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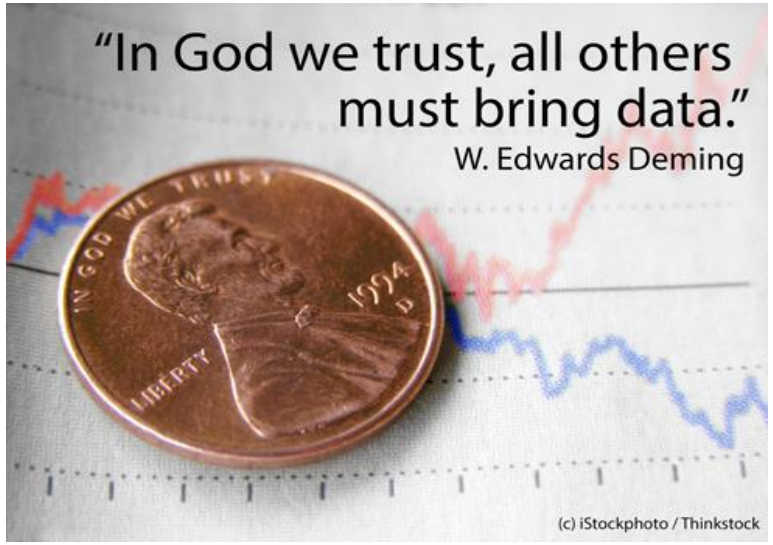
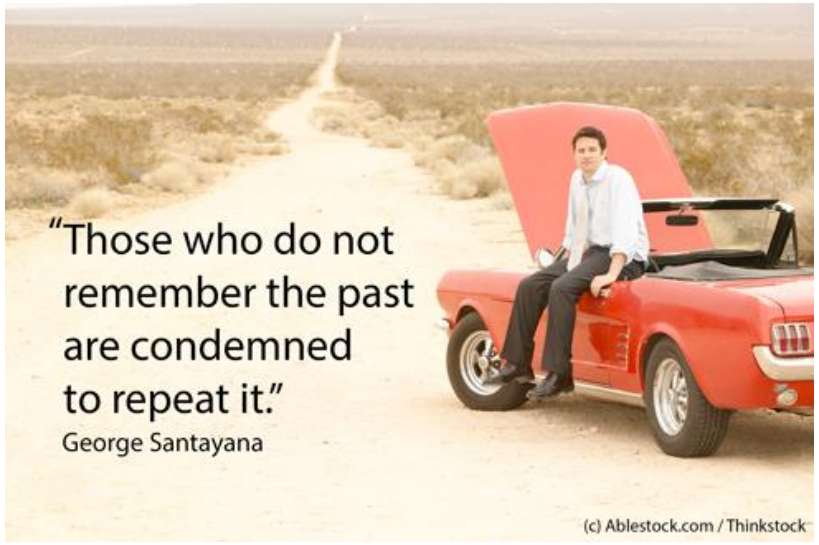
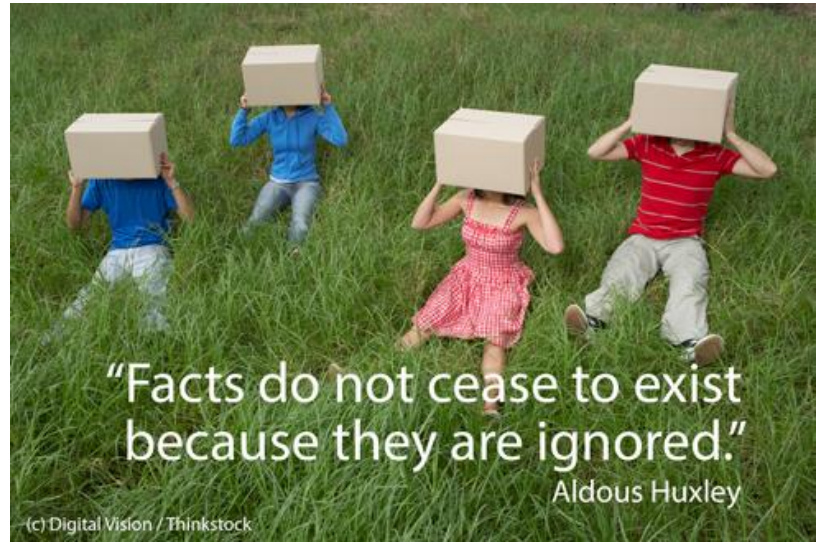
PASSION FOR PATTERN

Your Partner In Digital Transformation

Big Data, Data Science, Analytics







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Vardhmān

A Step towards Digitization Journey

Vardhman Acrylics Background

Vardhman, a leading textiles group in India ventured into manufacture of Acrylic Fiber & Acrylic Tow in 1999

The company has set up a 18000 TPA Acrylic Staple Fibre and Tow production plant at Jhagadia, Distt. Bharuch in the state of Gujarat, India

Critical Areas where advance analytics solution can be appreciated by VA are

A. Utility: Brine chiller, Water Treatment etc.

B. Heat Exchanger power consumption analysis & bad actor identification

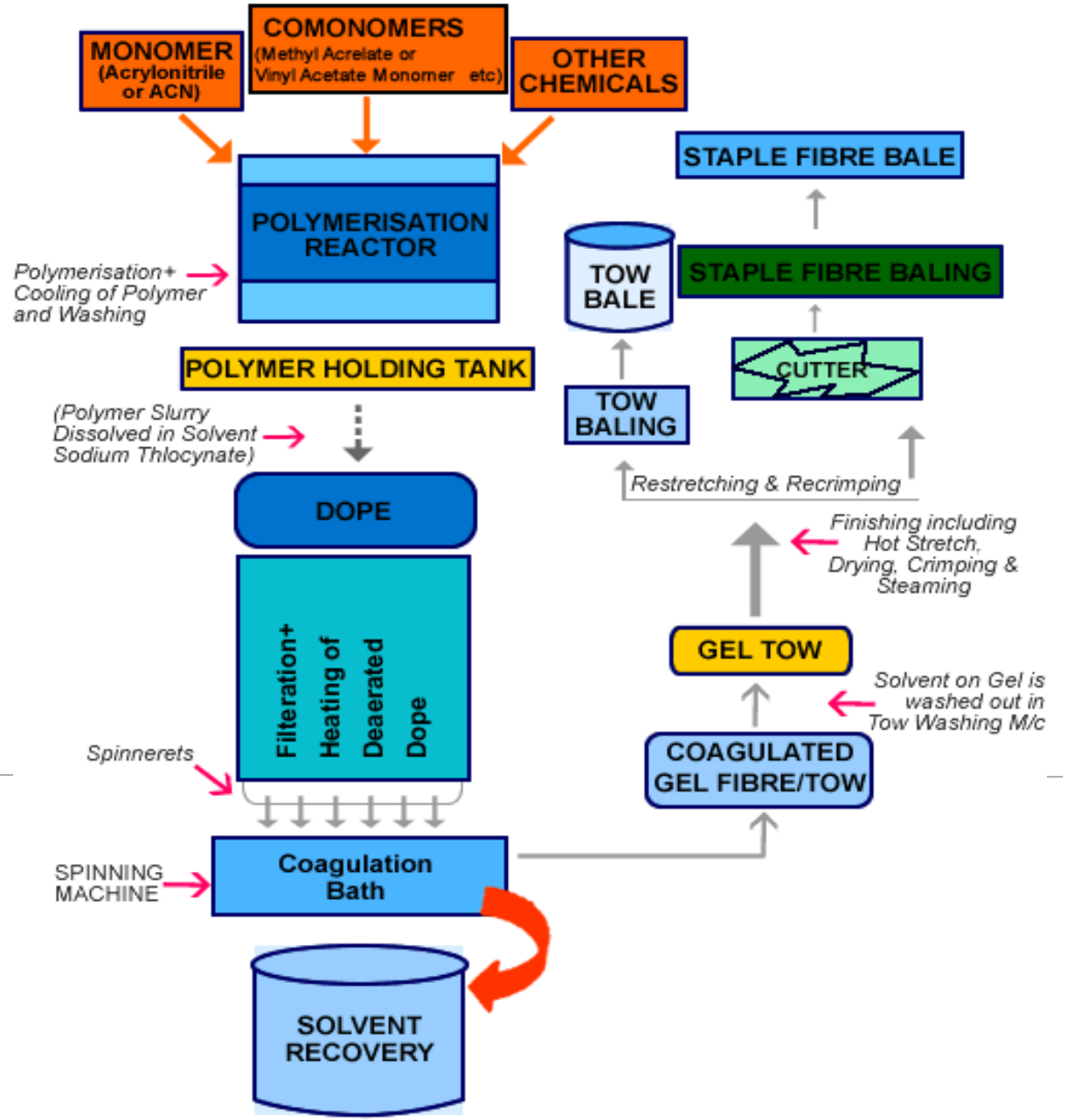
C. Configuring the advance analytics based alerts for various critical process parameters like:

- Concentration
- PH
- Polymer reactor level etc.

