

**TRAINING REPORT**

**Internet of Things (IoT) / Industry 4.0, SAP development and Hands-on APM Infrastructure**



# Hindustan Petroleum – Mittal Energy Limited

# Guru Gobind Singh Refinery,

# Bhatinda, Punjab

# Submitted By:

# Jatin Madan

# Vellore Institute of Technology, Vellore

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# Preface

I, Jatin Madan, a student of Vellore Institute of Technology, Vellore, Tamil Nadu is studying in the Fourth Semester. As a part of the 4-year BTech course, I have undergone a project as a Major Project work on “Internet of Things (IoT) / Industry 4.0, SAP development and Hands-on APM Infrastructure” to facilitate them with the automated software processes and Internet of Things Concept deployment.

Enterprise Resource Planning is that growing segment of Information Technologies that fulfill the needs of the enterprises like Quality, Time to Market, Customer Satisfaction, Performance and Profitability very effectively and efficiently.

The aim of the training was to gets a hand-on experience with the Industry 4.0 infrastructure with all its advantages over the previous Industry X.0 infrastructures. Along with the Usage of ERP System SAP software and learning about all its advantages over the manual systems. All the operations of the company can be integrated.

HMEL has embarked on a journey to implement Strategic Applications like Manufacturing Execution System (MES), SAP, Distributed Control System (DCS), Integrated Security System (ISS) and other refinery and pipeline application to operate a ‘World Class Refinery’. Project Prism is the umbrella program to implement MES, SAP and ISS.

# Acknowledgement

*“To matter what accomplishment we achieve somebody helps us. For every accomplishment we need the cooperation and help of others. As knowledge advances by steps and not by leaps so, ability advances by encouragement and guidance.”*

I, Jatin Madan, is pleased to submit my training report which I have been able to complete after closely studying the various operations at HPCL- Mittal Energy Ltd, Bhatinda.

I would like to thank HMEL for providing an opportunity to work on the Industry 4.0 aspects of the petroleum refinery architecture.

I am highly grateful to:

**Mr.** [**Abhishek Sankumalla**](mailto:abhishek.sankumalla@hmel.in%20%3cAbhishek.Sankumalla@hmel.in%3e) [Manager (Information Technology)],

**Mr.** [**Navneet Singh Brar**](mailto:Navneet.Brar@hmel.in) [Deputy Manager (Maintenance-Reliability)],

**Mr.** [**Ankit Sharma**](mailto:Ankit.Sharma@hmel.in) (Assistant Manager (MAINTENANCE – ROTARY)],

**Mr.** [**Vikas Mehta**](mailto:vikas.mehta@hmel.in) [Deputy Manager (Human Leadership)], and

**Mr.** [**Vikas Kumar Omar**](mailto:vikas.omar@hmel.in%20%3cVikas.Omar@hmel.in%3e) [Deputy Manager (Treasury)]

For their guidance and cooperation. I also extend my heartfelt gratitude and thank **all the Unit Heads and all the Technical and Non-Technical staff of GGSR** **REFINERY** for their great effort to enhance my practical knowledge.

I can definitely say that the on-site refinery training has ensured a positive effect on my capabilities and has trained me to perform better in the future.

# Jatin Madan

# Vellore Institute of Technology, Vellore

# Declaration

This is to certify that Jatin Madan, a student of Vellore Institute of Technology, Vellore, enrolled in BTech Computer Science program has completed his Summer Vocational Training with our organization.

The participant has worked on the aspect “Internet of Things (IoT) / Industry 4.0, SAP development and Hands-on APM Infrastructure” as a partial fulfillment of the requirement for Degree of BTech and a Hands-On Training for Personal Development.

This Training Report is an authentic record of our own work carried out by the end of fourth semester Vellore, and has been approved by the training in-charge after an oral examination on the same, in collaboration with a head of I.T. department.

# Jatin Madan

Above statements of the candidate are true to the best of my knowledge.

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# Mr. [**Abhishek Sankumalla**](mailto:abhishek.sankumalla@hmel.in%20%3cAbhishek.Sankumalla@hmel.in%3e)

# Manager (Information Technology)

# ABSTRACT

A refinery is a process plant in which raw material in the form of crude oil is processed to get various products like petrol, diesel, LPG, Propylene etc. The Guru Gobind Singh Refinery uses energy efficient, environment friendly and distillate yielding process technologies that will produce clean fuels which causes minimum harm to the environment.

This report covers the introductory concepts about the ERP Software, Intelligent Asset Strategies (IAS) Software, and the Operation units of a crude processing refinery.

The **ERP Software used is “SAP Software”**. Enterprise Resource Planning, a software solution that addresses the enterprise needs taking the process view of an organization to meet the organizational goals tightly integrating all functions of an enterprise.

The **IAS Software used is “Meridium Enterprise - Asset Performance Management (APM) Software”**. APM provides the infrastructure to support a complete solution and framework for implementing intelligent asset strategies through consistent administration tools, and asset criticality analysis meant to optimize the performance of assets at the system, facility and enterprise levels.

In the **Operation Unit of the refinery**, the first step is the fractionation of crude oil in atmospheric and vacuum distillation towers. Heated crude oil is physically separated into various fractions, or straight-run cuts, differentiated by specific boiling point ranges and classified in order of decreasing volatility, as gases, light distillates, middle distillates, gas oils and residuum. These products are then sent to the other units for further refining.

# COMPANY OVERVIEW

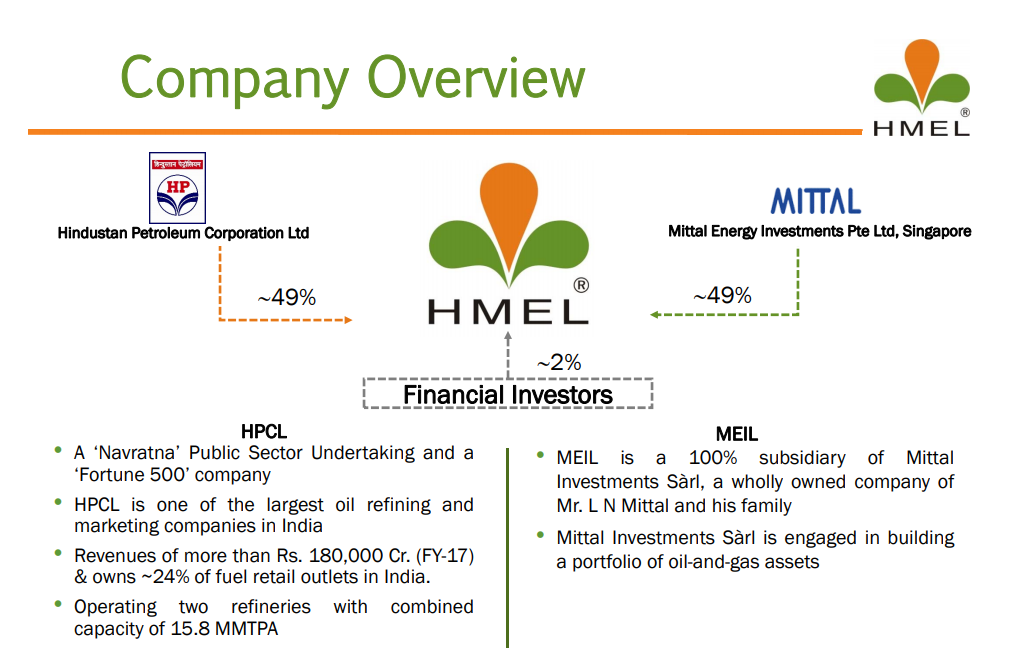
# Overview

# Of

# Guru Gobind Singh Refinery

# HPCL- Mittal

# Energy Limited



* **About HMEL**
  + HPCL-Mittal Energy Limited (HMEL) is a joint venture between **Hindustan Petroleum Corporation Limited (HPCL) and Mittal Energy Investment Pte. Ltd, Singapore**.
  + Both the JV partners hold a stake of 49% each in the company and the remaining 2% is held by financial institutions.
  + HPCL-Mittal Energy Ltd (HMEL) owns and operates the Guru Gobind Singh Refinery (GGSR) of **11.3 MMTPA capacity** at Bhatinda, Punjab.
  + HMEL’s wholly owned subsidiary, HPCL-Mittal Pipelines Limited (HMPL), **owns and operates a Single Point Mooring (SPM)** for receipt of Crude Oil, **Crude Oil Terminal (COT)** for storage of Crude Oil and **1017km cross country pipeline** for transportation of the crude from Mundra, Gujarat to the refinery at Bhatinda.
  + The enormity of the Guru Gobind Singh Refinery project makes it the **single largest investment in the state of Punjab**.
  + It is the **first oil and gas project** to be set up in the state.
  + The refinery produces eight liquid product and three solid products of **EURO-IV specifications** using world-class environment-friendly technologies.
  + The refinery is a zero bottom plant, with a very **high Nelson Complexity Index**.
  + HMEL’s guiding beacon are its six core values which have helped build an environment of trust, transparency and teamwork; growing from 25 employees in 2008 to present number of **over 2000 committed employees** with diverse experience from over 150 leading organizations from India and abroad working relentlessly towards our vision of being the best refining company in the world.
* **About JV Partners**
  + **Hindustan Petroleum Corporation Ltd.**
    - HPCL is a fortune 500 company. HPCL operates two major refineries, producing a wide variety of petroleum fuels and specialties.
    - One of these is situated in Mumbai (West Coast) of 7.5 Million Metric Tonnes per Annum (MMTPA) capacity and the other is situated in Visakhapatnam (East Coast) with a capacity of 8.3 Million Metric Tonnes Per Annum (MMTPA).
  + **Mittal Energy Investment Pte Ltd.**
    - Mittal Energy Investment Pte Ltd is a part of Arcelor Mittal Group owned by Mr. Lakshmi Niwas Mittal.
    - Mittal Investments Sarl (‘MITTAL’), a Luxembourg incorporated company, is ultimately beneficially owned by Mr. Lakshmi N. Mittal and family.
    - In 2007, MITTAL through its subsidiary - Mittal Energy Investments Pte Ltd, Singapore, became 49% shareholder in an upcoming 9-MMTPA Greenfield refinery at Bhatinda
* **Core Values of HMEL**

* + Company’s values define and measure it.
  + The core values of HMEL speak of their actions so ingrained to steer them towards success and at as a driving force behind the company’s infrastructure.
  + Their values are their philosophy and culture, helping to build a world-class Energy company.
  + They are governed by six core values:
    - **Safety First**
    - **Teamwork**
    - **Continuous Improvement and Learning**
    - **Respect for People**
    - **High Ethical Standards**
    - **Achieve Targets and Meet Deadlines**
* **About Guru Gobind Singh Refinery (GGSR)**

Guru Gobind Singh refinery is the single largest investment and the first oil and gas industry to be set up in the state of Punjab, India.

