AVEVA PI WORLD

30-09-2021

Remote monitoring and Data Analytics using the PI System

Presented By:

Pradeep Mahajan (HZL)

Shrenik Shah (ecubix)

Hindustan Zinc Limited and usage of PI System capabilities

Hindustan Zinc Limited : #1 in Metals & Mining category (Asia-Pacific) in Dow Jones Sustainability Index 2020, 4th largest smelting operations

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Rampura Agucha Mine

Reserves & Resources : 96.5 Mt
Ore Production Capacity : 6.15 Mtpa

Kayad Mine

Reserves & Resources : 8.3 Mt
Ore Production Capacity : 1.2 Mtpa

Sindesar Khurd Mine

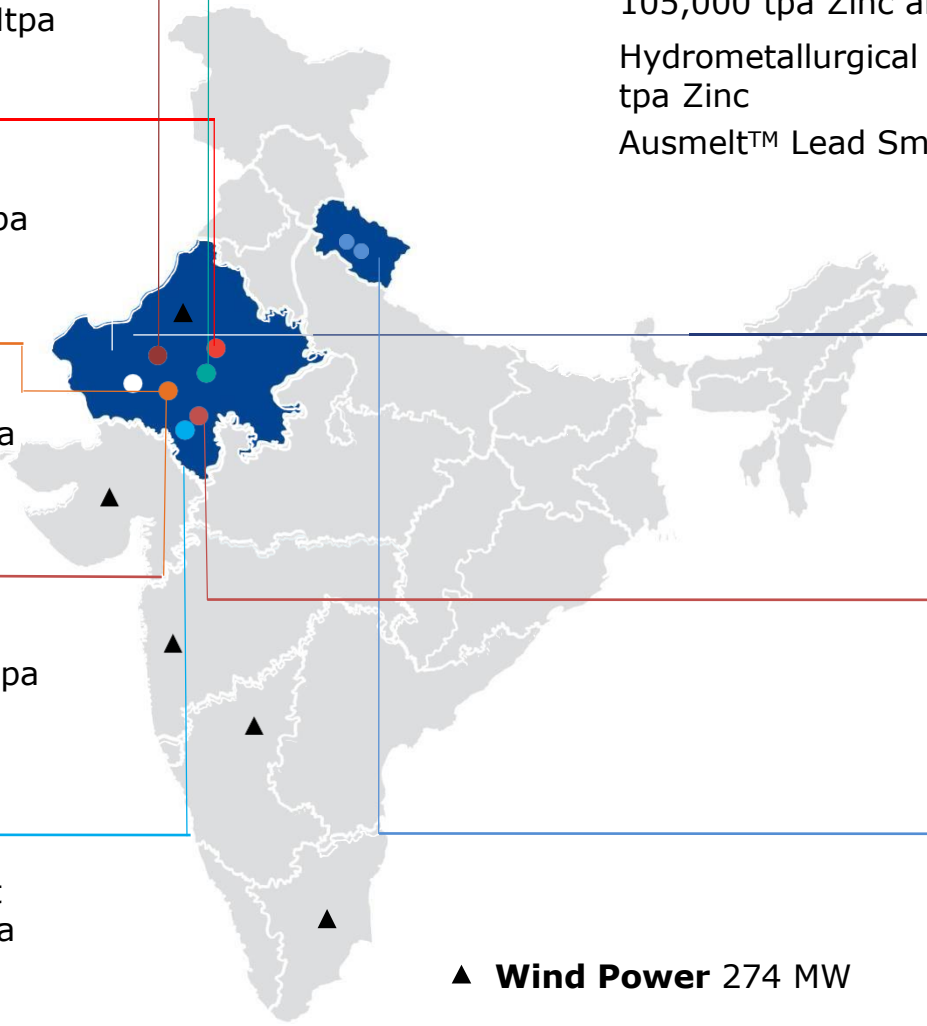
Reserves & Resources : 126 Mt
Ore Production Capacity : 6.0 Mtpa