D. Bearing: Smart analytics based dashboard for bearing health analysis with the help of vibration & temperature monitoring & analysis

- Vibration- For slow speed (RPM less than 10) , Temperature

Vardhman Acrylics Process Flow



Introduction To IoT

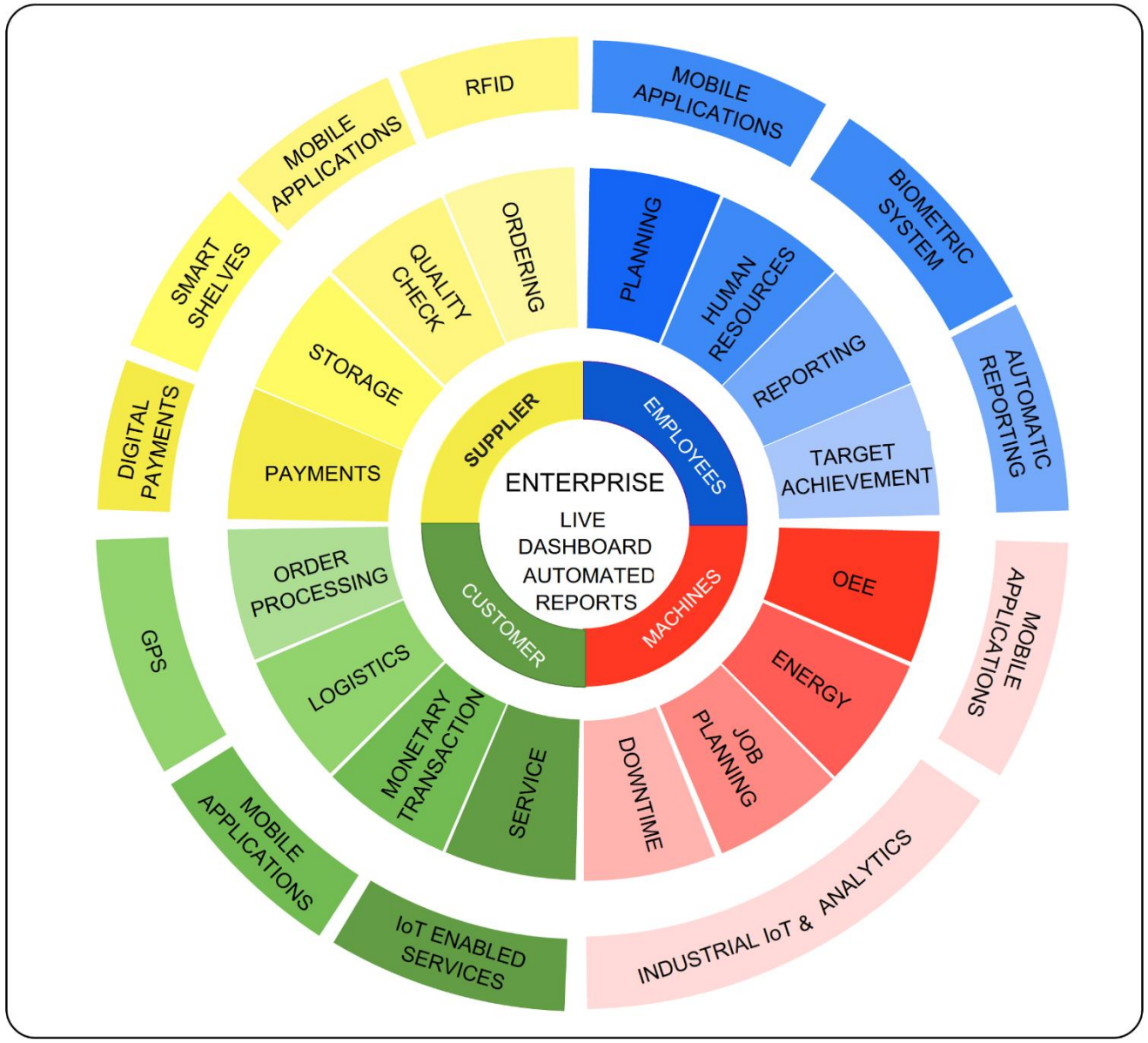
- Applying IoT in the industry is called industrial Internet of Things (IIoT)

- the latest manufacturing trend of automation, cyber-physical systems, data collection, storage and cloud computing, heavily uses IIoT for creating the dream of smart factory

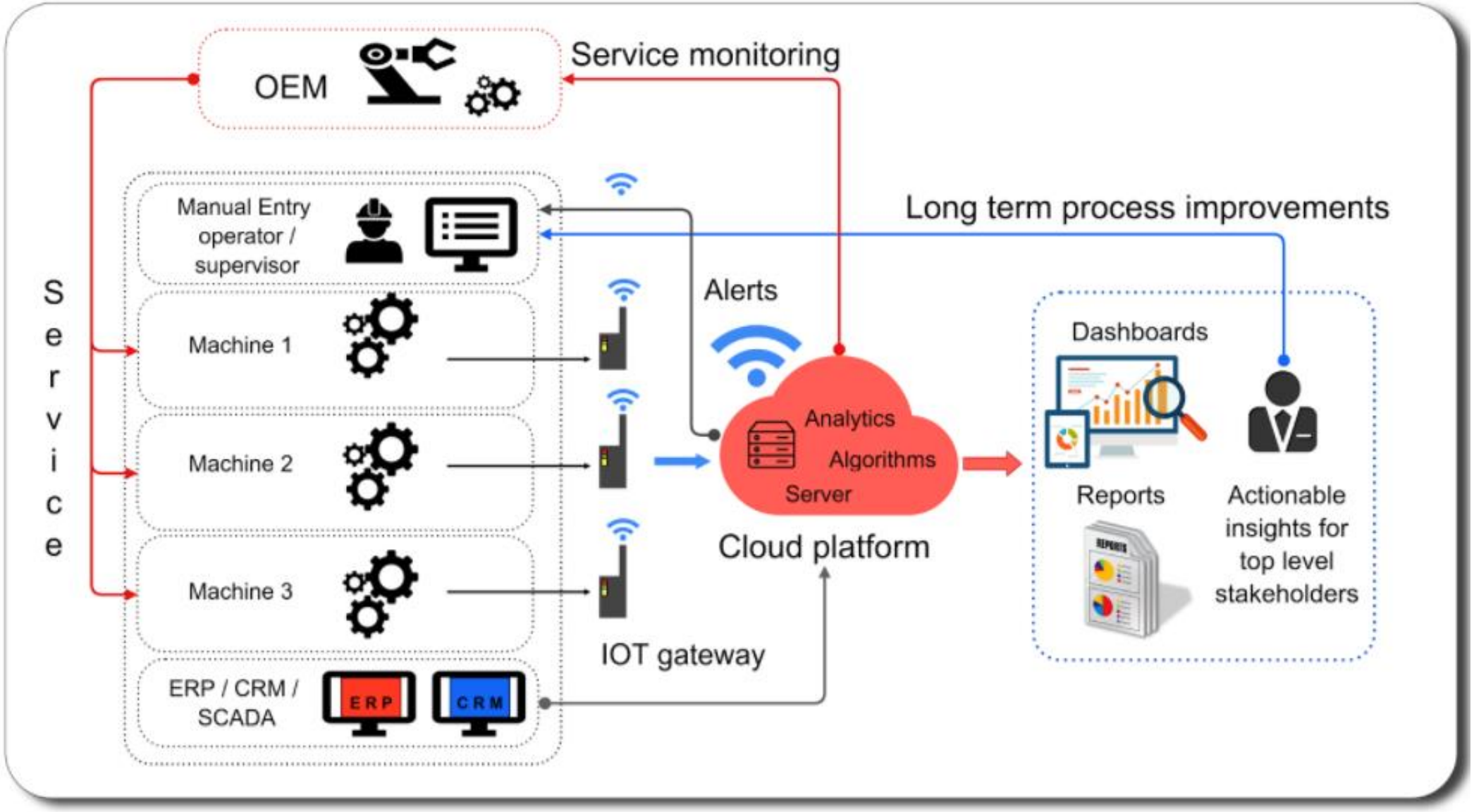
- So what are the important components of an IIoT system?

1. Data Acquisition
2. Data Transmission
3. Data Management
4. Data Analytics

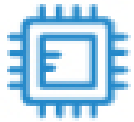
- IoT Gateways collect the data from the sensors, electronics, and PLCs via a communication port and transmits it to the cloud using either GPRS, WiFi, or wired internet.