* + Operates on 11.3 MMTPA Crude processing Level
  + 1017 KM 28” and 30” diameter Crude Oil Pipeline from Mundra to Bhatinda.
  + Crude Oil Terminal at Mundra with a storage capacity of 8,40,000 KL
  + Single Point Mooring and 17Km 48” Diameter Offshore/ Onshore pipeline at Mundra.
  + Total plot area is 2300 acres\* (Refinery Block: 1600 Acres; Water Block: 400 Acres; Green Belt Area: 307 Acres)
  + State of Art safety and environmental features with world class technology.
  + Flexibility to process a wide variety of crude oils including heavy, sour and other opportunity crudes.
  + High value added products, LPG, Naphtha, Petrol, Diesel, Aviation Fuel, Polypropylene, Hexane etc.
  + Diesel/ Petrol of Euro IV Quality.
  + Crude range of 26.5 – 32 de. API (American Petroleum Institute).
  + Capability to process high Sulfur Crudes up to 3% wt. “S”.
  + Capability to process high acidic crudes up to TANS 0.5 mg KOH/g.
  + High Nelson Complexity Index (10.7) for meeting indigenous demand.

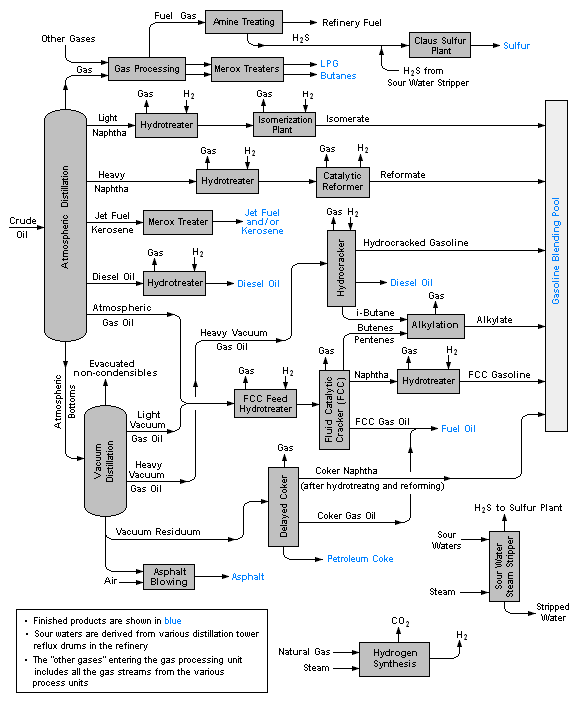
# Overview

# Of

# Processes Involved

# In

# Crude Refining and Processing



# Petroleum Refining Process: An Introduction

**Oil Refinery:**

An oil refinery is an industrial process plant where crude oil is processed and refined into more useful petroleum products like Liquefied Petroleum Gas (LPG), Petrol, Kerosene, Aviation Turbine Fuel, Diesel, etc.

Petroleum refining begins with distillation, or fractionation, of crude oils into separate hydrocarbon groups. The resultant products are directly related to the characteristics of the crude oil being processed. Most of these products of distillation are further converted into more usable products by changing their physical and molecular structures through cracking, reforming and other conversion processes.

These products are subsequently subjected to various treatment and separation processes such as extraction, hydro treating and sweetening in order to produce finished products. Whereas the simplest refineries are usually limited to atmospheric and vacuum distillation, integrated refineries incorporate fractionation, conversion, treatment, and blending with lubricant, heavy fuels, and asphalt manufacturing; they may also include petrochemical processing.

The numbers and types of different processes used in modern refineries depend primarily on the nature of crude feedstock and finished product requirements. Processes are also affected by economic factors including crude costs, product values, availability of utilities and transportation.

# Basic Refining Processes and Operations

Petroleum refining processes and operations can be classified into the following basic areas:

* **Separation**

Crude oil is physically separated by fractionation in atmospheric and vacuum distillation towers, into groups of hydrocarbon molecules with various boiling point ranges, called “fractions” or “cuts”.

* **Conversion**

Conversion processes used to change the size and/ or structure of hydrocarbon molecules include:

* + **Decomposition**: (Dividing) by Hydro, Thermal, and Catalytic Cracking and Coking.
  + **Unification**: (Combining) through Polymerization
  + **Alteration**: (Rearranging) with Isomerization and Catalytic Reforming
* **Treatment**

Since the beginning of refining, various treatment methods have been used to remove non-hydrocarbons, impurities and other constituents that adversely affect the performance properties of the finished products or reduce the efficiency of the conversion processes.

Treatment involves both chemical reactions and physical separation, such as dissolving, absorption or precipitation, using a variety and combination of processes. Treatment methods include removing and separating aromatics and naphthenes, as well as removing undesirable impurities and undesirable contaminants.

Sweetening compounds and acids are used to desulfurize crude oil before processing, and to treat products during and after processing.

Other treatment methods include crude desalting, chemical sweetening, acid treating, hydro-desulfurizing, solvent refining, caustic washing, hydro treating, dying, solvent extraction, and solvent de-waxing.

* **Formulating and Blending**

Formulating and blending is the process of mixing hydrocarbon fractions, additives and other components to produce finished products with specific desired performance properties.

* **Auxiliary Refining Operations**

Other refining operations which are required to support hydrocarbon processing include light ends recovery; sour water stripping; solid waste; waste water; and process water treatment and cooling; hydrogen production; sulfur recovery; and acid and tail gate treatment. Other process functions are providing catalysts, reagents, steam, air, nitrogen, oxygen, and hydrogen and fuel gases.

* **Refinery Non-Process Facilities**

All refineries have a multitude of facilities, functions, equipment and systems which support the hydrocarbon process operations. Typical support operations are heat and power generation; product movement; tank storage; shipping and handling; flares and relief systems; furnaces and heaters; alarms and sensors; and sampling, testing and inspecting. Non-process facilities include fire-fighting, water and protection systems, noise and pollution controls, laboratories, control rooms, warehouses, maintenance, and administrative facilities.

# Major Products and Crude Oil Refining

Petroleum refining has evolved continuously in response to changing consumer demand for better and different products. The original process requirement was to produce kerosene as a cheaper and better source of fuel for lighting than whale oil. The development of internal combustion engine led to the production of benzene, gasoline and diesel fuels. The evolution of airplanes created a need for high octane aviation gasoline and jet fuel, which is a sophisticated form of the original refinery product, kerosene. Present-day refineries produce a variety of products, including many which are used as cracking processes and lubricant manufacturing, and for the petrochemical industry. These products are broadly classified as fuels, petrochemical feedstock, solvents, process oils, lubricants, and special products such as wax, asphalt, and coke.

* **Fuels**

The principal fuel products are liquefied petroleum gas, gasoline, kerosene, jet fuel, diesel fuel, heating oil, and residual fuel oil.

* + **Liquefied Petroleum Gas (LPG)**

It consists of mixtures of paraffinic and olefinic hydrocarbons, such as propane and butane, is produced for use as a fuel, and is stored and handled as liquids under pressure. T is colorless, and the vapors are heavier than air and extremely flammable.

* + **Gasoline**

The most important refinery product is motor gasoline, a blend of relatively low-boiling hydrocarbon fractions, including reformate, alkylate, aliphatic naphtha (light straight-run naphtha), aromatic naphtha (thermal and catalytic cracked naphtha) and additives. The critical qualities for gasoline are octane number, volatility, and vapor pressure. Aviation gasoline is high-octane product, specially blended to perform well at high altitudes.

* + **Jet fuel and Kerosene**

Kerosene is a mixture of paraffins and naphthenes with usually less than 20% aromatics. It is used for lighting, heating, solvents and blending into diesel fuel. Jet fuel is middle distillate kerosene and is used in aircrafts.

* + **Distillate Fuels**

Diesel fuels and domestic heating oils are light-colored mixtures of paraffins, naphthenes and aromatics, and may contain moderate quantities of olefins. They are often hydro-desulfurized for improved stability. Distillate fuels are combustible and when heated may emit vapors which can form ignitable mixtures with air.

* + **Residual Fuels**

Many ships and commercial and industrial facilities use residual fuels or combinations of residual and distillate fuels, for power, heat and processing. Residual fuels are dark-colored and highly viscous liquid mixtures of large hydrocarbon molecules. The critical specifications for residual fuels are viscosity and low sulfur content.

* **Sour Water**

Sour water is process water which contains hydrogen sulfide, ammonia, phenols, hydrocarbons and low molecular-weight sulfur compounds. Sour water is produced by steam stripping hydrogen sulfide during hydro-treating and hydro-finishing. Sour water is also generated by addition of water to the process of absorbing hydrogen sulfide and ammonia.

* **Some Other Products**
  + Sulfur is produced as a result of petroleum refining. It is stored either as a heated, molten liquid in closed tanks or as solid in outdoor containers
  + Coke is almost pure carbon, with a variety of uses from electrodes to charcoal briquettes, depending on its physical characteristics, which result from the coking process.

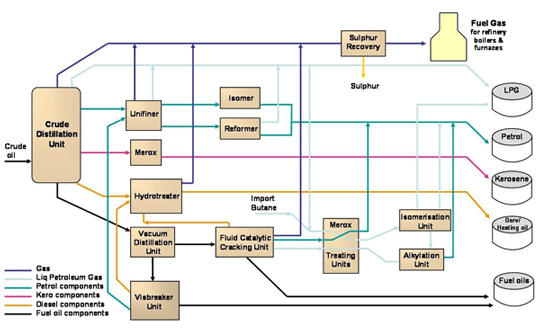
# Overview

# Of

# Process Units

# In

# Petrochemical Refining

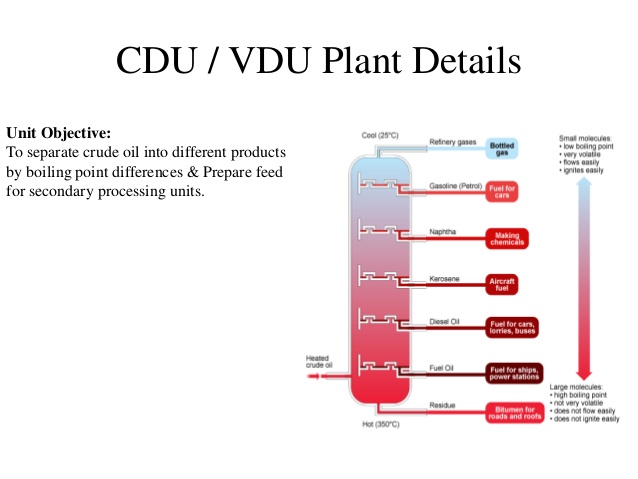


# CDU/ VDU Plant Details

* **Unit Objective**

To separate crude oil into different products by boiling point differences and prepare feed for secondary processing units.