Rajpura Dariba Mine

Reserves & Resources : 60 Mt
Ore Production Capacity : 1.08 Mtpa

Zawar Mining Complex

Reserves & Resources : 100.5 Mt
Ore Production Capacity : 4.0 Mtpa



▲ **Wind Power** 274 MW

Chanderiya Smelting Complex

Pyrometallurgical Lead Zinc Smelter: 105,000 tpa Zinc and 35,000 tpa Lead

Hydrometallurgical Zinc Smelter: 420,000 tpa Zinc

Ausmelt™ Lead Smelter: 50,000 tpa

Dariba Smelting Complex

Hydrometallurgical Zinc Smelter: 220,000 tpa Zinc

Lead Smelter: 100,000 tpa

Zinc Smelter Debari

Hydrometallurgical Zinc Smelter: 88,000 tpa Zinc

Pantnagar & Haridwar

Processing & Refining of Zinc, Lead & Silver

World's Largest
Underground zinc mining operations at Rampura Agucha*

World's 2nd Largest
Zinc-lead miner & one of the lowest-cost producers of zinc globally*

World's 6th Largest
silver producer*

25+ Years
Mine Life#

Total captive capacity
561.19 MW
(Thermal - 485.5 MW
Solar - 40.42 MW
WHRB - 35.27 MW)

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Data Sources and Partner's platforms

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Honeywell
SANDVIK
ABB
normet
Epiroc
SKF
YOKOGAWA
OSIsoft.
Rockwell Automation
Woodgrove TECHNOLOGIES INC.
mobilaris
ecubix
CAT
GE
MINTEK
SAP
metso Outotec
CISCO

- Predicted operations
- Consistency in operations
- Improved Quality
- Improved OEE
- Capex and Opex Saving

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Industry opportunities and challenges

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Industry challenges – Metal and Mining

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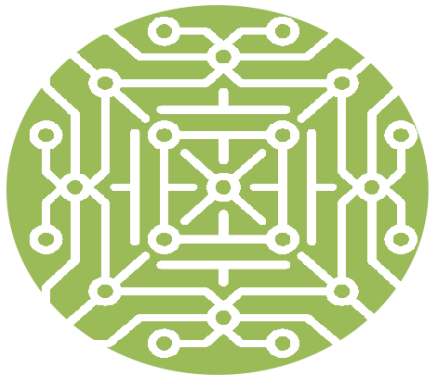
Data Collection

Data Analysis

Safety Hazards and mitigation of risks

We want to be **data-driven**, but…

85% **of the effort** is in gathering and aggregating the data



We need to **cut costs**, but…

don't know which cuts push us over our **risk tolerance**

Less **Innovation and investment** as compared to other sectors

Care for Environment and natural resources

Unplanned Downtime

High Maintenance Cost

Operational Silos

Organizational Knowledge Loss

Data Not Accessible or Proactively Analyzed

LOST REVENUE

LOWER PROFITABILITY

Resistance to Change, Skills upgradation, Holistic Solution Provider, Retention of Talent

PEOPLE | PROCESS | TECHNOLOGY

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Solution

Applicability of OSIsoft PI System on different business levers

Efficiency

- Single source of truth
- Quicker response
- Automated shift reports
- Event based notifications
- Easy to communicate with various DCS and ERP platforms to have end to end business visibility
- Mobility capability

Asset

- Data driven RCA
- Model based predictive maintenance and material planning
- Improved safety and reduction in unscheduled breakdown

OSIsoft + ecubix

People

- Data driven discussions & decisions
- Manpower engagement to value added work and future prospects
- Performance monitoring & training identification
- Analytical based capability measurement and appraisals

Cost

- Real Time Consumables tracking
- Energy Saving
- Consumables/Spares optimization
- Building cost consciousness to bottom most layer