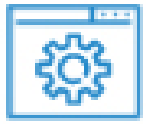
IIoT Applications



The IoT Technology Stack



Device Hardware



Device Software

Communication

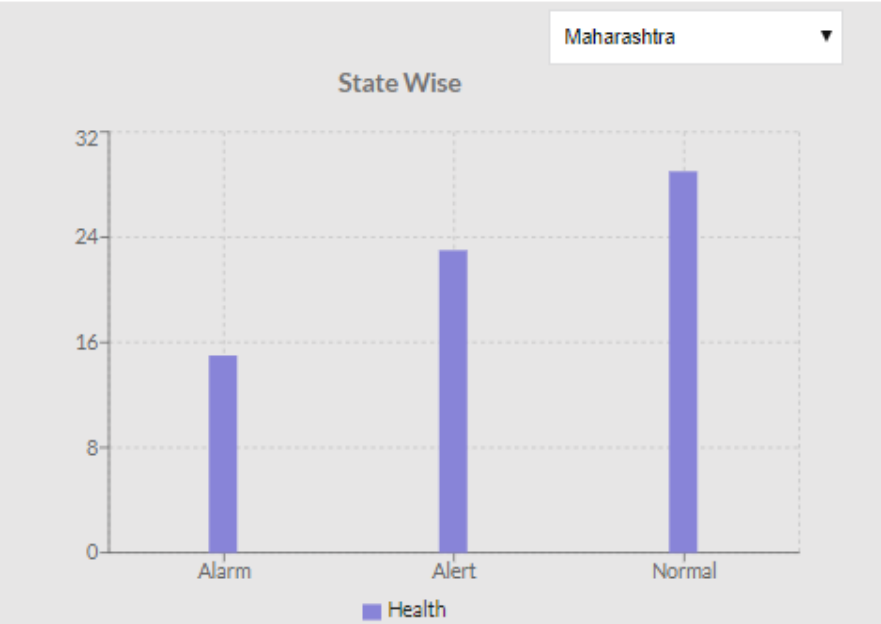
Cloud Platform

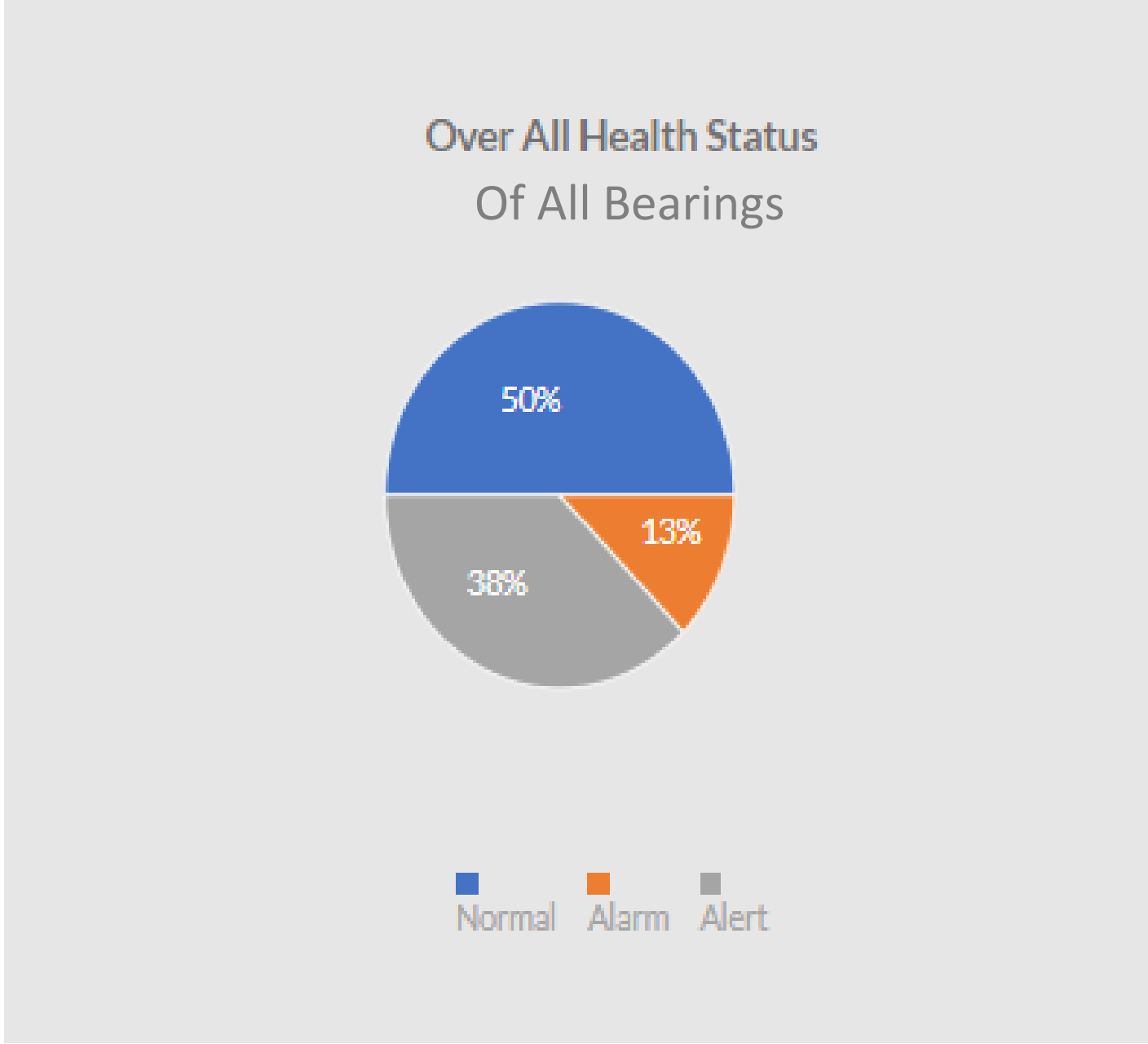
Cloud Application

Release 1: Vibration Monitoring	Add Sensor	Read data from sensor Push data to clouds	Transfer the data to the cloud	Store the data Create APIs	Display the raw data on dashboard
Release 2: Maintenance				Predictive analytics Maintenance event APIs	Display alerts Trends report
Release 2: Emergency Shutdown		Real-time analytics Shutdown the motor		Generate Shutdown alert	Display alerts on the dashboard Display alerts on a mobile device

Sample Dashboard – Equipment Monitoring & Fault Prediction

- Executive dashboard
- Overall health of machine
- Graph of Alert alarm
- Machine status
- User Access Detail





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Client Registration Form

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User Name

Menu

- Executive Dashboard
- Overall Health
- Add Client
- Add Machine
- User Access
- Setting
- Logout

Sign Up

First Name | Last Name

Mobile Number | Enter email

Enter Your Address

Enter Your Employee Code

Enter Company Name

Enter password

Add Client

Already Registered ? Click here to Sign In...

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User Name

- Menu
  - Executive Dashboard
  - Overall Health
  - Add Client
  - Add Machine
  - User Access
  - Setting
  - Logout

Add Machnie Here !!!

Machine Name | mm/dd/yyyy

Enter Date Of previous breakdown | Enter Reason For Previous Breakdown

Enter Action

Current Value | Normal Value | Alarm Value | Alert Value

Enter Company Name | Enter Plant Name

Enter City | Enter State

Add Machine

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- Logout

Bearing Predictive Maintenance Analysis

Machine Details

Add Machine

ID	Company	City	Plant Name	Machine	Value	Unit	Normal	Alert	Alarm	PBD	Action	Status
73	XYZ	Pune	Pune	HAMMER MILL DC FAN	3.9	Mm/s RMS	7	12	25	2018-06-23 10:07:18	keep close monitoring over system feedback during routine field observations.	Normal View Trend
74	ABC	Pune	Pune	SSB 1011 01 HV Motor DE	7.89	Mm/s RMS	10	12	23	2018-06-23 10:18:55.31	Symptoms of structural / rotational looseness & considerable misalignment indicated in FFT spectrum.	Alarm View Trend
75	PQR	Pune	Pune	SSB 1011 01 SSB Motor DE	12.5	Mm/s RMS	15	12	29	2018-06-25 00:22:13.22	considerable misalignment indicated in FFT spectrum.	Alert View Trend

localhost:4200/#/component/carousel

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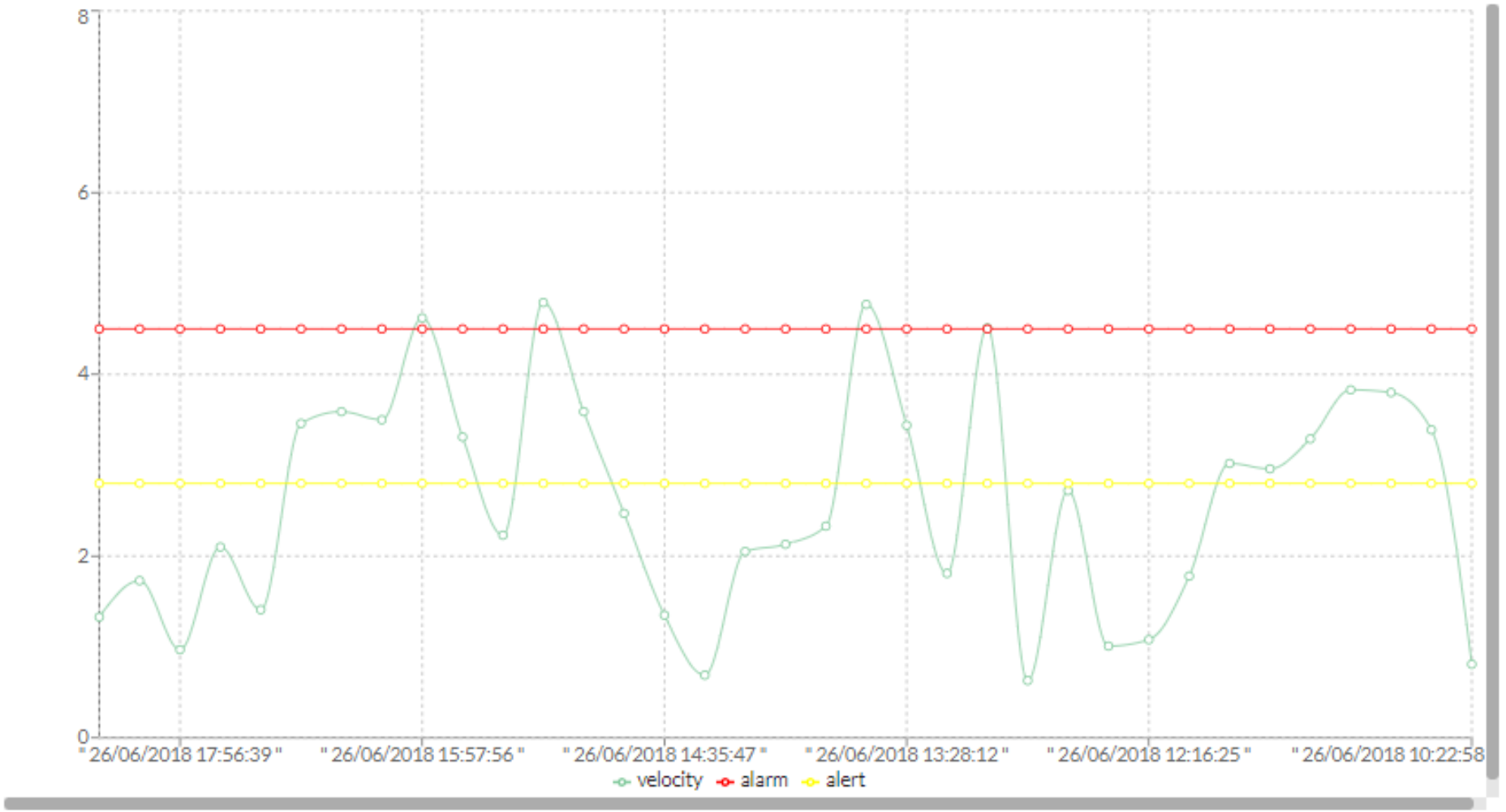
Trend Analysis - Operation Parameter