* **Feed Input**
  + Crude Oil
* **Products**
  + LPG to LPG Treater
  + Stabilized Naphtha to NHT/ HGU/ HRU
  + Swing Naphtha to Naphtha Pool
  + Light Kerosene to ATF Merox/ Kero Pool/ DHDT
  + Heavy Kerosene to DHDT/ Kero Pool
  + Light and Heavy Gas Oils to DHDT
  + Light and Heavy Vacuum Gas Oils to VGO-HDT
  + Vacuum Reside to DCU



# Naphtha Hydro-Treating Unit Details

* **Unit Objective**

Naphtha Hydro-Treating Unit is used for the process of Hydro-Treating Naphtha Streams produced from Crude distillation and FCC and DHDT units to produce treated Naphtha containing less than 0.5 wt. ppm (parts per million) sulfur and less than 0.1 wt. ppm Nitrogen.

* **Feed Input**
  + Naphtha Streams from Crude Distillation, FCC, and DHDT
* **Products**
  + Light Naphtha to Isomerization units
  + Heavy Naphtha to CCR Unit Feed

# Naphtha Isomerization Unit Details

* **Unit Objective**

The objective of this unit is to increase the Research Octane Number (RON) of the Hydro-Treated Light Naphtha cut from [NHDT](#_Naphtha_Hydro-Treating_Unit) in order to meet the required target of gasoline pool production.

Isomerate product is the blend of light and heavy isomerate from Deisohexaniser Column.

* **Example**

**CH3- CH2- CH2- CH2- CH2- CH3** (low octane no.) **🡪 CH3-C (CH3)2- CH2- CH3** (high octane no.)

* **Feed Input**
  + Hydro-Treated light Naphtha Cut from [NHDT](#_Naphtha_Hydro-Treating_Unit)
* **Products**
  + Isomerate
  + An off gas stream sent to [CCR](#_Continuous_Catalytic_Reformer) Unit

# Continuous Catalytic Reformer Unit Details

* **Unit Objective**

The Continuous Catalytic Reformer units produces high octane aromatics from paraffins and naphthenes to be used as a High Octane Blending Component.

* **Reforming**

Reforming involves the conversion of low octane paraffinic &naphthenic compounds to aromatics

* **Feed Input**
  + Hydro-Treated Heavy Naphtha cut from [NHDT](#_Naphtha_Hydro-Treating_Unit)
  + Off gas from Isomerization Unit
* **Products**
  + Reformate
  + LPG
  + Hydrogen

# Diesel Hydro-Treatment Unit Details

* **Unit Objective**

The primary objective is to maximize production of diesel to meet the Euro IV specifications.

* **Feed Input**
  + Mixture of LGO/ HGO/ Vacuum Diesel, LKO and HKO, Heavy Naphtha from CDU/ VDU
  + Coker Naphtha, LCGO from DCU
  + LCO from FCC Unit
  + DSO rich stream from the LPG treating Unit
* **Plant Details and Parts**
  + Heater
  + DHDT Reactor
  + Recycle Gas Compressor
  + HP Amine Absorber
  + Make-Up Gas Compressor
  + Naphtha Stabilization
  + Fractionator Column
* **Products**
  + Naphtha (10%) to NHT and Storage
  + Aviation Turbine Fuel/ MTO (6%) to Final Product Blending
  + Diesel (83%) to Final Product Blending

# Delayed Coking Unit (DCU) Details

* **Unit Objective**

Delayed Coking unit is used to convert low value residual products to lighter products of higher value and to produce a coke product.

* **Feed Input**
  + Vacuum Residue from VDU/ VR Tanks
  + VGO HDT Back Flush
  + FCCU Slurry Back Wash
  + Slop Oil from Tank
  + Crude Sludge for Crude Tanks
  + Sludge From ETP
  + Lean Amine
* **Salient Features**
  + Converts Vacuum Residue into fuel gas, LPG, Naphtha, Gas Oil, and Petroleum Coke
  + Satisfies Refinery FG (Fuel) Requirement
  + Converts Fuel Oil to other valued Products LPG, Naphtha, Coker Diesel, Coke in Refinery
  + No Catalyst Cost
  + Low Chemical/ Additive Cost
  + Coke as By-product For Power Plant/ Cement Plant
  + Coker can process Refinery Slops and Sludge
* **Products**
  + Fuel Gas to RFG Header
  + LPG to LPG Treating Unit
  + Rich Amine to ATU
  + LCGO+ Naphtha to DHT
  + Sour Water to SWS
  + HCGO to VGO HT
  + Petroleum Coke

# Vacuum Gas Oil Hydro-Treatment Unit Details

* **Unit Objective**

The primary objective of this unit is to produce Hydro-Treated Vacuum Gas Oil (VGO) having the desired level of Hydrogen, Low Sulfur, and low Nitrogen for the various design feed cases. The Hydro-Treated Vacuum Gas Oil (VGO) serves as the feedstock for the FCC (Petrochemical) Unit.

* **Feed Input**
  + Mixture of Straight Run Vacuum Gas Oil from CDU/ VDU and
  + HCGO from DCU unit
* **Licensor**
  + Axens
* **Detailed Engineering**
  + Engineers India Limited
* **Products**
  + Sweet Gas to PSA for H2
  + LPG to LPG Treating Units
  + Naphtha For Blending
  + Diesel to DHDT
  + Hydro-Treated VGO to FCC Unit

# Fluidized Catalytic Cracking Unit Details

* **Unit Objective**

The Fluidized Catalytic Cracking Unit Petrochemical Complex is a Deep Catalytic Cracking Unit. The main objective of the unit is to convert heavy hydrocarbon (Propane, Propylene, Butane, and Butylene etc.) products. It produces feeds to various units like PPU, MS Block & offsite.

* **Feed Input**
  + Mix of Straight Run Vacuum Gas Oil (VGO)
  + HCGO from CDU/ VDU and DCU
* **Licensor**
  + Stone and Webster
* **Detailed Engineering**
  + Engineers India Limited
* **Products**
  + Propylene to PPU
  + Fuel Gas to FG Treating Unit
  + LPG to LPG Treating Unit
  + LCN/ MCN Naphtha to MS Block
  + LCN/ MCN to MS Blending in off-sites

# Hydrogen Generation Unit (HGU) Details

* **Unit Objective**

The main objective of this unit is to Generate Hydrogen of High Purity required for Hydro-Processing the various units involved in the refinery such as NHT, DHDT, and VGO-HDT, ISOMER, PP and SRU TGT

* **Feed Input**
  + SR Naphtha from NSU
  + DHDT Naphtha from DHDT
* **Licensor**
  + Haldor Topsoe
* **Detailed Engineering**
  + L&T
* **Products**
  + Pure Hydrogen for DHDT, VGO HDT, PPU, SRU, NHT, HRU

# Polypropylene Unit (PPU) Details

* **Unit Objective**

The primary objective of the Polypropylene unit is to produce Polypropylene from propylene molecules.

* **Polypropylene**

Polypropylene is a long chain polymer made from propylene monomers. After exposing the propylene to both heat and pressure with an active catalyst, the propylene monomers combine to form a long chain polymer. Polypropylene is a thermoplastic polymer

* **Feed Input**
  + Propylene from Propylene Recovery Unit of FCCU
  + Propylene Mounted Bullets
* **Licensor**
  + Novolen
* **Detailed Engineering**
  + Engineers India Limited
* **Products**
  + Polypropylene Polymer
* **Uses of Polypropylene**
  + Fibers
  + Automobiles Plastic
  + Wires and Cables, etc.

# SR/ CR LPG Treating Plant Details

* **Unit Objective**

The primary objective of the unit is to remove H2S, Mercaptans and Carbonyl Sulfate (COS) from Straight Run LPG (SR LPG) and Cracked LPG (CR LPG) from CDU and DCU respectively

* **Feed Input**
  + SR LPG Treating Unit
    - SR LPG from [CDU](#_CDU/_VDU_Plant)
    - SR LPG from Vacuum Gas Oil Hydro-Treatment
  + CR LPG Treating Unit
    - CR LPG from [DCU](#_Delayed_Coking_Unit)
* **Products**
  + LPG
  + Auto – LPG

# Sulfur Recovery Unit (SRU) Details

Sulfur Recovery Unit (SRU) Block consists of the following units

* Sour Water Stripper – I and II
* Amine Regeneration Unit
* Sulfur Recovery Unit – I and II

Sour Water Stripper Unit Details

* **Unit Objective**

The primary objective of the unit is to process the Sour Water streams generated in the refinery process unit such as CDU/ VDU, DCU, Flare KOD, ARU, SRU-TGTU, HGU, and DCCU for Single Stage Stripper, Sour Water streams for Vacuum Gas Oil Hydro-Treatment and NHTU for Two Stage Stripper for the removal of H2S and NH3.

* **Licensor**
  + Engineers India Limited
* **Detailed Engineering**
  + Toyo Engineering India Ltd., Mumbai
* **Feed Input**
  + Sour Water Stripper 1 (SWS-I)
    - Sour water from CDU/ VDU
    - Sour water from DCU
    - Sour water from FLARE KOD
    - Sour water from ARU
    - Sour water from TGTU
    - Sour water from FFCU
  + Sour Water Stripper 2 (SWS-II)
    - Sour water from VGO HDT
    - Sour water from DHDT
    - Sour water from NHTU
* **Products**
  + Stripped Water to effluent treatment plant or water to CDU/ VDU, FCCU, DCU.
  + Stripped Water to effluent treatment plant or water to VGO HDT, DHDT, NHTU

Amine Regeneration Unit Details

* **Unit Objective**

The primary objective of the unit is to recover H2S from Rich Methyl Di-Ethanolamine streams received from Vacuum Gas Oil Hydro-Treater (VGO HDT) and Diesel Hydro-Treater (DHDT). Fuel Gas ATU, LPG ATU, and DCU.

