3M.



□ **Ford:** Downstream machines can detect if work pieces they receive are off in a particular minute dimension, indicating possible problems in upstream machines.



□ **GE “Brilliant Factories”** initiative doubled production of defect free dishwashers and washing machines.



# IoT and Predictive Maintenance- Navistar

To help fleet and vehicle owners move from a reactive approach to a more predictive model, Navistar needed to analyze a wider range of data in real time, including vehicle sensor data.

Navistar built an IoT-enabled remote diagnostics platform, called OnCommand.

The platform brings in over 70 telematics and sensor data feeds from more than 300,000 connected vehicles—including engine performance, truck speed, acceleration, coolant temperature, and brake wear.

This data is then correlated with other Navistar and third party data sources, including meteorological, geolocation, vehicle usage, traffic, historical warranty, and parts inventory information.

Navistar has helped fleet and vehicle owners reduce maintenance costs by up to 40 percent.



# IoT and Predictive Maintenance- Energy

Even a few minutes of downtime for these massive turbines can mean significant costs due to lost productivity.

And that meant hydropower plants were still dependent on sending experienced inspection personnel every week to check on the condition and health of equipment.

How could we automate inspections and monitor the health of these assets so they could learn about potential equipment issues earlier and avoid costly downtimes?

An innovative IoT based predictive maintenance solution for hydroelectric power plants based on acoustic monitoring. The solution captures, analyzes, and interprets sounds in hydropower plants to diagnose the health of the turbines and generators.





# IoT and Predictive Maintenance- Robotics

For auto manufacturers, operational uptime is of paramount importance. Some auto manufacturers estimate that unplanned downtime in a factory can cost them as much as \$15,000 - \$20,000 per minute and that a single downtime can cost them approx. \$2 MN in lost revenues.

Using Cloudera Enterprise as the data management engine to gather, store, process, and analyze sensor data files from 10,000 robots across manufacturing facilities in real-time

Application analyzes data from coming from robots throughout its factories to monitor the health of these critical machines and detect potential issues that could lead to failures in the production line.

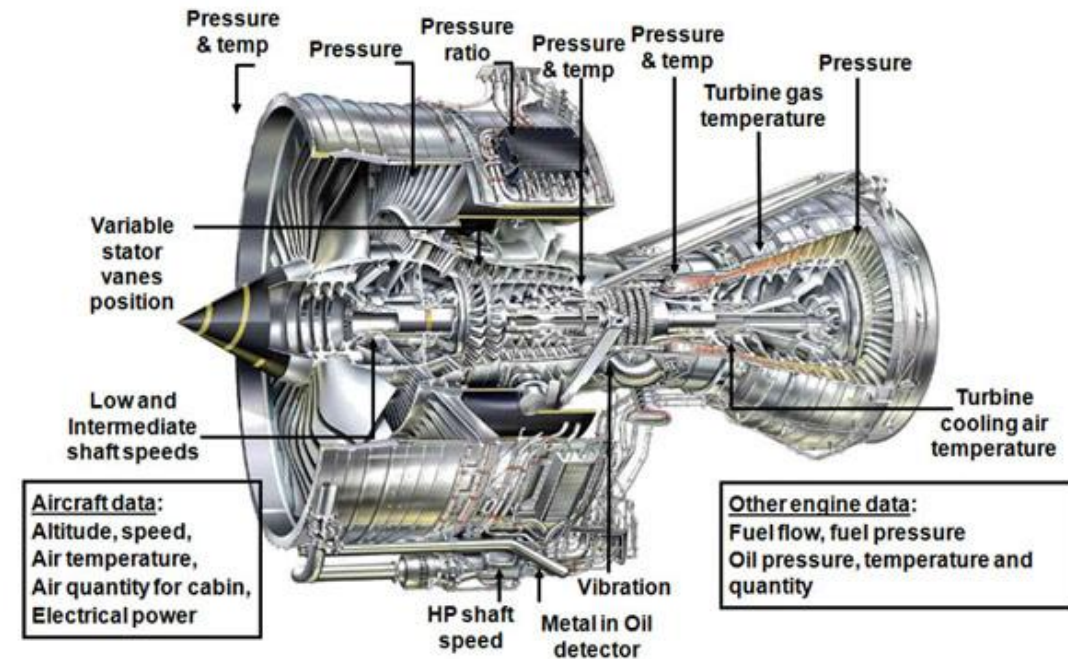


# Rolls Royce Engine Health Management

Rolls Royce uses Engine Health Management (EHM) to track the health of thousands of engines operating worldwide, using onboard sensors and live satellite feeds in real-time.

EHM is a pro-active technique for predicting when something might go wrong and averting a potential threat before it has a chance to develop into a real problem. EHM covers the assessment of an engine's state of health in real time or post-flight and how the data is used reflects the nature of the relevant service contracts.

EHM uses a range of sensors strategically positioned throughout the engine to record key technical parameters several times each flight







# Supply Chain Management

**“The supply-chain encompasses every effort involved in producing and delivering a final product or service, from the supplier's supplier to the customer's customer.**

**the technology holds the potential for providing significant “freedoms” that will reduce considerable human labor from certain workflows as well as for facilitating the possibility of making information readily available to all participants throughout the value chain.**

**The major purpose of deploying RFID is identification, authentication, location, or automatic data acquisition (ADA).**

**RFID can also provide supply chain security when RFID tags are used to electronically seal containers and monitor movements of the containers, so that any tampering can be tracked**





## RFID applications

**Demand management and RFID-** RFID would produce accurate information related to the inventory of finished goods, work-in-progress, and in-transit stages with reliable due dates .