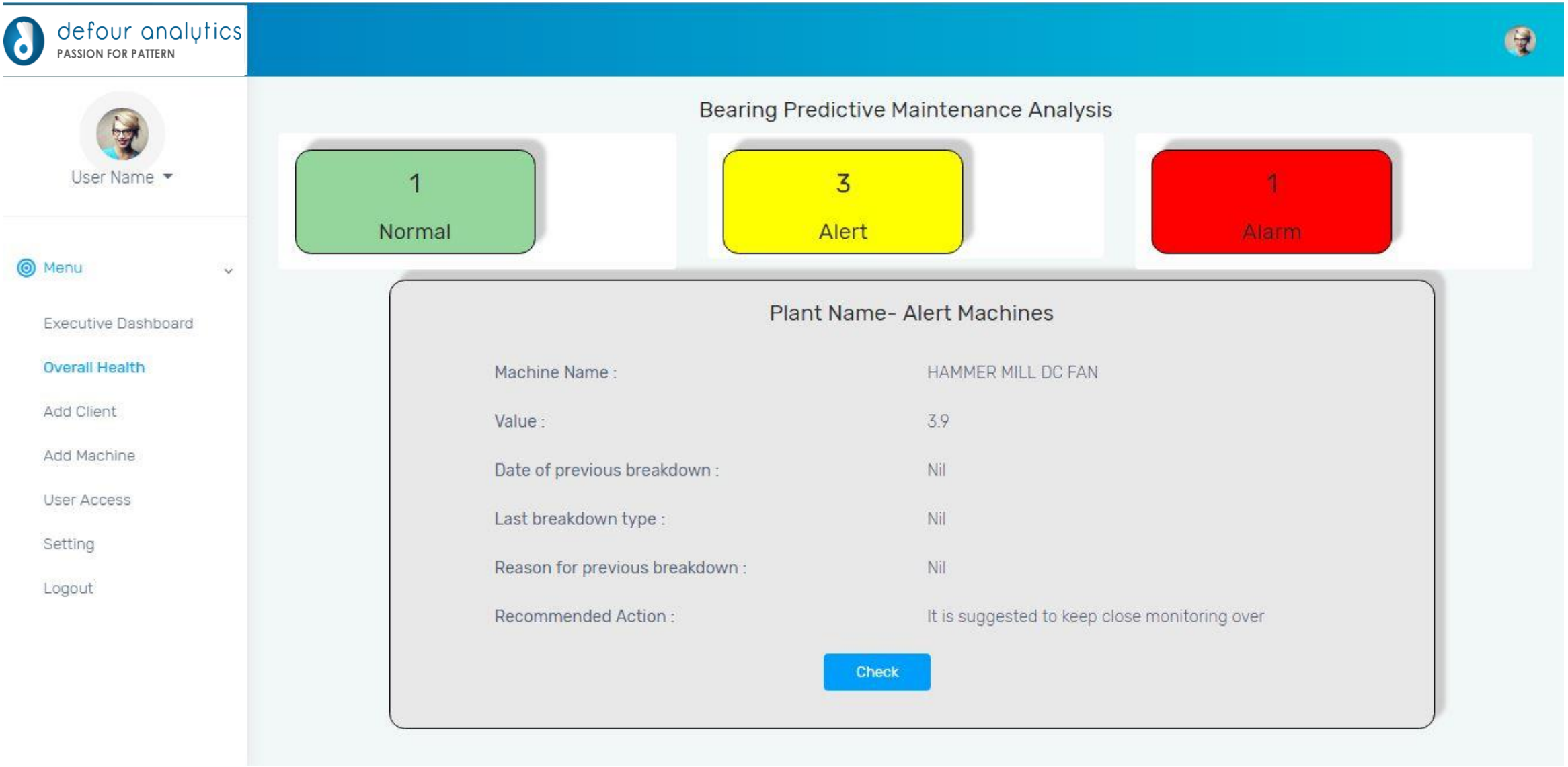
Select Date: 06/26/2018

Select From Time: 10:00:00

Select To Time: 06:00:00

Apply Filter





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User Name

- Menu
  - Executive Dashboard
  - Overall Health
  - Add Client
  - Add Machine
  - User Access
  - Setting
  - Logout

Bearing Predictive Maintenance Analysis

Users

ID	Name	Mobile Number	Company	Address	Emp Code	E-Mail	Action	Action
29	Gaurav	9900099000	Defour Analytics	Pune	001	gauravnikam1@gmail.com	Enabled	Delete
32	Vishal	7700770000	Defour Analytics	Pune	5645	vishal.goswami@defouranalytics.com	Enabled	Delete
33	Anil	9700232323	Defour Analytics	Pune	003	anil.kharde@defouranalytics.com	Disabled	Delete
34	Mahesh	8989898989	Defour Analytics	Pune	007	mahesh@defouranalytics.com	Enabled	Delete
35	Nipun	7447447444	Defour Analytics	Pune	008	nipun@defouranalytics.com	Enabled	Delete

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User Name

Menu

- Executive Dashboard
- Overall Health
- Add Client
- Add Machine
- User Access
- Setting
- Logout