* **Licensor**
  + Engineers India Limited
* **Detailed Engineering**
  + Toyo Engineering India Ltd., Mumbai
* **Feed Input**
  + Rich Methyl Di-Ethanolamine (MDEA) solution from Fuel Gas Treating Units, SR/ CR LPG treating Units, VGO HDT, DHDT, and DCU.
* **Products**
  + Lean Methyl Di-Ethanolamine (MDEA) to Refinery Units
  + Add H2S gas feed to Sulfur Recovery Unit – I and II

Sulfur Recovery Unit – I and II Details

* **Unit Objective**

Sulfur recovery refers to the conversion of hydrogen sulfide (H2S) to elemental sulfur.

Hydrogen sulfide is a by-product of processing natural gas and refining high-sulfur crude oils.

There are many sulfur recovery technologies available for different applications, however the most common conversion method used is the Claus process.

Approximately 90 to 95 percent of recovered sulfur is produced by the Claus process. The Claus process typically recovers 95 to 98 percent of the hydrogen sulfide feed-stream.

* **Licensor**
  + Porsenat
* **Detailed Engineering**
  + Toyo Engineering India Ltd., Mumbai
* **Feed Input**
  + Acid Gas (H2S) from Amine Regeneration Unit (ARU)
  + Sour Gas (H2S) from Sour Water Stripper Unit (SWS)
* **Products**
  + Elemental Sulfur

Captive Power Plant Details

* **Unit Objective**

The primary objective of the Captive Power Plant is to meet the total steam and power requirements of the Refinery Complex, besides the internal Requirements of the package.

* **Captive Power Plant Details**
  + 2 nos. Gas Turbine Generators (GTGs) along with Heat Recovery Steam Generators (HRSGs)
  + 3 nos. Steam Turbine Generators (STGs) – 2 Condensing Type and 1 Backpressure Type
  + 4 Nos. Utility Boilers (UBs) – 3W + 1S
  + Pressure Reducing De-Superheaters – For generating HP, MP, LP Steam
  + De-aerator and Condensate Storage Buffer Tank
  + CPP Cooling Tower
  + Chemical Dosing Systems
* **Total Power Generated**
  + 164 MW (including internal consumption of CPP)
* **Total Steam Generated**
  + 900 TPH of Steam
* **Feed/ Fuel**
  + FG, Light Cycle Oil (LCO), HSD for GTG’s and HRSG’s
  + FG, LCO for UB’s
  + DM Water from RO DM Plant

Condensate Polishing Unit Details

* **Unit Objective**

Condensate Polishing Unit (CPU) is a centralized facility for treating the suspect condensate in various process units, received from Refinery Complex, and meet the DM water quality parameters.

CPU Plant is an Integral Part of RO DM plant unit.

* **Major Steps Involved**
  + Feed Condense Cooling

Cooling of suspect condensate in a Heat exchanger to reduce the Condensate Temperature.

* + Adsorption

Removal of oil present in feed condensate by passing the condensate through an archived Carbon Bed

* + Mixed Bed Polishing

Mixed Bed unit has both Strong Acid Cation Resin and Strong Base Anion Resin mixed in a single vessel. Cations/ Anions are removed in Mixed Bed Exchanger in order to achieve the required quality of treated condensate.

* **Plant Capacity**
  + Three (3) Parallel and similar chains, each of net capacity of 75 m­3/ hr.
  + When two (2) chains are under operation and active, the third chain is left idle/ on standby for regeneration
* **Feed Input**
  + Suspect Condensate from Refinery Process Units

Reverse Osmosis/ Demineralization Plant Details

* **Unit Objective**

The Reverse Osmosis Demineralization (RO DM) plant is a centralized facility for producing de-mineralized (DM) water for the Refinery Complex. DM water is required for the following purposes:

* + Boiler Feed Water makeup for generation of Steam
  + Process Water for dilution of chemicals, washing etc.
* **Plant Details**
  + **Pre-Treatment Stage**

Cooling of suspect condensate in a Heat Exchanger to reduce Condensate temperature.

* + **Hardness Removal Unit**

Removal of oil present in Feed Condensate by passing the Condensate through an Activated Carbon Bed

* + **Degasification**
  + **High Efficiency Reverse Osmosis Skid**
  + **Mixed Bed Exchanger**
  + **DM Water Storage and Pumping**
  + **Chemical Handling and Regeneration Facilities**
  + **Sludge Handling Facilities**
  + **Waste Disposal Facilities**
* **Plant Capacity**
  + 850 m3/ hr of DM water generation on continuous basis
* **Feed Water**
  + Cooling Tower Blow Down
  + Treat Effluent from ETP
  + Boiler Blow Down
  + Treated Raw Water

Raw Water Treatment Plant (RWTP) Details

* **Unit Objective**

The primary objective of the Raw Water Treatment Plant (RWTP) is to produce filtered and treated water to meet the requirements of

* + Cooling Water Make-Up
  + DM Plant Feed
  + Drinking Water
  + Service Water
* **Plant Details**
  + **Raw Water Reservoir**

11, 00,000 m3 of reservoir corresponds to 14 days of normal demand

* + **Aeration Tank**
  + **Rapid Gravity Sand Filters**
  + **Filtered Water Reservoir**
  + **Pre and Post Chlorination System**
  + **Cooling water make-up, Service water, Drinking Water PUMPS**
  + **Chemical handling and Regeneration Facilities**
  + **Sludge Handling Facilities**
  + **Waste Disposal Facilities**
* **Plant Capacity**
  + Total Design capacity of 5400 m3/ hr.
  + Comprises of two chains, each of 2700 m3/ hr design capacity
* **Feed Water**
  + Raw water from Raw Water Reservoir

# Effluent Treatment Plant (ETP) Details

* **Plant Objective**

The Effluent Treatment Plant (ETP) is responsible for the treatment of effluent water received from the various units in refinery and produce treated water for the reuse in Refinery.

* **Plant Details**

Following treatments are done to the effluent water in ETP

* + **Physical Treatment**
    - API, CPI, DAF, Clarifier, RO, UF, DMF, ACF, etc.
  + **Chemical Treatment**
    - H2O2, Cationic and Anionic Coagulant, Flocculent and other polymers.
    - Acid, Alkali, Chlorine, Biocides and their alternatives etc.
  + **Biological Treatment**
    - Activated Sludge Process, SBR, MBR
  + **Spent Caustic Treatment**
  + **VOC Treatment**

# Flare System Details

* **Plant Objective**

The flare system is provided for the safe disposal of combustible, toxic gases, which are relieved from the process plants and the off-sites during start-up, shutdown, normal operations, or in case of an emergency such as

* + Cooling Water failure
  + General Power Failure
  + External Fire Case
  + Any other Operational Failure
  + Blocked Outlet
  + Reflux Failure
  + Local Power Failure
  + Tube Rupture, etc.
* **Plant Details**

The refinery complex has two flare systems installed, one for Hydrocarbon flare for process units and off-site handling hydrocarbons, and the other for the sulfur block handling sour flare

* + HC HP Flare Header
    - Maximum allowable back pressure of 5.3 Kg/ cm2g at unit battery level
  + HC LP Flare Header
    - Maximum allowable back pressure of 1.4 Kg/ cm2g at unit battery level
  + Sour Flare Header
  + Hydrocarbon Flare Knock Out Drum
  + Sour Flare Knock Out Drum
  + Flare Stack
  + Pilot Ignition System

# Fire Water System Details

* **Unit Objective**

The primary objective of the Fire Water System is to fight two major fires simultaneously in the refinery complex

* **System Details**
  + 11 no. of main Fire Water Pumps of capacity 1000 m3/ hr each
  + 7 Pumps working, 4 pumps Standby
  + 5 Electric Driven Pumps, 6 Diesel Driven Pumps
  + 4 Nos. of Jockey Pumps, 2W + 2S
  + Fire Water reservoir Storage capacity is 50, 000 m3, adequate for 6 hours of fire water storage
  + Fire Water Distribution network in closed loop
  + Designed for a minimum residual pressure of 7.0 Kg/ cm2g at the remotest point of complex

# Cooling Water System Details

* **Unit Objective**

The primary objective of the Cooling Water System is to cater to the cooling water demand of the refinery complex

* **System Details**
  + Refinery Circulating cooling water system
  + FCCU recirculating cooling water system
  + Cooling water pumps
  + Chlorination system
  + Side Stream Filters

* **Design Capacity**
  + Total Capacity is 80, 000 m3/ hr

# Nitrogen and Instrument Air System Details

* **Unit Objective**

The Cryogenic Nitrogen Plant consists of LP, HP air compressors which supply Plant Air, Instrument Air, and Gaseous Nitrogen to meet the demand of various consumers in the refinery complex. High purity nitrogen is required by various consumers for purging, blanketing, inerting, and catalyst regeneration etc.

* **System Details**
  + Main Air Compressors, HP Air Compressor
  + Refrigeration Compressors
  + Air Purification Vessels\
  + Main Heat Exchanger
  + MP Column
  + Expansion Turbine
  + LIN Storage Vessels
  + Instrument Air Driers and Instrument Air Storage buffer vessels

* **Design Capacity**
  + 7, 500 Nm3/ hr (GAN) and 475 Nm3/ hr (LIN)

# Overview

# Of

# ERP Software

# \*SAP\*

# 

# Abstract

The Enterprise Resource Planning (ERP) software used is SAP. Enterprise Resource Planning (ERP) is a software solution that addresses the enterprise needs, taking in account the process view of an organization to meet the organizational goals tightly integrating all functions of an enterprise.

Enterprise Resource Planning (ERP) can be viewed as a business management system that integrates all the facets of a business, including planning, manufacturing, sales, and marketing. ERP had its origins in manufacturing and production planning. In the mid – 90’s it was extended to other back-office functions such as financial management and human resource management. More recently these systems have addressed applications specific to higher education such as student systems and grants management.

SAP is an Enterprise Resource Planning (ERP) software product capable of integrating multiple business applications, with each application representing a specific business area. These applications update and process transactions in a real time scenario.

This report covers the FIORI, and the development module in SAP for a new enterprise. The customizations include the customization of the Master Data as well as the Transaction Data. After this, enterprise would be ready to run and implement the SAP Fiori layer integration to the company infrastructure.

# Evolution of ERP

Automation was a magic word in the early 90’s. The focus then shifted to computers and the trends were to replace the human power with the microprocessor power, pink slip the employee and hopefully expect that the costs and the faults will come down. From then onwards, automation was considered the panacea of all ills of business. But, then there was much that was wrong with this approach. As these automation packages used to come in different forms and in a non-integrated fashion, loading too much Information Technology (IT) on to the in-efficient processes and packages that leads to double entendre.