Implementation Details

Soft Sensor for predicting P80 in Mills : ~95% accuracy

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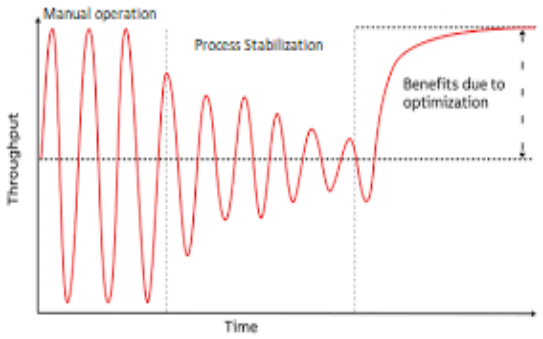
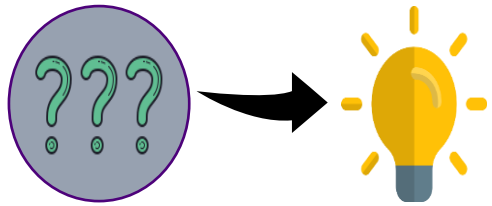
GRINDING SECTION – "GOLDMINE" OF OPPORTUNITIES

1. Step of mineral extraction
2. Energy Intensive Unit
3. A lot of manual interventions



PROBLEM STATEMENT

The particle size (P80) which is a key operational parameter, was not available for real-time monitoring on consistent basis.



Procedure for building soft sensor

- Problem Identification
- Requirement & Data Gathering through Pi Integrator
- Model Building – 2nd Order Regression
- Preliminary Validation & Finetuning of model
- Final Validation using Pi Datalink
- Deployment of Model into Control system using Pi

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Soft Sensor for predicting P80 in Mills : ~95% accuracy

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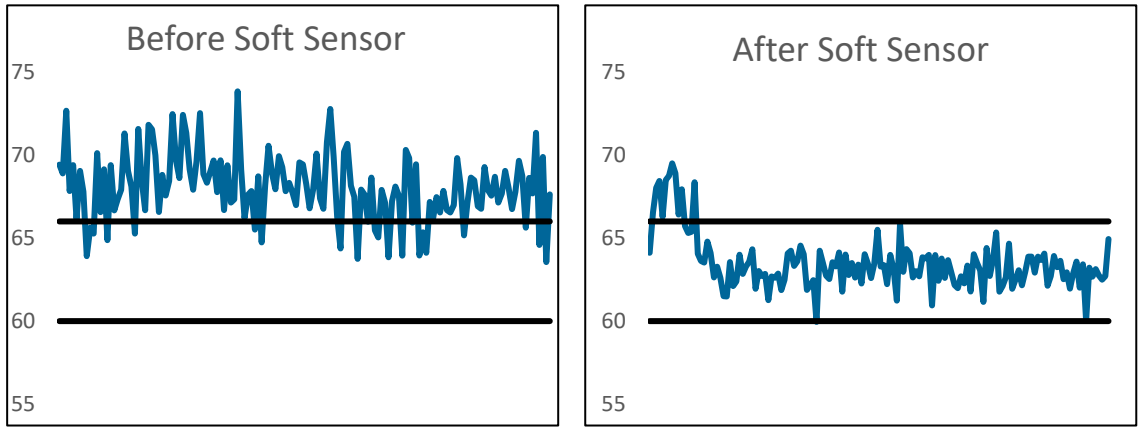
Dashboard for Live P80 Monitoring

Control of grinding process



Key Benefits

Gauging Performance
Particle size is the Grinding performance indicator which is being predicted using process modelling.

Optimizing Process & consumables
Monitoring P80 has resulted into optimization of consumables such as grinding media, power & water

Cost Avoidance
Soft sensor has eliminated the requirement of 6 Nos online analyzer (PSI), which resulted into Capex Saving

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Soft Sensor for Sulphide Sulphur in Roasters : ~90% Accuracy

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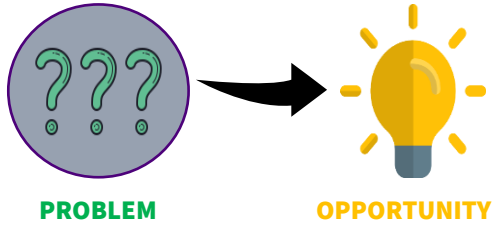
PROBLEM STATEMENT

Sulphide Sulphur determines the quality of the Roaster output (calcine) and it is being tracked based on the periodic Lab reports.