Bearing Predictive Maintenance Analysis

User Setting Panel

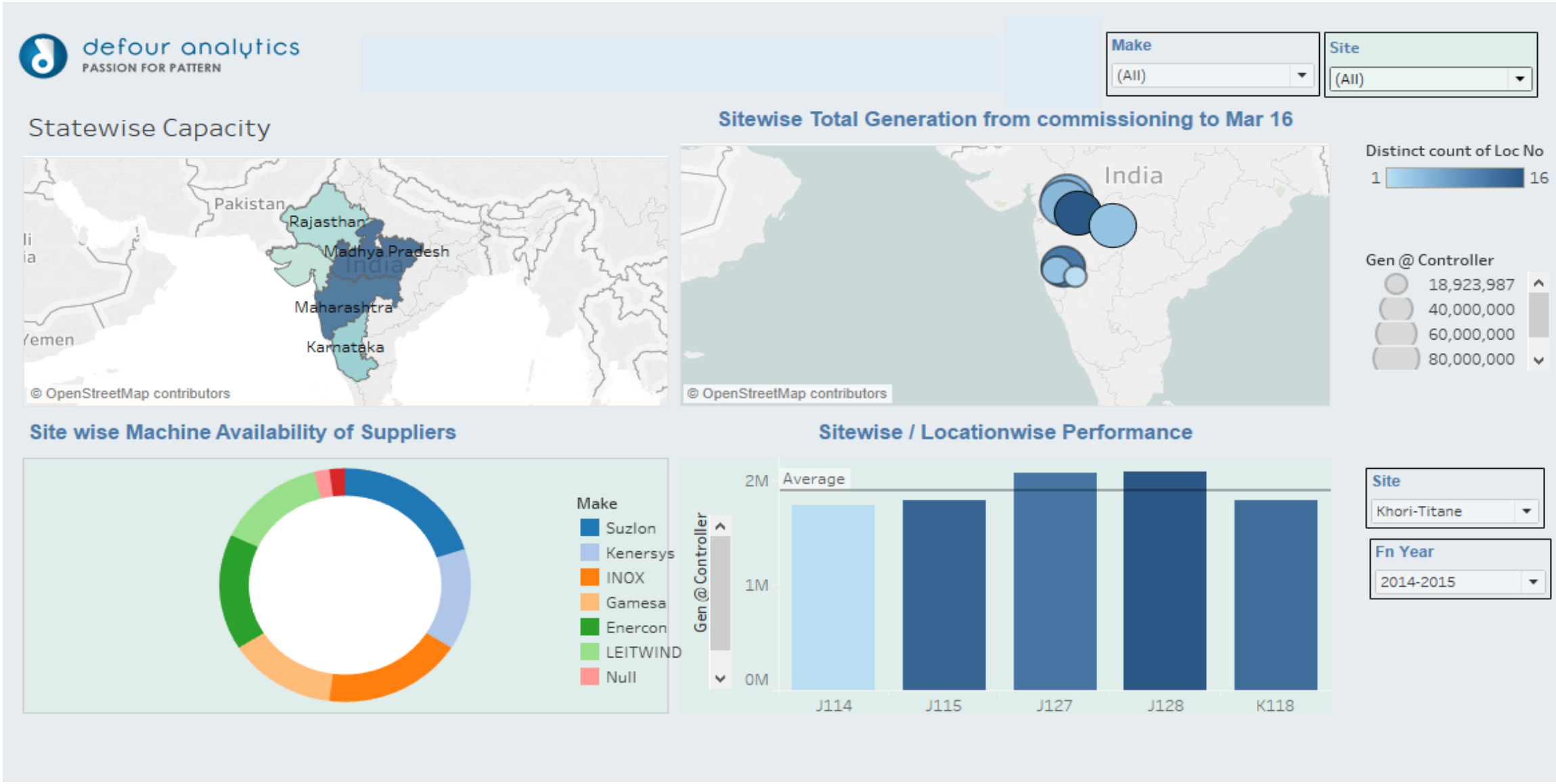
Password change

User Rights

Machine delete

Etc…

Turbine Energy Efficiency



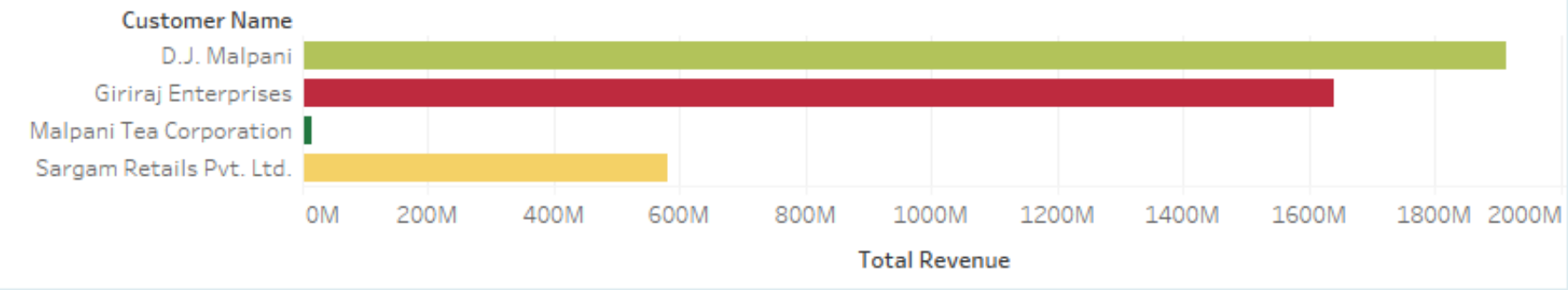
Monthly MA%

Month	Loc No C15	C16	K412	K413	K429
January	98.46	98.41	97.45	89.77	89.42
February	99.31	99.24	99.31	89.71	89.72
March	97.68	98.42	97.73	88.76	96.91
April	96.80	98.22	96.91	97.68	97.70
May	98.76	96.82	90.82	96.92	91.60
June	96.95	96.41	93.81	97.44	92.96
July	95.77	96.79	98.20	98.09	95.29
August	96.92	95.14	97.29	97.42	94.66
September	93.70	81.92	98.64	98.12	98.00
October	97.90	97.81	98.40	98.92	98.61
November	97.94	97.64	97.91	98.85	98.00
December	98.71	98.28	99.22	90.13	89.69

Monthly GA%

Month	Loc No MK054	MK055	MK056	SKD187
January	82.26	82.05	81.96	81.99
February	81.73	81.61	82.40	82.00
March	85.35	82.54	88.03	87.36
April	86.98	81.77	84.92	86.16
May	90.30	90.19	90.82	90.36
June	98.63	98.08	98.75	97.09
July	97.93	98.10	98.17	96.42
August	97.77	98.37	98.44	98.37
September	82.43	82.64	82.46	82.54
October	82.03	82.42	82.31	82.23
November	82.23	82.26	82.41	82.29
December	82.10	82.22	82.30	82.11

Comp. wise Gen vs Revenue



Wind Type
- [x] (All)
- [x] High Wind
- [x] Low Wind

Site
Nandurbar

Avg. MA%
81.92 — 99.31

Avg. Investment
17,800,000 — 105M

Site
Sanu

Wind Type
- [x] (All)
- [x] High Wind
- [x] Low Wind

Avg. GA%
81.61 — 98.75

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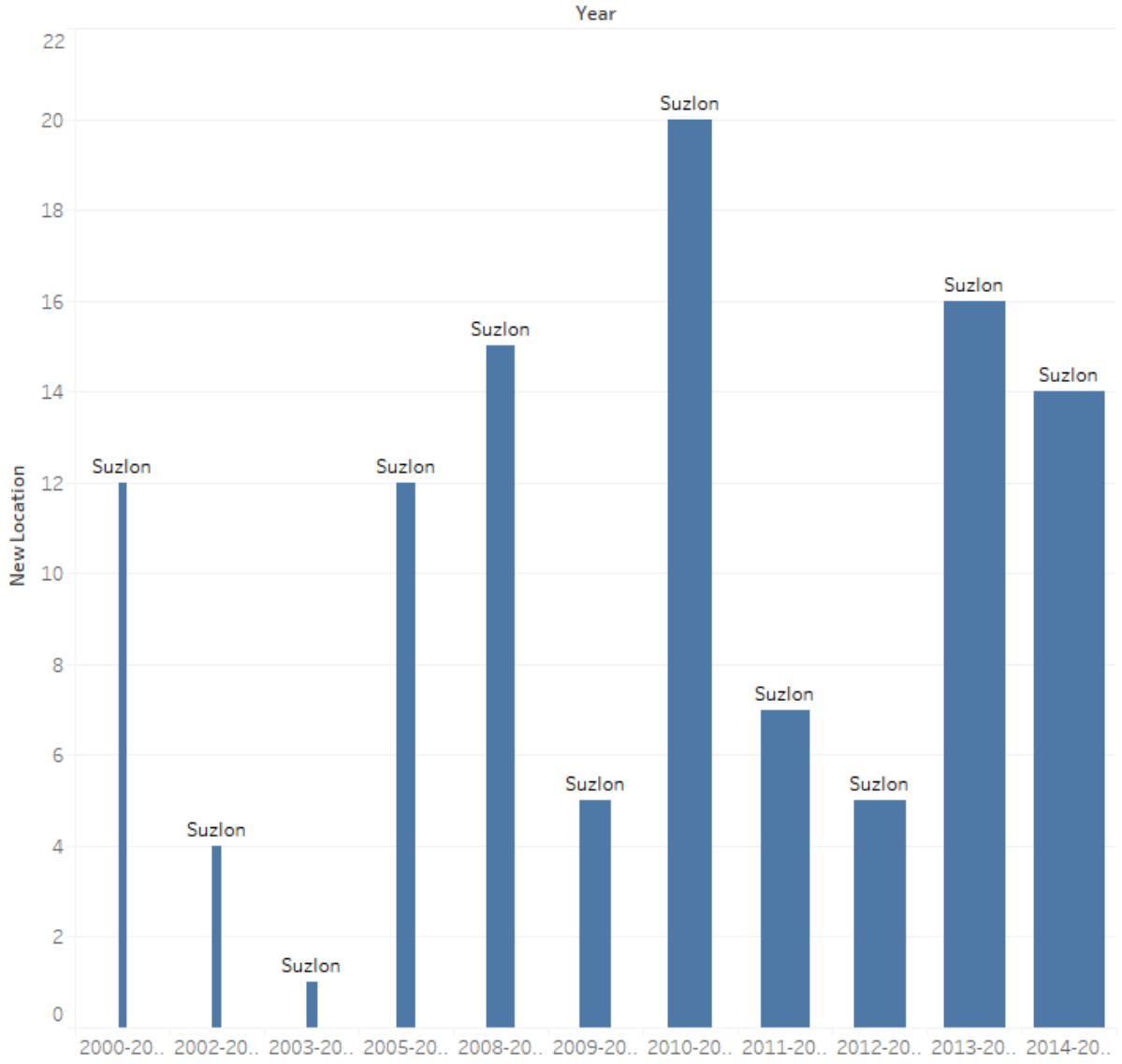
Year on Year number of Locations