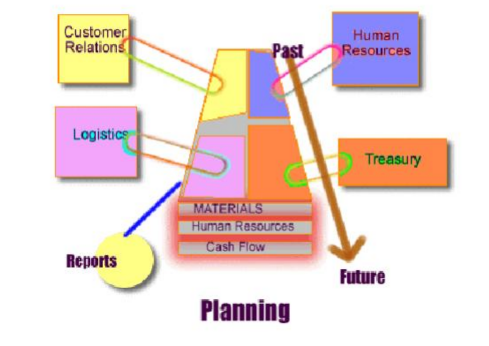
Actually, the confusion raised due to the fact that companies developed separate computer applications to satisfy the needs of their particular functional segment, e.g. Accounts, Purchase, Inventory, and Planning. Such systems grew as inconsistent islands of information and hence their consolidation was not possible which lead to numerous organizational problems and data inconsistencies to occur. As a result the decision makers were denied of access to timely information for making urgent business decisions. This gave rise to the need of an integrated system (ERP) that would address the information requirements of the entire enterprise



# Scope of ERP

The various areas that can be covered under the concept of Enterprise Resource Planning (ERP) are discussed below:

* **Customer Relations**
  + Sales Support
  + Delivery
  + Billing
  + Credit
* **Logistics**
  + Procurement
  + Production
  + Materials Management
* **Human Resources**
  + Commitments
  + Investments
  + Currencies



Advantages of using an ERP Solution

And ERP software is an Integrated, Uniform, Relevant, and up-to-date information is vital for the existence of the enterprise. ERP brings together people who work on share tasks within the same enterprise. Some of the tangible benefits of an Enterprise Resource Planning system are

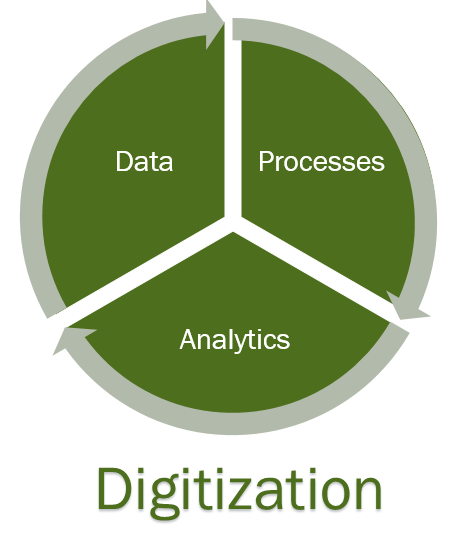
* Reduction of Lead Time by 60%
* 99% on-time Shipments
* Doubled Business
* Increase of inventory turns to over 30%
* Manufacturing of a single product time reduced by 80%
* Better Customer Satisfaction
* Improved Vendor Performance
* Increased Flexibility
* Reduced Quality Cost
* Improved Workflow and Efficiency
* Improved Access to Information

# Overview

# Of

# IAS Software

# \*Meridium APM\*



# HMEL Assets

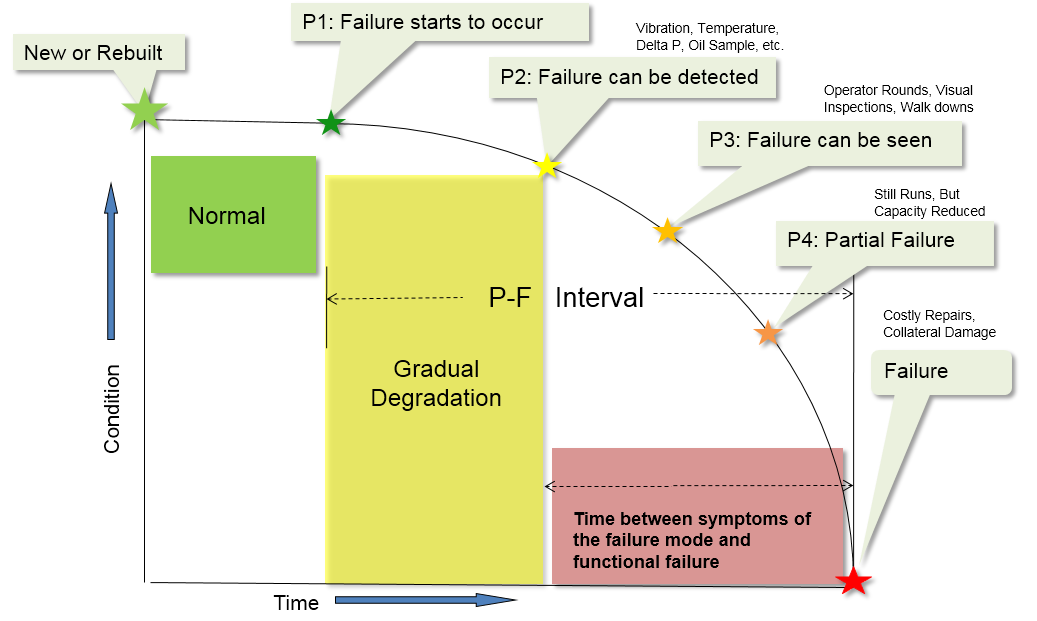
* **Total Population of Mechanical Rotating Equipment Assets is around 3000.**
* **Total Population of Electrical Equipment Assets is around 6900.**
* **Total Population of Instrument Equipment Assets is around 28000.**

# Scenario: Reliability Management at HMEL

* **After commissioning of refinery, Preventive maintenance strategies were adopted based on OEM guidelines as there was no equipment running history available till 2012.**
* **In house criticality analysis was carried out in-house during stabilization phase till 2013. The maintenance strategies were redefined.**
* **2014 onwards, Dedicated cross functional reliability team, IRRR – Integrated reliability risk register, RCA process development (What went wrong).**
* **2015 onwards, Systems maturity and benchmarking, utilization of reliability tools such as FMEA – Failure modes & Effect analysis (What can go wrong), LLFS – Look Listen Feel Smell, drafting of Maintenance & Reliability KPIs. The system was MS Excel based.**
* **2016 onwards, Benchmarking reliability Key performance indicators, Turnaround planning for super-critical equipment.**
* **2017 onwards, Asset Performance Management System kick-off, (for integration (digital) of all available independent maintenance practices tool). Turnaround execution and designing asset performance solution as per HMEL requirements to achieve maintenance excellence.**

# Scenario: Maintenance Management at HMEL

* **2018: Perform advanced predictive analytics by pattern recognition of behavior and trends (budget approved for pilot project). - E.g. product like smart signal.**
* **2019/ 2020: Artificial Intelligence Product such as digital twins to perform virtual analytics (Process). Still under development. (Saudi Aramco working with solution provider on similar project).**
* **2021: Matured Asset Management program at HMEL site: equipment health data is fully in digital form at single platform along with matured maintenance strategies, enjoying the benefits of APM & smart assets.**



# Asset Performance Management

The APM solution is a digital platform and single solution with inbuilt workflow to perform multiple activities for optimization of maintenance strategies resulting into lower maintenance cost, increased refinery reliability & availability and decreased unplanned downtime over a period of time.

APM process is complaint ISO 55000 asset management framework for providing closed cycle loop and is applicable on all types of equipment.

**Note: ISO-55000 is a standard for Asset Performance Management.**

**Why GE – Meridium?**

It has maximum data base and presence in globally in reliability solutions. Mainly oil and gas sector. (Shell, Chevron, Exxon Mobil, BP, RIL, ESSAR, BPCL)

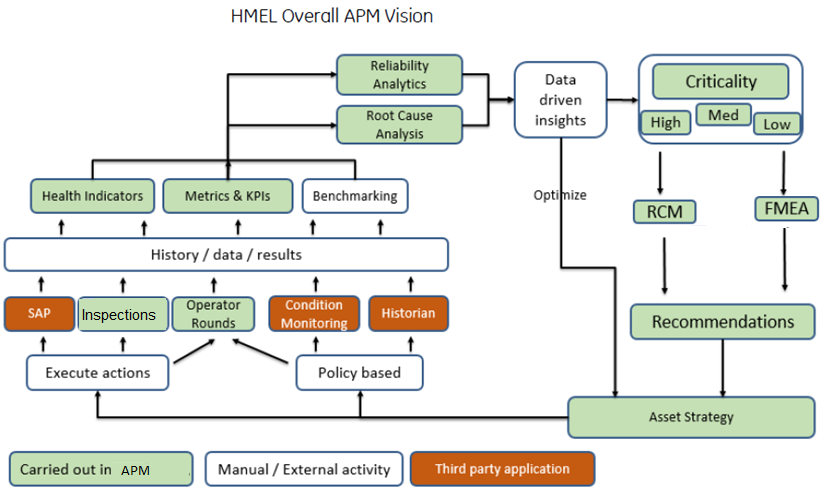
Development and integration of various equipment monitoring techniques at single platform, health indication of all refinery equipment at single location. Subsequent SAP recommendation generation based on analysis of integrated data from ODR/LLF rounds, FMEA, offline vibration monitoring, System 1 and Process Historian.

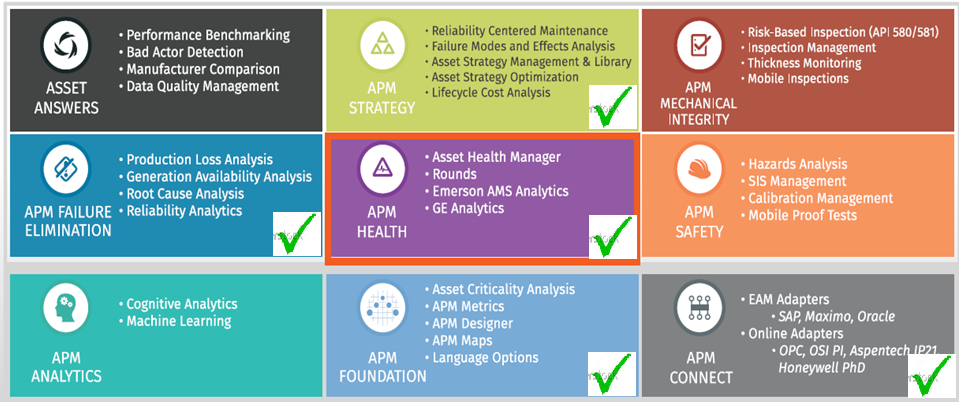
Optimization of preventive/predictive maintenance & job planning strategies based on collective recommendation data of an equipment at single location but from various sources resulting into optimization of asset’s performance.