CHALLENGES FACED DURING IMPLEMENTATION

CHALLENGES	SOLUTIONS
➢ Deployment of complex Random Forest Model	✓ The model prediction was written back to Pi using Pi WebAPI.
➢ Providing Feedback of the Model prediction to DCS	✓ Used OSI PI to write back to the DCS.
➢ Fetching of Lab data	✓ Integrated LIMS with PI

Procedure for building soft sensor

- Problem Identification
- Requirement & Data Gathering using Pi Integrator
- Model Building – Random Forest Model
- Preliminary Validation & Finetuning of model
- Final Validation using Pi Datalink
- Deployment of Model using Pi WebAPI in control system

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Soft Sensor for Sulphide Sulphur in Roasters : ~90% Accuracy

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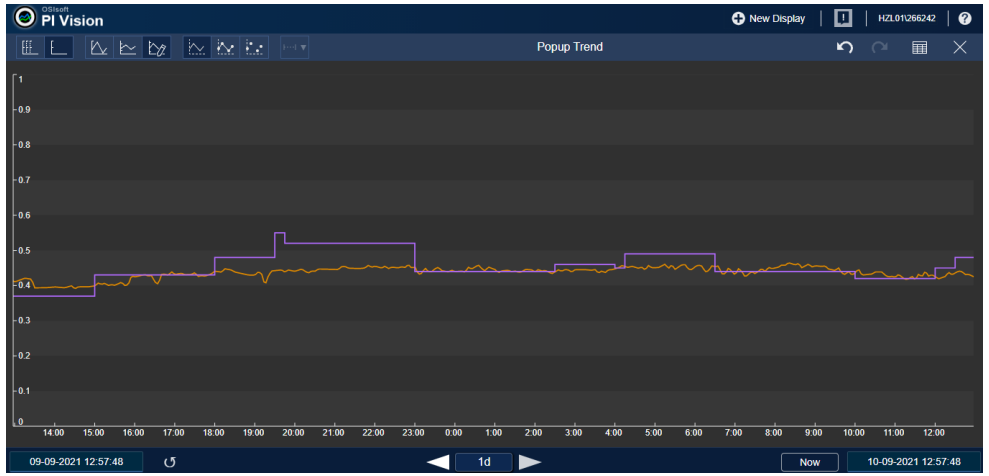
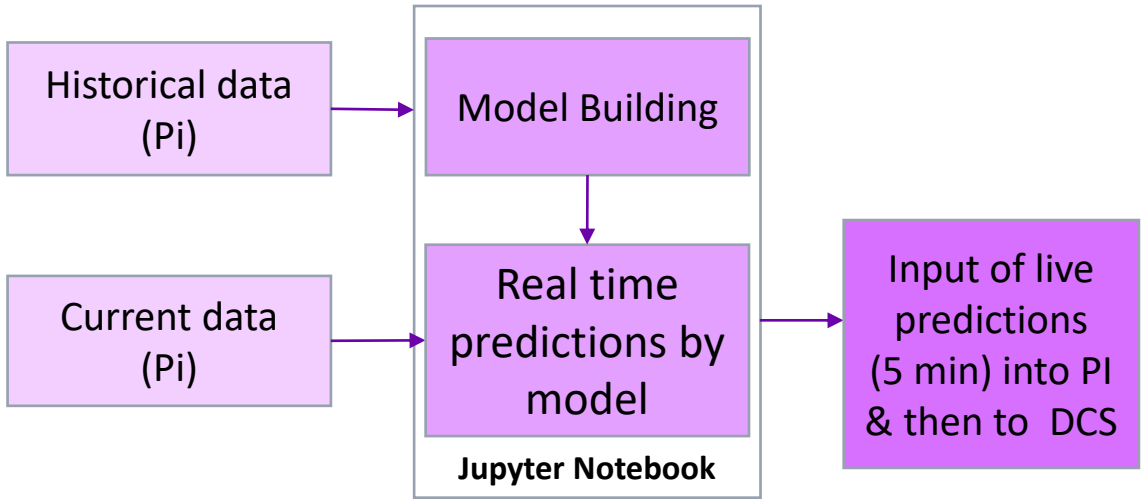
Dashboard for Live S/S Monitoring