SUM(Cummulative Loc...
12
40
60
80
100
111

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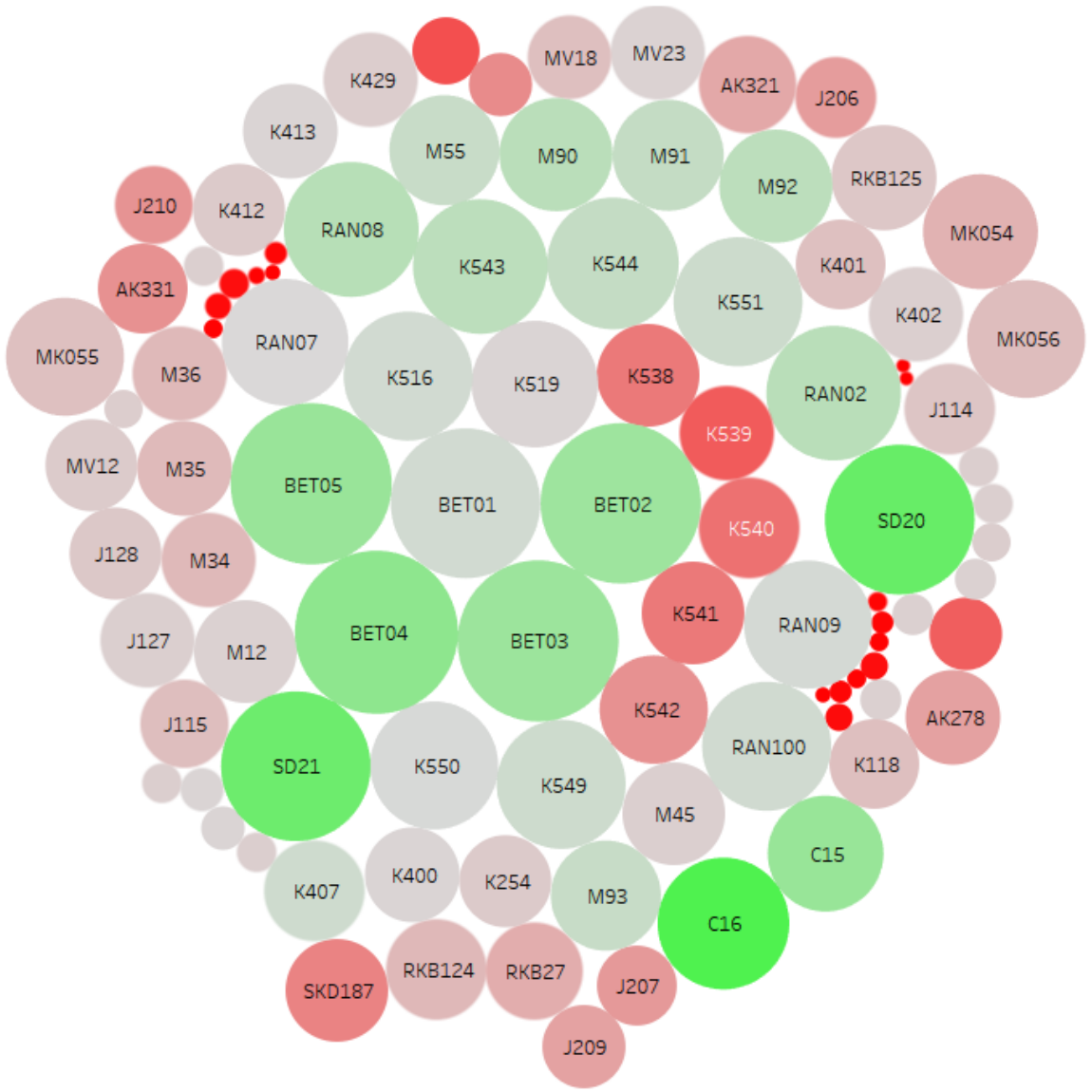
Location wise Deviation from Estimated Generation



Fn Year

2013-2014

SUM(Deviation)

-2,975,247 1,999,354

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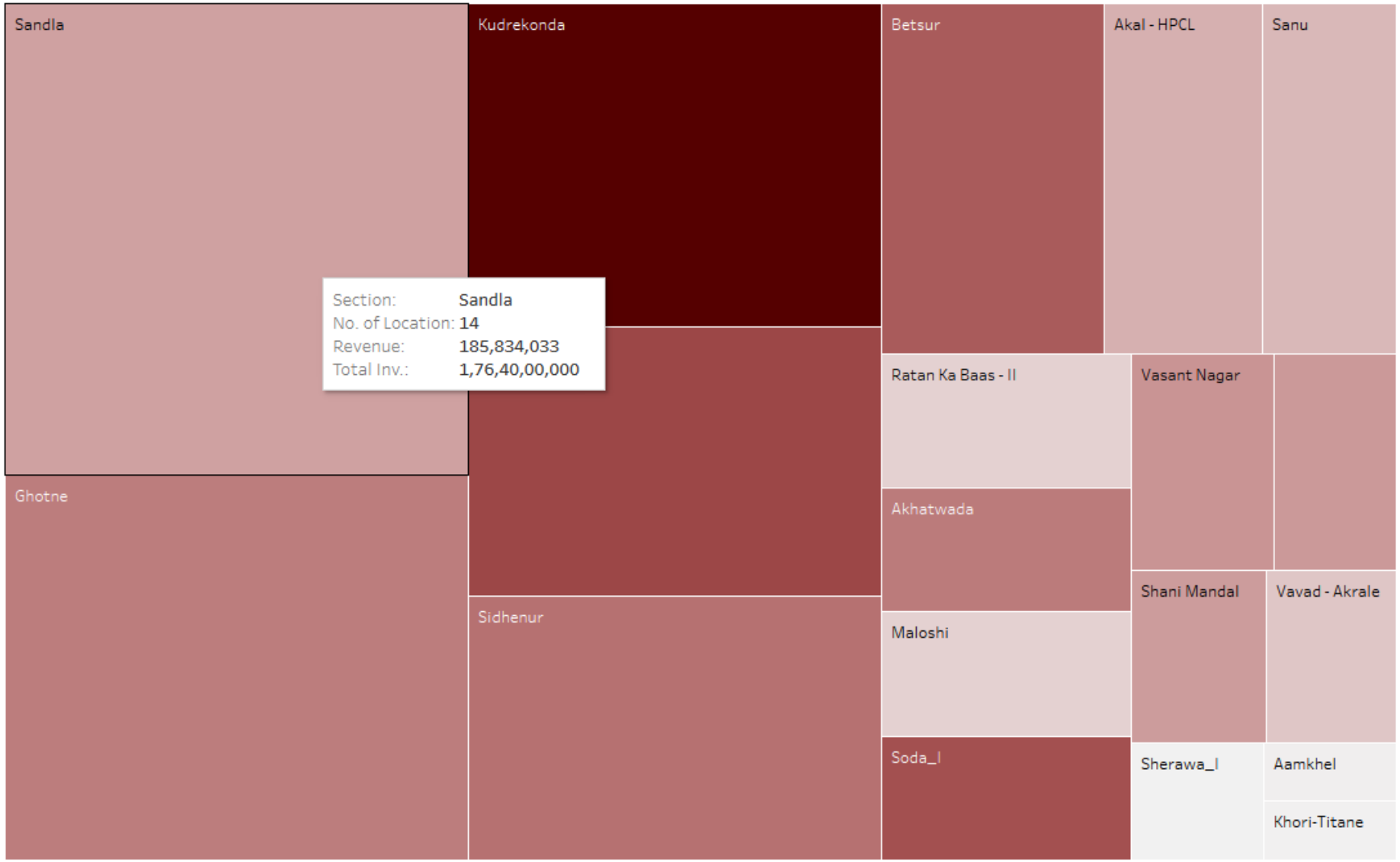
Dashboard 1 | Dashboard 2 | Yearly no. of Locations | **Location wise Estimated vs Ac...** | Site wise Revenue vs Generation | Season wise Performance | Project Tracker | Project Feasibility

Site wise Revenue vs Generation



SUM(Revenue)
48,309,252 674M

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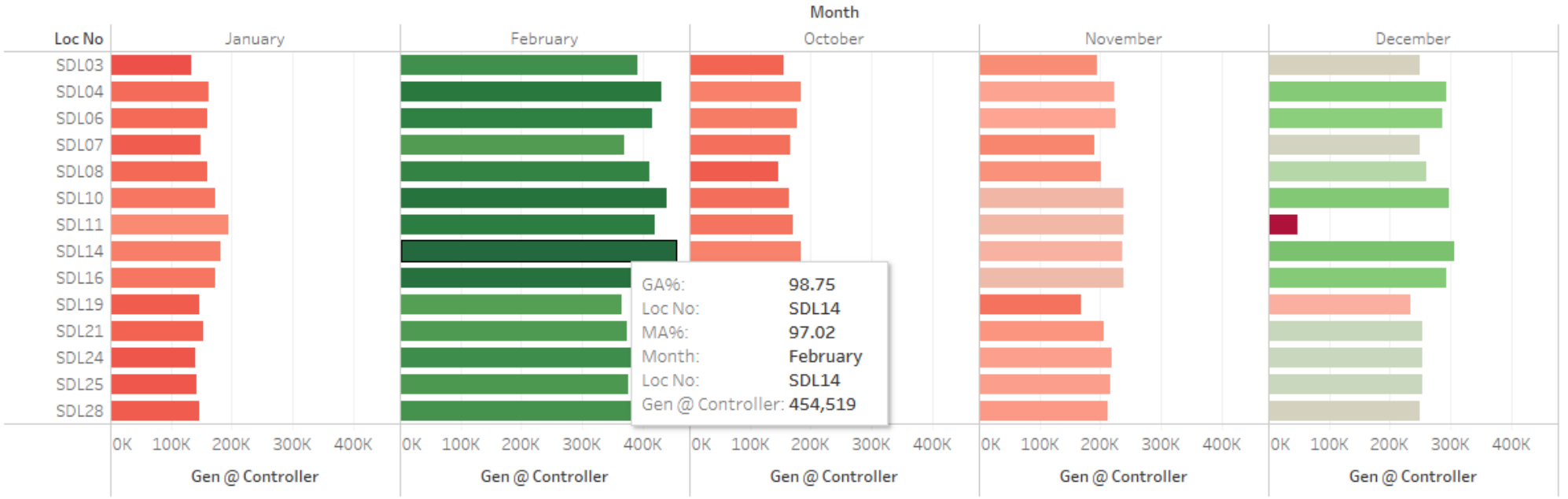
Dashboard 1 | Dashboard 2 | Yearly no. of Locations | Location wise Estimated vs Actu... | **Site wise Revenue vs Generation** | Season wise Performance | Project Tracker | Project Feasibility