Asset performance management (APM) aims to make refinery operations safer and more reliable. APM methodology helps building intelligent asset strategies that balances;

**Cost, Availability, Reliability, Operational Efficiency, Manage risks**

# APM Infrastructure

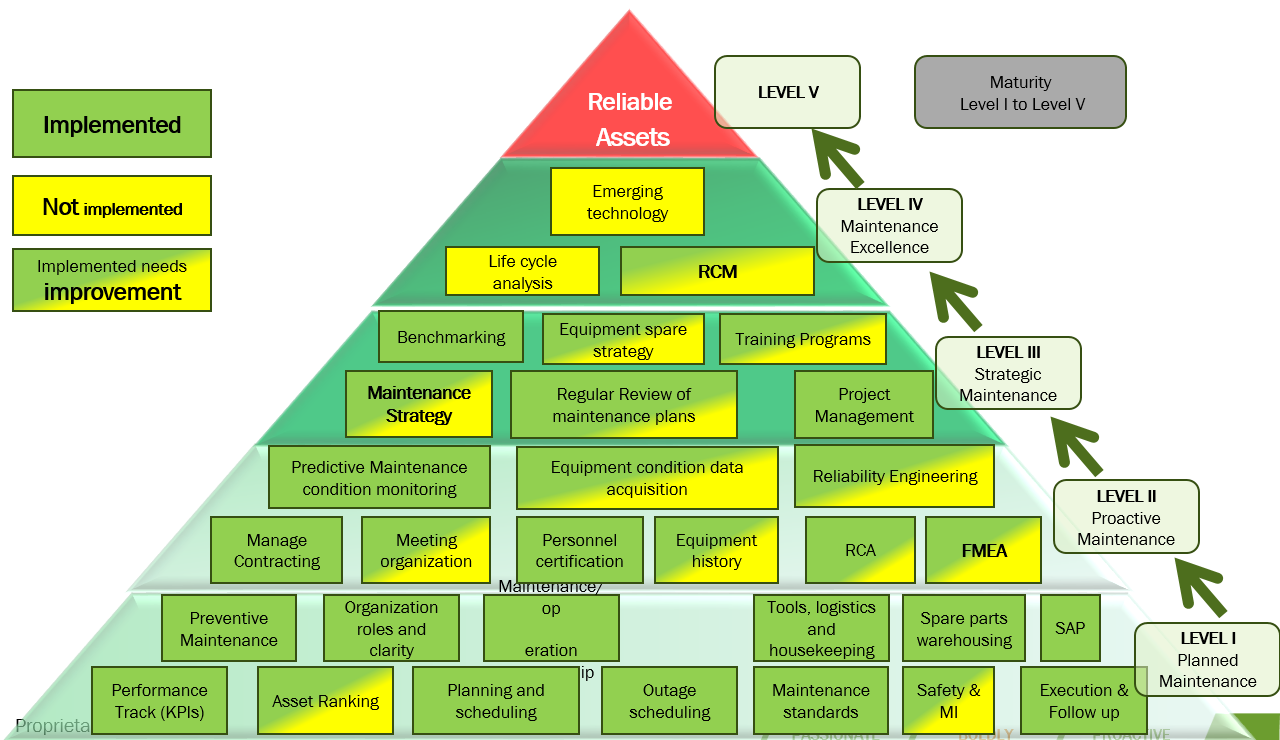




# Benefits of APM

* Improved personnel efficiency and productivity by recording LLF data and PM data through hand held electronic devices.
* Optimized preventive, predictive and corrective maintenance cost by evaluating effectiveness of PM, PDM tasks and their frequencies based on scientific method (advanced analytics).
* Minimized cost to repair by early identification of failure symptoms by Integration of all predictive maintenance platforms at single platform to monitor overall asset health.
* Optimized PM and PDM frequency by performing RCM/FMEA at higher APM maturity Level.
* Increased plant availability by converting unplanned downtimes days to planned downtimes reduced days.
* Presence of Google’s Development Team
  + Google has various strength in digital world. But has not represented yet in Core industrial reliability solutions (Oil & Gas).
  + Currently its strength is Big Data analytics, Setting (Industrial internet of things) IIOT platform, artificial intelligence in fields other than Oil & gas.
  + Google is also working in managing smart cities using big data analysis.

# Processes and their Respective Maturity Levels



**There are 5 levels defined to organize the processes into different Maintenance Schedules**

* **Level 1 (PLANNED Maintenance)**

Processes at the above mentioned maturity level follow a pre-defined schedule for the maintenance of their respective processes. These are pre-defined routines set up for each particular process.

* **Level 2 (Proactive Maintenance)**

Proactive maintenance is the maintenance philosophy that supplants “failure reactive” with “failure proactive” by activities that avoid the underlying conditions that lead to machine faults and degradation.

Unlike predictive or preventive maintenance, proactive maintenance commissions corrective actions aimed at failure root causes, not failure symptoms.

Its central theme is to extend the life of machinery as opposed to

1. Making repairs when often nothing is wrong
2. Accommodating failure as routine or normal
3. Detecting impending failure conditions followed by remediation.

Proactive maintenance depends on rigorous machine inspection and condition monitoring.

In mechanical machinery it seeks to detect and eradicate failure root causes such as wrong lubricant, degraded lubricant, contaminated lubricant, botched repair, misalignment, unbalance, and operator error.

* **Level 3 (Strategic Maintenance)**

Strategic Maintenance Planning deals with the concepts, principles and techniques of preventive maintenance, and shows how the complexity of maintenance strategic planning can be resolved by a systematic ‘Top-Down-Bottom-Up’ approach.

It explains how to establish objectives for physical assets and maintenance resources, and how to formulate an appropriate life plan for plant.

It then shows how to use the life plans to formulate a preventive maintenance schedule for the plant as a whole, along with a maintenance organization and a budget to ensure that maintenance work can be resourced.

* **Level 4 (Maintenance Excellence)**

Maintenance excellence is a framework for a challenging and critical review of the integrity and productivity of any business process or project.

Through Maintenance Excellence, any company seeks to provide a high quality process that supports continuous improvement focusing on various areas such as strategy, employees, information, work and other business aspects of maintenance.

* **Level 5 (Reliable Assets)**

The final layer corresponds to the completely reliable assets that are deployed and are bound to function smoothly without any abrupt failures.

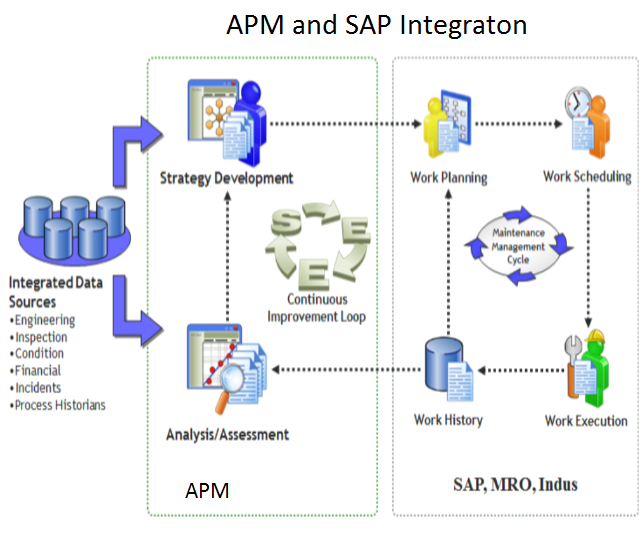
# APM Processes

Data from all the individual platform shall be integrated for equipment health analysis at single platform (APM). Data from available online sources **(Emerson, GE system1, Honeywell, MES, and SAP & ODR)** shall be integrated to APM and LLF/Operator round data shall be captured by ODR Tablets.

Maintenance Processes such as Criticality/ RCM/ FMEA/ /asset strategy builder/Metrics & Scorecards shall be carried through APM platform.

Reliability analytics tools such as efficiency calculation, logics implementation, failure distribution, graphs, reliability growth, and probability distribution analysis shall be carried through APM platform.

**ODR-** Operator Driven reliability (ODR) Tablet is a hand held electronic device that provides a platform to drive reliability from field.



# APM Modules

* **Asset Criticality Analysis (ACA)**

APM contains its separate risk matrix to define equipment criticality based on safety, environmental, operational and financial impacts. Same criticality shall be superimposed on the existing equipment criticality.

* **Core Analysis and Data Integration**

APM can be integrated with following different platforms

* + SAP - To capture work history
  + GE system1 - Online Vibration/Temperature Healthiness
  + Emerson - Offline vibration
  + Honeywell PHD - Process data

This integrated data can be used to create Logics to prompt changes in calculated parameters on continuous basis. Data can also be used to create graphs for further analysis of monitoring parameter, SAP history etc.

* **Key Performance Indicator (KPI)**

APM can track all the KPI's (due to availability all the work history data), and can be converted into corresponding online trends, and be further communicated and used for improved and efficient decision making.

* **Policy**

APM Policy is used to define logic based maintenance plans.

For example:

Compressor Efficiency, Exchanger Efficiency, Overloading Scenarios can be captured by APM and subsequently recommendation/ email can be raised.

* **Reliability Centered Maintenance (RCM)**

The APM RCM process promotes a thorough understanding of the functions of a system and focuses on ways to ensure that those functions are not compromised.

In an RCM analysis, failure of one or more system components may be acceptable, provided that the function of the system is maintained.

By focusing on system functions, the APM RCM capability facilitates the development of strategies that will reduce the effects of functional failures, which may have a more significant impact on production cost.

* **Failure Mode Effect Analysis (FMEA)**

APM FMEA analyst forms team, identifies failures and effects for each piece of equipment and then recommends actions to mitigate those failures.

Unlike an RCM analysis, which focuses on preventing functional failures at the system level, the FMEA capability facilitates the identification and mitigation of the most critical failure modes defined at the equipment level.

* **Asset Strategy Implementation (ASI)**

The reliability team is the owner of the maintenance plan which includes all 5 level of process maturity and the mid/ long-term improvement of the maintenance plan and maintenance practices.

APM provides advanced analytical platform to study time to failure and data gives outcome such reliability growth, probability distribution, cumulative distribution.

* **Life Cycle Analysis (LCA)**

APM Lifecycle Cost Analysis capability enables strategy maintenance costs to be viewed from the perspective of the total cost of ownership of the assets. By contributing to decisions when to repair versus when to replace, intelligent asset strategies can be optimized over the long term.

* **Asset Health Manager (AHM)**

AHM provides the ability to responds to emerging trends and initiate action to respond to the warnings and alarms through Recommendation Management.