Dataflow



Key Benefits

Throughput Optimization
Real-time prediction of S/S can help in identifying the potential opportunities to optimize the Roaster throughput

Quality Assurance
As S/S is a Critical Quality Parameter in Roasters, the Soft Sensor is helping us in ensuring the quality product

Cost Avoidance
It eliminates frequent lab analysis and the need for an online analyser, thus avoiding the Capex & Opex

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Efficiency Monitoring : SO2 Blower (2800 KW)

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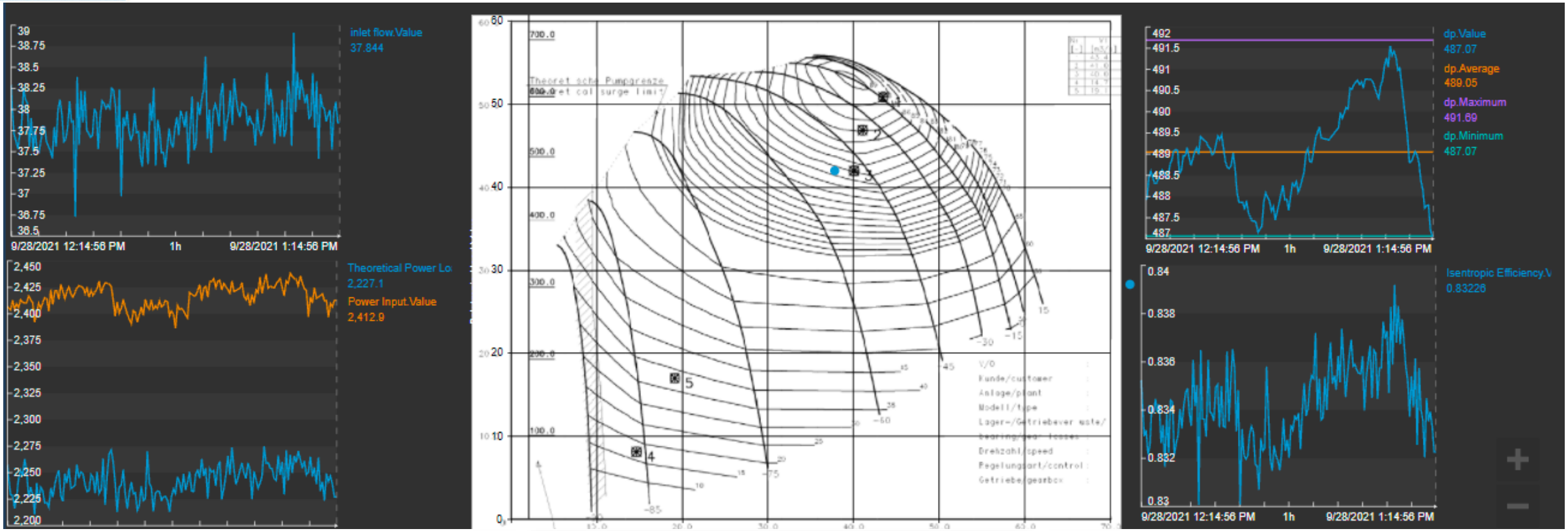

Challenge

SO2 blower is one of the most power intensive equipment in hydro smelting. There were many instances when SO2 Blower consumed more energy than designed nominal operations.