Season wise Performance



Fn Year
2015-2016

Wind Type
Low Wind

Site
Ratlam

SUM(Gen @ Controller)
48,523 454,519

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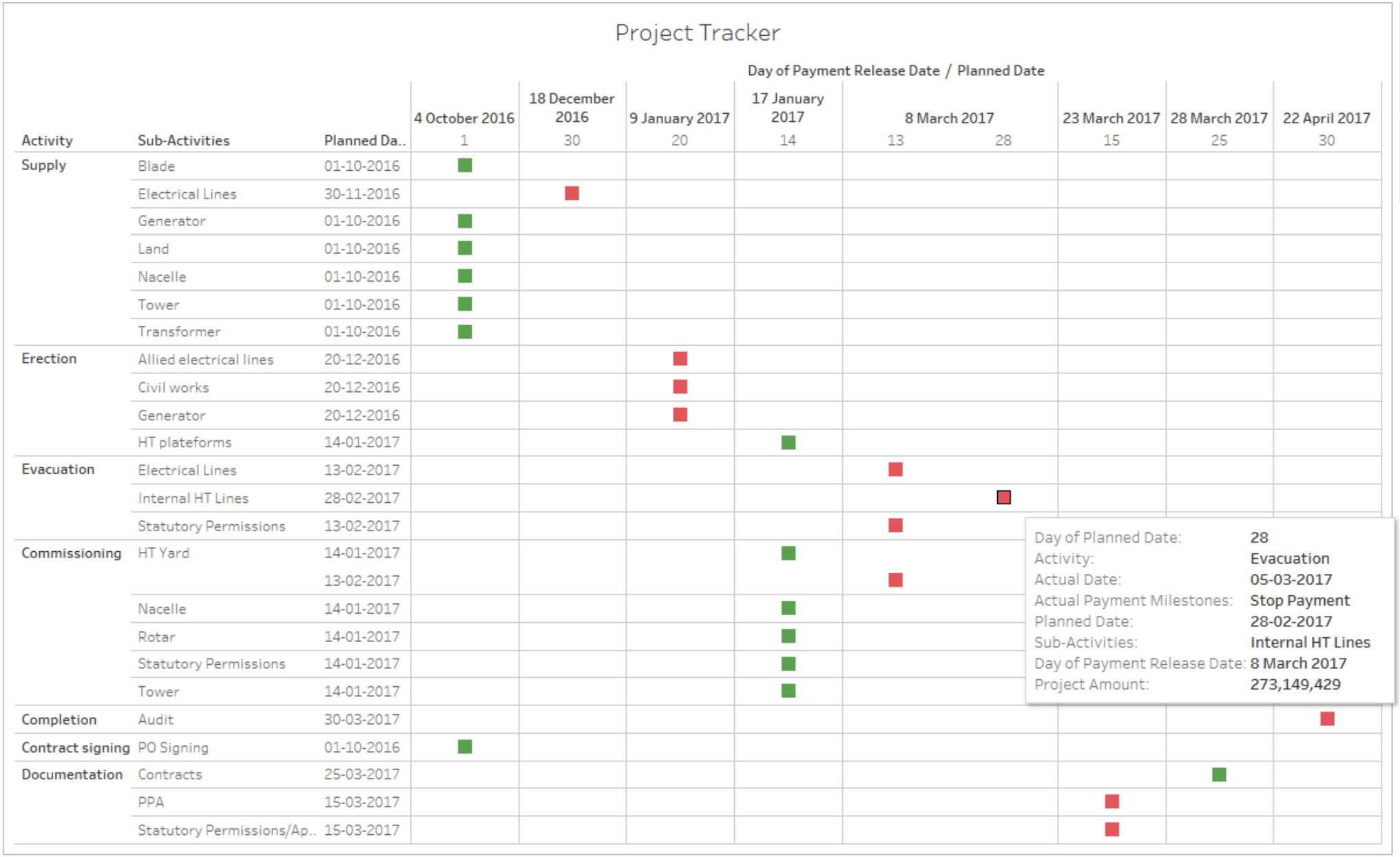
Dashboard 1 | Dashboard 2 | Yearly no. of Locations | Location wise Estimated vs Actu... | Site wise Revenue vs Generation | **Season wise Performance** | Project Tracker | Project Feasibility

Project Tracker



Activity	Sub-Activities	Planned Da..
Supply	Blade	01-10-2016
	Electrical Lines	30-11-2016
	Generator	01-10-2016
	Land	01-10-2016
	Nacelle	01-10-2016
	Tower	01-10-2016
	Transformer	01-10-2016
Erection	Allied electrical lines	20-12-2016
	Civil works	20-12-2016
	Generator	20-12-2016
	HT plateforms	14-01-2017
Evacuation	Electrical Lines	13-02-2017
	Internal HT Lines	28-02-2017
	Statutory Permissions	13-02-2017
Commissioning	HT Yard	14-01-2017
		13-02-2017
	Nacelle	14-01-2017
	Rotar	14-01-2017
	Statutory Permissions	14-01-2017
	Tower	14-01-2017
Completion	Audit	30-03-2017
Contract signing	PO Signing	01-10-2016
Documentation	Contracts	25-03-2017
	PPA	15-03-2017
	Statutory Permissions/Ap..	15-03-2017

Day of Planned Date: 28
Activity: Evacuation
Actual Date: 05-03-2017
Actual Payment Milestones: Stop Payment
Planned Date: 28-02-2017
Sub-Activities: Internal HT Lines
Day of Payment Release Date: 8 March 2017
Project Amount: 273,149,429

Actual Payment Milesto...
- [x] (All)
- [x] Realease Payment
- [x] Stop Payment

Actual Payment Milesto...
- Realease Payment
- Stop Payment

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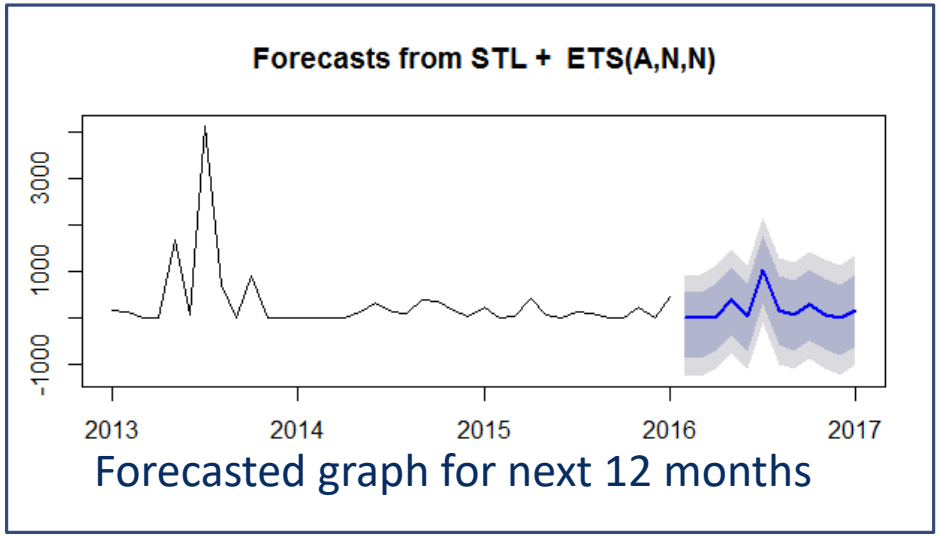
Dashboard 1 | Dashboard 2 | Yearly no. of Locations | Location wise Estimated vs Actu... | Site wise Revenue vs Generation | Season wise Performance | **Project Tracker** | Project Feasibility

Spare Part Optimization Case



Forecasted graph for next 12 months

Problem Statement:

- ❑ Which are the most 10 high moving spare parts by value and quantity?
- ❑ Demand forecast for those 10-high moving spare parts (next year forecast for demand rate per month or per year).
- ❑ What should be the ideal min – max level in quantity for those 10-high moving levels?

Dates	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
Feb-16	0	0	553.5416	0	928.9714
Mar-16	0	0	566.0788	0	944.7206
Apr-16	29.63989	0	750.9279	0	1132.755
May-16	385.68083	0	1112.936	0	1497.921
Jun-16	33.51018	0	766.6834	0	1154.802
Jul-16	1060.48763	321.4434	1799.532	0	2190.758
Aug-16	163.04823	0	907.9171	0	1302.227
Sep-16	62.72448	0	813.3728	0	1210.742
Oct-16	287.286	0	1043.67	0	1444.075
Nov-16	92.49097	0	854.5668	0	1257.985
Dec-16	0	0	737.1129	0	1143.522
Jan-17	183.36838	0	956.7028	0	1366.081

Spare Part Optimization Case

Solution:

1. These Forecasted values for next 12 months can be used to keep a spare part inventory.
2. Gone are the days when companies use to have a fixed minimum maximum level throughout the year. With these kind of forecasts companies can have dynamic minimum and maximum levels for each month.
3. The model should run on monthly basis with the addition of new data each month for better forecasting and minimizing errors.