For any warning, alarm, or trend, a recommendation can be initiated for follow-up action for corrective work or changes to strategies in the form of planned work, procedures and/or policies. AHM is fully integrated with all the platform and health index can be mapped.

* **Rounds**

Accurate and timely asset condition assessment enables operations visibility, preventing failures and reducing disruptive unplanned downtime. Rounds puts the power of APM software in the hands of field personnel through a mobile

Application that lets them execute aspects of the asset strategy by monitoring asset performance and capturing condition data electronically in the field.

* **Reliability Analytics**

Understanding the historical costs, failure frequencies, and trends of production assets is a critical component of any comprehensive APM program.

With a clear understanding of poorly performing equipment, where improvement opportunities exist, and the impact of design changes, asset owners can implement the most effective strategies and designs to optimize utilization and costs

* **Reliability Distributions**

Reliability Distributions (Weibull, Exponential, Lognormal, and Normal) provide an understanding of current failure patterns and expected life using relatively small datasets.

Reliability Distributions can also be used to optimize preventive maintenance (PM) intervals and accurately forecast future failures.

* **System Reliability Analysis**

APM allows to understand the future reliability of assets given the historical values that have been calculated in the Reliability Growth and/or Reliability

Distribution analyses.

What-if scenarios can also be used to compare changes in asset configurations, changes in the maintenance strategy, or changes in reliability

* **Recommendation Management**

APM provides a centralized area to track all recommendations, as well as the ability to send e-mail reminders when recommendations are overdue. APM recommendation management features ensure that corrective actions from the analysis are implemented.

* **Smart Reliability and Maintenance Management**

Smart reliability refers to the application of machine learning tasks and processes to formulate a reliability and maintenance plan for the various equipments based on their previous failure data and reasons.

A Meta data is generated for each equipment analyzed through various machine learning algorithms for the predictive analysis.

Each pattern that is recognized is taken into consideration. Multiple attributes are generated by the various real time scenarios. The correlated attributes are then groped together to form the basis of machine learning algorithms.

* + Artificial Intelligence based
  + Software based modeling of equipment using advanced pattern recognition
  + Uses historical data to describe how a piece of equipment normally operates and build a model
  + Continuously monitors behavior in real-time
  + Alerts when the operation differs from the historical norm
  + Early warning detection of equipment problems
  + Advanced analysis capabilities including problem identification and root cause analysis

# Operator Driven Reliability (ODR)

Operator Driven Reliability (ODR) is an asset management program that involves operators in the maintenance reliability of their assets. This concept has been an integral part of an overall proactive maintenance strategy, yet many modern industrial facilities have been hesitant. The objectives of the ODR program are to increase asset availability, eliminating causes of asset defects and waste, only that it will be the operators doing the maintenance. In simple words, it is to transfer basic preventive maintenance tasks on the assets from the maintenance team to the operators who use the assets. This saves time and resources for the maintenance team to concentrate on higher and more complex maintenance activities.

**I can suggest 2 definite advantages** of implementing an ODR in the workplace after spending time with it.

The first will be that implementing an ODR in the workplace means **involving the operators in the maintenance process**. This in turn frees up resources for the maintenance technicians to concentrate on higher level of predictive maintenance.

Secondly, these operators spend a great deal of time with these equipment and as such **know of the equipment’s activities better than anyone else**. This makes the operators highly valuable in the maintenance chain. Preventive maintenance will be much easier and cheaper if the operators are able to head off problems before they occur with basic maintenance activities. The idea is to find and assign task that creates less downtime for the operators to perform than if a maintenance technician was required to carry out the task.

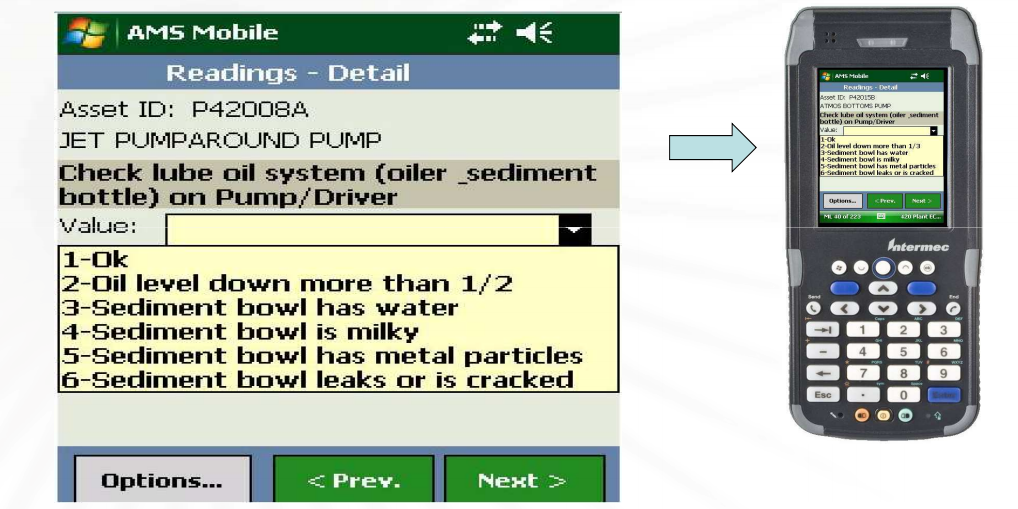
When the operators begin to take care of equipment even before they run into failure such as checking for plugged lines, leaks and noises, oil filling, screwing nuts, and general eliminating of defects, the cost of downtime will fall, production will increase which totals to more profits. When operators carry the “flags” for reliability, breakdowns are seriously minimized.

In short, Operator Driven Reliability (ODR) is an asset management program that provides a platform for maintenance, and operators to drive the reliability from the field.

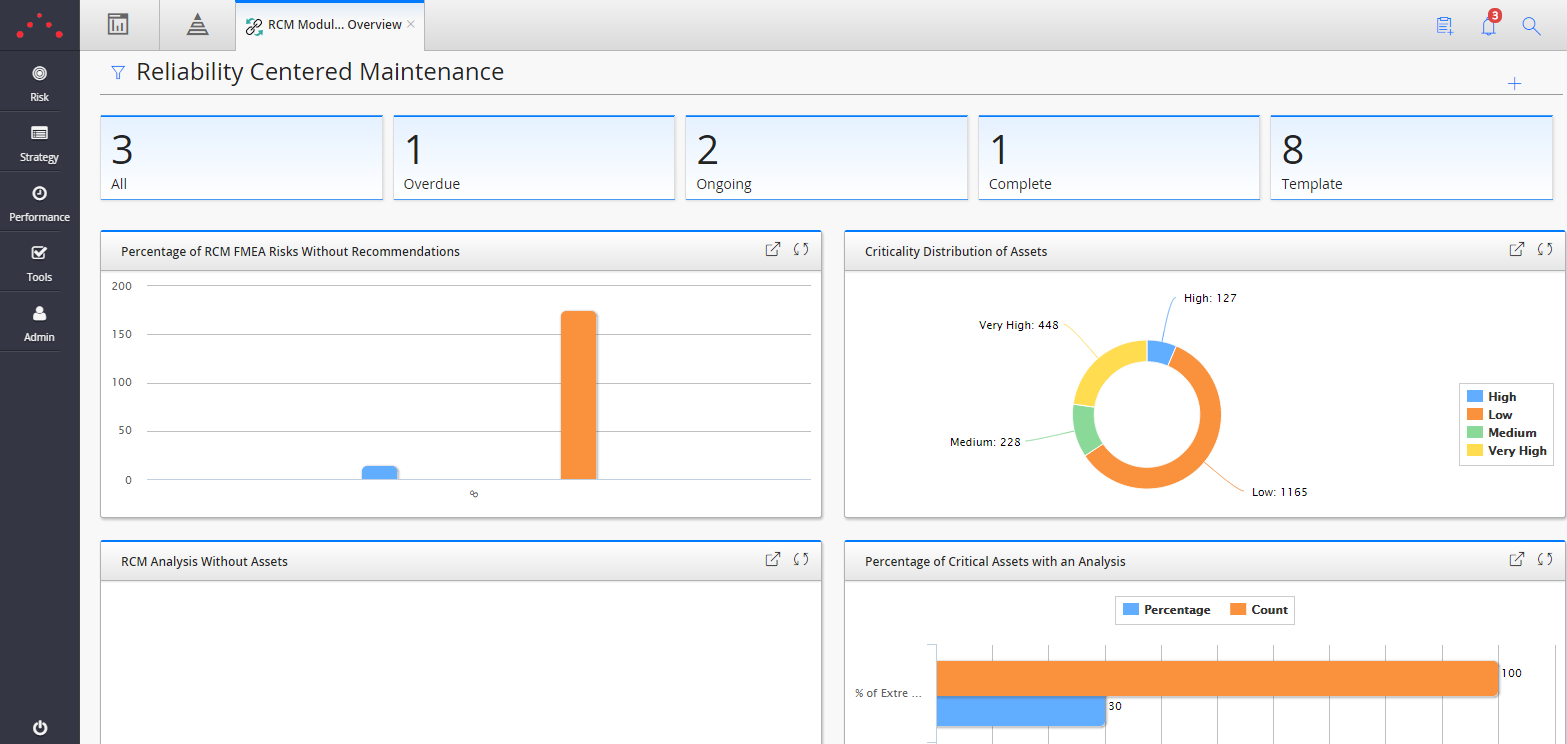
ODR is a handheld device that can be utilized in the field and will be used to capture all the Line Loss Factors (LLFs) and the complete Round Data.