Solution Developed

Took all relevant Parameters responsible for efficiency, developed equation to derive actual efficiency and plotted it against the ideal curve

Benefits

- Real-time blower operating region
- Real-time comparison of actual power consumption with ideal power

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SPC/SQC/Control Charts for Mills & Smelters

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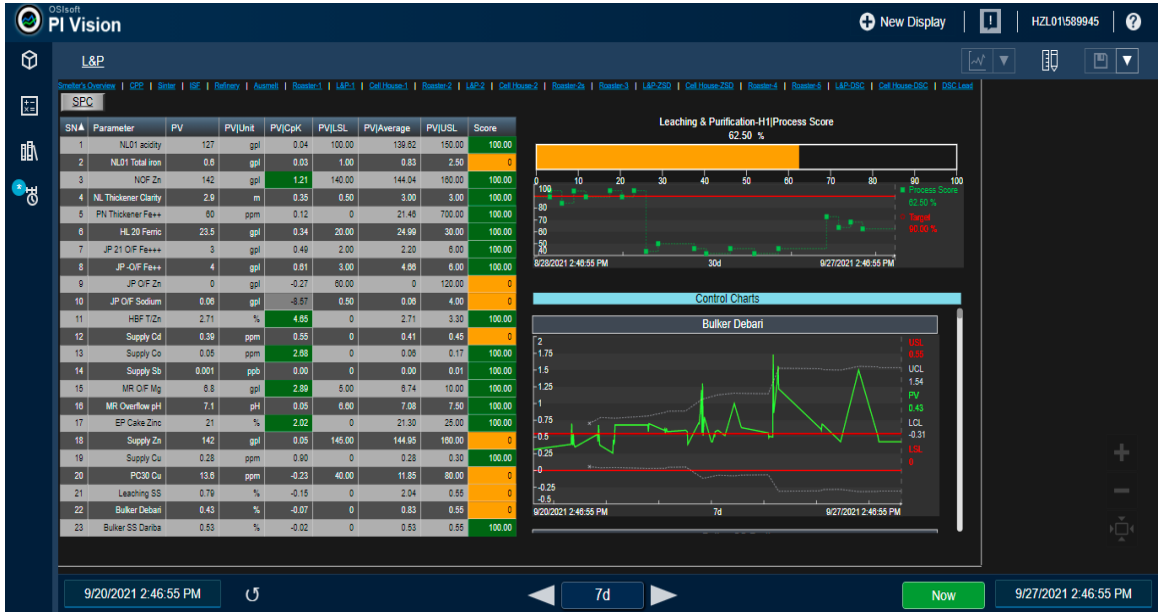
Control Charts for Mills

SPC & Scorecards for Smelters



- The SPC/SQC and Process scorecards have been automated by developing them on PiVision and additional functionalities such as CpK, Process Scores, Status and the deviation time have also been incorporated in the dashboard for better utilization.

KPI Benefits: Process Streamlining, Better Process Control & Improved Process Effectiveness

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Customized dashboards and report generation on PowerBI

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SKM: Truck Performance - Shift