Equipment Life Prediction

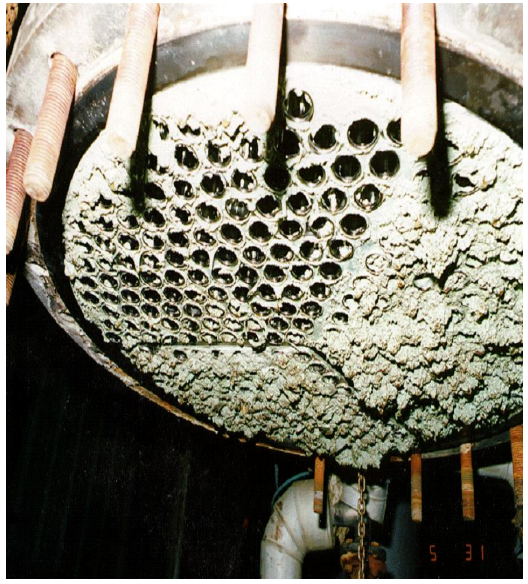
CHALLENGES

- Overall heat transfer coefficient reduces significantly during operation due to fouling.
- The rate of fouling is highly dependent on the properties of the crude blends being processed as well as the operating temperature and flow conditions.
- Thus, leading to decreased energy efficiency of the crude train and the need for maintenance intervention by cleaning, affecting the availability of the crude train.

SOLUTION

- Plan their maintenance effectively in a way that the equipment is worked to its full capability and there is minimum capital loss.
- Limit break down time
- Improved Efficiency

Heat Exchanger Case

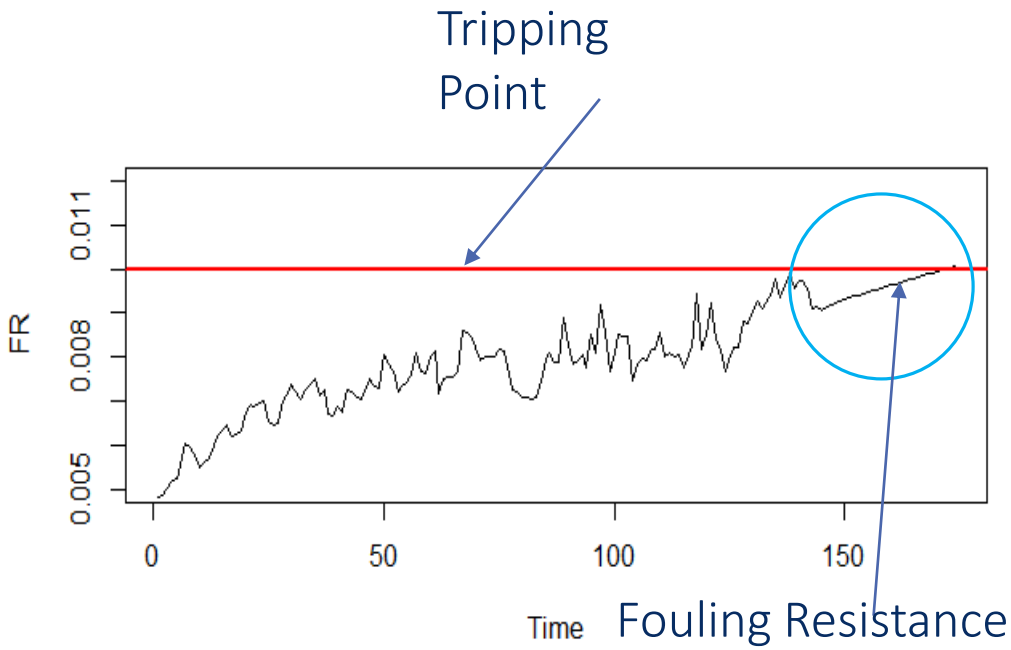


Problems in Heat Exchanger:
Fouling, Corrosion & Vibrations

Problem Statements:

1. Forecast when those parameters will reach the tripping point in how many hours / days?
2. Predicting the next maintenance date.

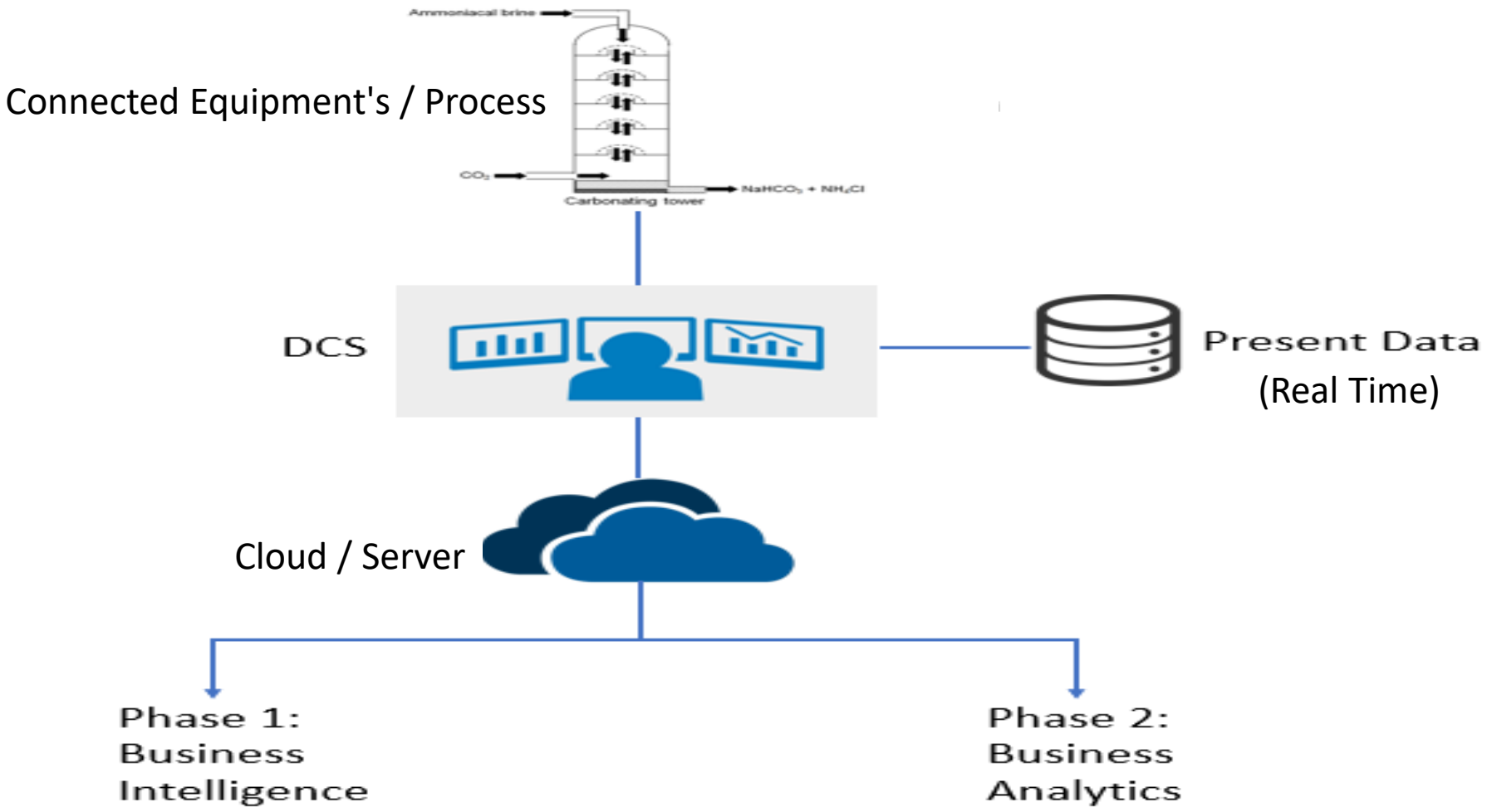
(Data: Date for 144 Days, Formula: FR=1/U*LMTD)



Solution:

1. Historical data is used to predict Fouling Factor for heat Exchanger.
2. Analytical algorithm is build using advanced tools which takes real time data and predicts on real time.
3. Alerts can be generated in advance when heat exchanger is about to reach it's tripping point.

Solution Architecture



Enterprise Solution Phase 1

Business intelligence through DCS system integration

- The proposed system will integrate with the existing DCS and ERP system for creating historian and further analysis
- The various data values related of each equipment to performances for generation of reports
- For better understanding & easy visualization, Defour will design and develop an executive dashboard
- The system will have a provision to maintain historical reports along with the present one which will be indexed as per service date

Enterprise Solution Phase 2

Operation Excellence using advance analytics platform:

- A self learning and an intelligent algorithm
- Any bad actor or anomaly will get predicted through advance patter recognition concept

System will help Vardhman Acrylic to:

- Upscale of operations , increase plant uptime , Improved efficiency
- Actionable Insights for effective decision making
- Optimize Operations with saving cost & time
- Retention of asset performance & its health through predict reliability
- Optimize cost by reducing the downtime
- Achieve Operational Excellence - Plan, Predict & Optimize

Way forward

Plant visit

POC problem statement finalization

Scope of project