**Benefits**

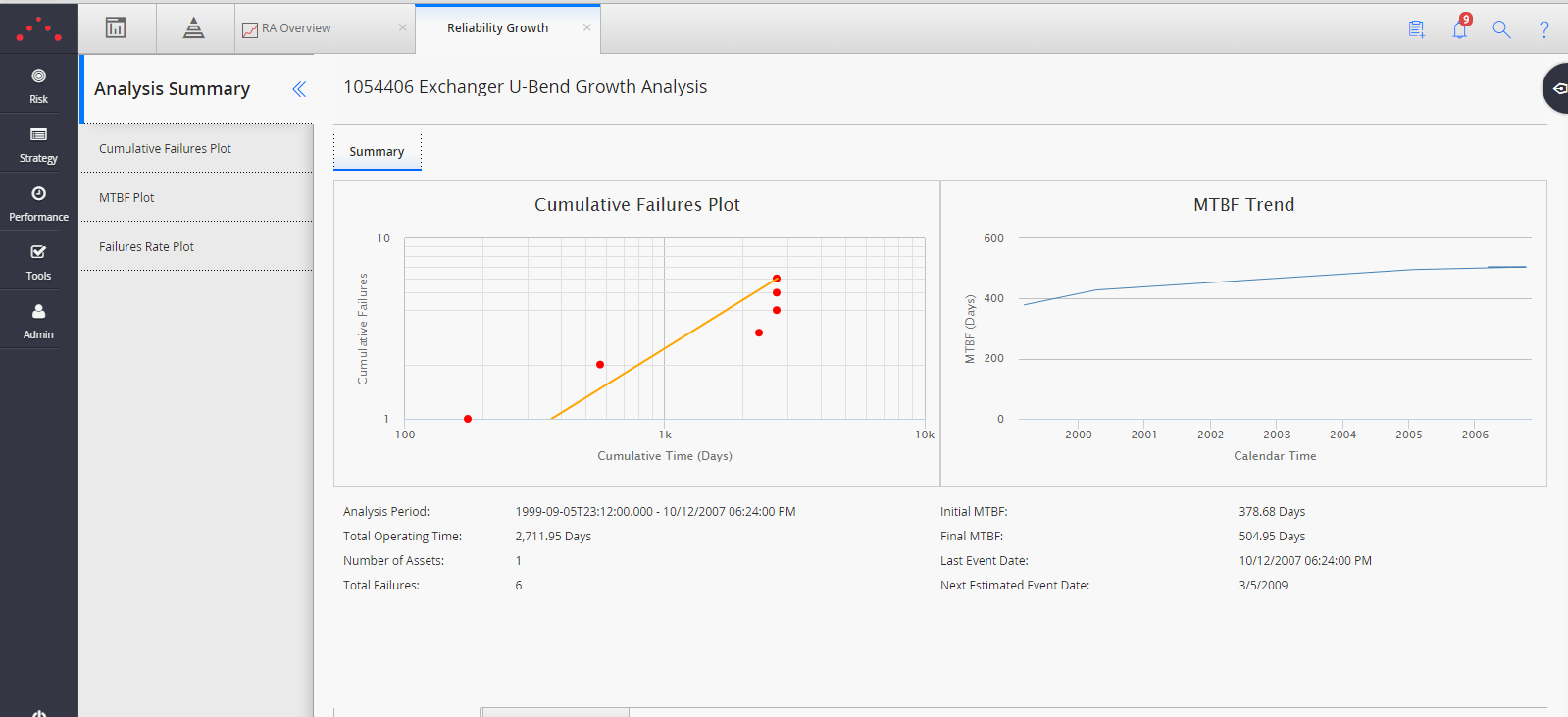
* Problematic equipment can be readily identified.
* Problems repeatable in nature gets caught.
* Increase Asset Availability and Reliability.
* Convert data into Useful information.
* Historical Trending and Analysis.



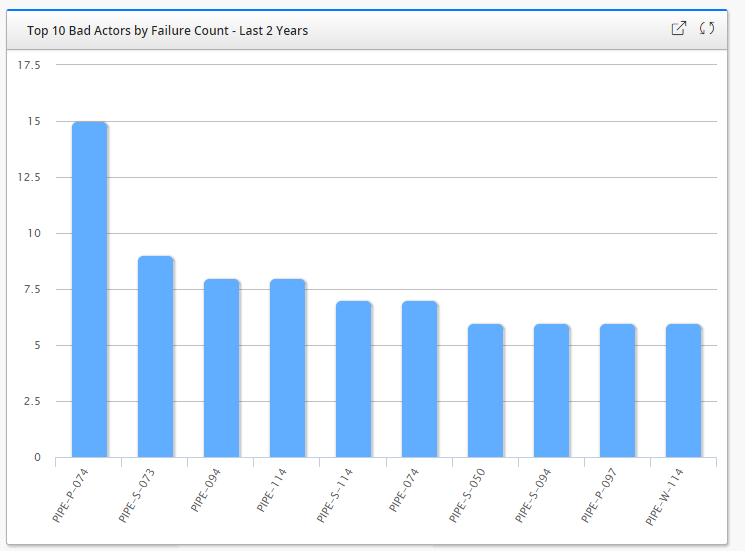
# Dashboards



**Reliability Centered Maintenance (RCM)**

****

**Reliability Analytics**

****

Equipment Tag

No. of Failures in last 2 years

**Example of Analysis**

***Integrated view of asset data will be used to identify top 10 bad actors***

# Roles of Various Departments in APM

**Mechanical Aspects of APM**

* Maintenance Rounds using ODR Tablets
* Maintenance Plans using FMEA
* Maintenance Plans using RCM
* Assess Health of Equipment through Health Manager
* Perform recommendation through APM

**Electronics and Instrumentation Aspects of APM**

* Electrical & Instrument Rounds using ODR Tablets
* Electrical & Instrument Plans using FMEA
* Electrical & Instrument Plans using RCM
* Assess Health of Equipment through Health Manager
* Perform recommendation through APM

**Operations Aspects of APM**

* Operator Rounds using ODR Tablets
* Prepare Operation strategy of Equipment using RCM/FMEA
* Assess Health of Equipment through Health Manager
* Perform recommendation through APM

# Integration

# Of

# MES and ERP software

# Industry 4.0



# Industry 4.0: Harnessing the Power of ERP and MES Integration

***“By integrating ERP and manufacturing data for more accurate demand forecasts, companies can reduce inventories by avoiding overproduction.”***

- Yuval Lavi, VP, technology & innovation, Magic Software | Jul 20, 2017

In today’s competitive global markets, having a lean manufacturing process is more important than ever. Sharing information between the manufacturing floor and business systems can enable manufacturers to achieve new levels of efficiency. With the industrial Internet of Things (IoT) revolutionizing manufacturing by leveraging intelligent, connected devices in factories, there are even more opportunities to fine-tune operations with better data and process integration.

In a recent survey by Accenture of more than 1,400 global business leaders, 84% confidently asserted that they could create new income streams from implementing IoT solutions. BI Intelligence expects the installed base of manufacturing IoT devices to swell from 237 million in 2015 to 923 million in 2020. By that year, manufacturers will spend approximately $267 billion on the IoT.

Indeed, the anticipated efficiency returns from digitization over the next five years across all major industrial sectors are substantial: nearly 3% in additional revenue and 3.6% in reduced costs per year, according to a recent PwC survey. By proactively leading the digitization effort, industrial manufacturers can earn a growing portion of these gains.

Since enterprise resource planning (ERP) systems contain information regarding inventory and customer demand, and manufacturing execution systems (MES) control how to build it, integrating the two worlds could help increase operational efficiency and enable organizations to become more flexible and more responsive to customized and changing demands. In addition, real-time information exchange between the business layer and the production layer could help increase overall equipment efficiency (OEE), reduce cycle times, and provide management with greater visibility for improved decision-making.

**Six ways integrating ERP with MES can help make Manufacturing Leaner:**

1. **Real-time Production Adjustments**

Demand changes that are recorded in ERP systems can be fed into manufacturing schedules to ensure quantities of products manufactured are more closely aligned with demand for leaner and more efficient manufacturing.

Most shop-floor machinery is now powered by embedded sensors and control mechanisms. Wireless sensor and actuator networks (WSAN) provide servo and motor control via IoT along with traditional computer numerical control (CNC) methods that allow for in-progress production adjustments on the factory floor.

RFID tags, which have been used to help connect partners and move goods from a logistics and supply chain management perspective across organizational boundaries, can also be used on the factory floor in order to track work-in-progress materials, route those materials efficiently, enable parts requirements, handle JIT replenishments, and manage the availability and utilization of assets.

When coupled with other data regarding materials as they flow through the factory and eventually to customers, RFID tags and other tracking mechanisms can provide plant operators with insights that enable them to efficiently process raw materials, right through to the finished product.

1. **Accurate Demand Forecasts**

Underestimating demand means running out of product when customer demand is at its highest, reducing a company’s revenues while hurting customer relationships.

Insufficient inventory or stock outs are detrimental to both short- and long-term revenues since delays in delivery schedules can tarnish a company’s perceived reliability and long-term customer relationships.

Overestimating demand means companies have to invest upfront in a lot of extra inventory, which then can’t be quickly turned around into a profit. Excess inventory—whether raw materials, work-in-progress, or finished goods—ties up cash in the business that can be put to better use elsewhere.

With inventory typically comprising between 25% and 40% of assets, demand uncertainty is often the single largest influence on stock levels.

By integrating ERP and manufacturing data for more accurate demand forecasts, companies can *reduce inventories by avoiding overproduction*

1. **Just In Time Delivery (JIT Delivery)**

Just-in-time (JIT) delivery and the surgical precision it requires have been around for quite some time, but now that supply chains are becoming increasingly intertwined with the Internet of Things, brands have a very large untapped opportunity to use the data.

Supply chain managers can track inbound and outbound inventory with incredible detail, and that visibility allows brands to react immediately to changes.

ERP schedules can be more realistic by incorporating quicker production times based on the latest improvements on the shop floor.

Wireless sensor networks provide data that impact just-in-time schedules, such as work-in-progress, parts inventory, and more.

Likewise, any downtime due to damaged or defective equipment can be reported to the ERP system to push back delivery dates, if necessary.

Even in transit, sensors on containers or trucks deliver real-time insights to products across the supply chain.

1. **Avoid Rush Orders**

By integrating ERP and MES, manufacturers are able to reorder from suppliers before inventory falls below a set level.

Satisfying customers by delivering demands at an agreed time can lead to customers’ trust in a company’s competence.

Rush orders are one of the main types of supply chain risks because of their negative impact on the overall performance.

Avoiding rush orders not only minimizes the possibility of production delays, it also prevents additional charges incurred by ordering materials at the last minute and by requesting expedited deliveries.

1. **Seamless Change Orders**

Better system integration supports more efficient execution of change orders.

Any product changes requested by customers need to be transferred to production systems as soon as possible to avoid delays in fulfilling orders.

Likewise, new manufacturing processes that impact production times and expenses need to be shared immediately with enterprise systems so that any pricing or product delivery information can be updated.

1. **IoT Equals Quality**

Manufacturing execution systems (MES) help streamline factory-floor operations by managing and monitoring all work-in-progress, including providing real-time visibility, and enabling traceability of both materials and products throughout their lifecycles, facilitating corrective actions for defective products.

If there is a quality issue on the floor, real-time notification to the business systems via IoT sensor networks can be made to trigger necessary corrective actions via real-time events and scheduled tasks.