**Order Fulfillment-** RFID will enable process automation in picking, shelving, cross-docking, implementing consolidation operations and reduce costly logistics mistakes such as sending an item to a wrong destination and not dispatching the right item at the right time .

**Manufacturing Flow Management-** With enhanced process automation and tracking capabilities enabled by RFID, the velocity and visibility of products in the supply chain will likely improve

**Returns Management** - The reverse logistics — product recall and return of defective products — is common in supply chain operations. The return track could be traced back very easily using RFID in the return process.

## RFID applications

Seeking for a traceability solution using RFID technology, can guarantee and ensure the exact location of each spare part, at any time, to not impact the availability rate of the plant in case of unplanned maintenance.

RFID tags UHF EPC Gen2 from OmniID to identify spare parts, tools and storage locations. These tags, operating equally on metal or nonmetal, were selected on the criteria of cost, performance and simplicity of installation.





# IoT and Supply Chain Management

**IoT can help manufacturers better manage their supply chains.**

☐ **BMW:** Knows the real-time status of all machines producing all parts/components from all suppliers going into vehicles.



☐ **Toyota:** Reduces recalls by knowing exactly what machine produced which components of which vehicles.



☐ **HP:** Integrates network analysis and data visualization into its supply chain management and monitoring; has reduced the time for supply chain management projects by up to 50%.





# IoT and Inventory Optimization

- ❖ **IoT helps manufacturers better manage inventory.**
- ❖ **Würth USA: Developed an “iBins” system that uses intelligent camera technology to monitor the fill level of a supply box and wirelessly transmit the data to an inventory management system that automatically reorders supplies.**
- ❖ **IoT can drive inventory optimization measures that can save 20 to 50% of factory inventory carrying costs.**



## Other IoT Apps. In Mfg. Processes

- ❖ **Safety:** IoT applied to devices and workers (e.g., badges) can alert or even halt equipment if in too close of proximity.
- ❖ **Leveraging data on factory equipment for usage-based design** (improve equipment performance or reduce parts needed.)



# Robotics oil and gas

## Subsea yesterday- ROV

ROV is a mature technology able to remotely execute unmanned underwater operations ranging as,,  
simple observation  
data collection  
transmission of information  
Manipulator and tooling operations

## Subsea Today: AUV

AUV can:  
Follow pre-programmed missions,  
Transmit small amounts of data  
Obstacle avoidance systems  
Run several hours before the battery needs recharging  
Active control  
Consider safety, energy use, and time to reach the destination





# Robotics palletiser

**A robotic palletizing or palletiser robot is a machine which provides automatic means for stacking cases of goods or products onto a pallet. Palletizing robot refers to loading and unloading parts, boxes or other items to or from pallets.**





## Industrial robot

**Loading and unloading robot is as an industrial robot. Loading and unloading robot can meet the "Fast / bulk processing the beat", "save on labor costs," "increase productivity.**

**process modification flexible: Industrial robot arm can modify the program and the gripper clamp, rapid changes in the production process, debugging speed, eliminating the need for employees but also for the training time, can be quickly put into production.**





## Robot for painting

1. Spraying accuracy, long uptime, paint consumption province, work short cycle times, can work 24 hours a day, and high reliability.
2. Spraying speed, spray evenly, according to the workpiece change automatically adjust the level of the gun, before and after the angular position of the spray size flexible control, 360 degree no dead spraying.
3. Painting robot designed explosion-proof, high environmental protection, safety, operation control is easy to learn.







## Robot for welding

use of mechanized programmable robots, which completely automate a welding process by both performing the weld and handling the part. Automatic welding robot consists of robot and welding device.

1. stable welding quality to ensure a high degree of uniformity of the product.

2. the perfect compact design greatly reduces the occupation of the site.

3. to improve labor intensity, can work in hazardous environments.

4. 24 hours of continuous production, maximize productivity

WELDING ROBOT



BRAND:  
HANDY

- Max Load: 6Kg
  - Number of axes : 6
  - Purpose:welding
- Working rang:
- J1 : -170°~+170°
  - J2 : -90°~+90°
  - J3 : -80°~+90°
  - J4 : -100°~+100°
  - J5 : -80°~+150°
  - J6 : -220°~+220°
- Welding speed:
- Vmin≤450mm/min
  - Vmax≥5000mm/min



## storage tank inspection- robot

Conventional inspections involve draining, cleaning with water or solvents, ventilating, containing waste residues, and certifying tanks as gas-free for manned entry.

Inspection of the tank bottom, interior structures, and structural coating systems can be carried out only after completion of this series of hazardous, costly, and time consuming activities.

This expensive process can be avoided by using a remotely operated robotics inspection vehicle submerged in the liquid.



storage-tank inspection capabilities  
in a large fuel oil storage tank

A close-up photograph of a hand holding a bright yellow flower, possibly a daffodil. The background is a soft, out-of-focus white and light blue. Overlaid on the image is the text 'THANK YOU' in a large, bold, green font with a red outline and a subtle drop shadow.

THANK YOU