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C
A
B

Date
23/08/2021

Truck No	Operator ID	Machine Running Hours	Transmission Hours	Idle Hours	Idle Time %	Total Distance Travelled (KM)	Overspeed Count	Speed (DT/MRH)	Speed (DT/Trans H)	Engine Fuel Rate (LPH)	Fuel Consumed (L)	Reverse Time (h)
CT-01	RDL292.RATTAN SINGH.LPDT	0.02	0.00	0.0	100.0	0	0	0.0	0.0	Infinity	0.2	0.00
CT-02	RDL427.SURESH KUMAR .LPDT	6.23	4.21	2.0	32.4	41	0	6.6	9.7	78.44	330.1	0.00
CT-04	RDL424.ROHIT RANA .LPDT	4.30	0.00	4.3	100.0	0	0	0.0	0.0	Infinity	283.4	0.00
CT-05	RDL290.DALEEP SINGH.LPDT	5.84	4.97	0.9	14.9	41	0	7.1	8.3	60.38	300.1	0.00
CT-06	RDL 374 GURVINDAR SINGH	5.20	2.02	3.2	61.2	24	0	4.6	11.9	86.63	174.9	0.00
TH601	CC5C78.NARAYAN LAL JAT.LPDT	0.00	0.00	0.0	100.0	0	0	0.0	0.0	Infinity	0.0	0.00
TH602	RDL250.UMRAV YADAV .LPDT	0.00	0.00	0.0	NaN	0	0	0.0	0.0	NaN	0.0	0.00
TH603	RDL52.BHAGWAT SINGH RATHORE .PC	6.02	3.92	2.1	34.9	35	0	5.9	9.0	52.28	204.9	0.40
TH604	RDL040.RAMESHWARLALLAL LPDT	6.47	4.26	2.2	34.2	34	0	5.2	7.9	51.56	219.7	0.20
TH605	RDL515.SAMPAT LAL SUKHWAL LPDT	5.29	3.84	1.4	27.4	27	0	5.1	7.0	30.07	115.5	0.92
TH606	RDL50.ROOP SINGH CHOUHAN .LPDT	0.00	0.00	0.0	NaN	0	0	0.0	0.0	NaN	0.0	0.00
TH607	RDL022.HEERALALKHAROL LPDT	4.92	4.01	0.9	18.5	33	1	6.8	8.3	37.88	151.9	0.45
TH608	RDL138.KISHAN LAL GADRI	0.00	0.00	0.0	NaN	4	0	0.0	0.0	NaN	0.0	0.00
TH609	RDL132.KAILASH CHANDRA SHARMA .LPDT	6.05	3.01	3.0	50.3	22	0	3.6	7.1	39.87	120.1	0.55
TH610	RDL40.RAMESHWAR LAL JAT .PCSL	6.13	3.56	2.6	42.0	29	0	4.8	8.2	48.20	171.5	0.50
TH611	RDL135.DINESH GADRI.LHD	6.56	3.75	2.8	42.9	30	0	4.5	7.9	43.71	163.9	0.34
TH612	RDL49.VIJAY KUMAR KHATIK	5.55	3.03	2.5	45.4	24	0	4.4	8.1	43.80	132.8	0.55
TH613	RDL157.KAILASH CHANDRA GADRI	6.30	3.60	2.7	42.9	25	0	3.9	6.8	51.48	185.3	0.47
TH614	RDL022.HEERALALKHAROL LPDT	0.09	0.00	0.1	100.0	0	0	0.0	0.0	Infinity	0.2	0.00
TH615	RDL307.JOGINDRA SINGH	3.32	2.08	1.2	37.4	13	0	3.9	6.2	44.16	91.7	0.45
TH616	RDL135.DINESH GADRI.LHD	0.00	0.00	0.0	NaN	0	0	0.0	0.0	NaN	0.0	0.00
TH617	RDL293.JAVED AKHTAR.LPDT	4.72	3.47	1.2	26.4	26	0	5.4	7.3	31.85	110.7	0.41
TH618	RDL232.NEPAL SINGH .LPDT	0.02	0.01	0.0	61.0	0	0	0.1	0.4	0.00	0.0	0.00
TH619	RDL138.KISHAN LAL GADRI	6.00	4.40	1.6	26.7	34	0	5.6	7.7	43.96	193.4	0.54
Total	RDL52.BHAGWAT SINGH RATHORE .PC	89.05	54.14	34.9	39.2	441	1	5.0	8.1	38.85	2,103.2	5.78

Truck Violations Daily Trend

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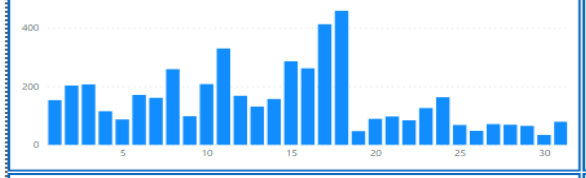
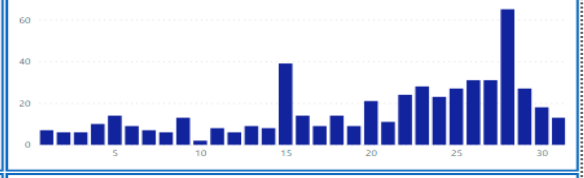
Month
August

Braking Violation Total: 4,908

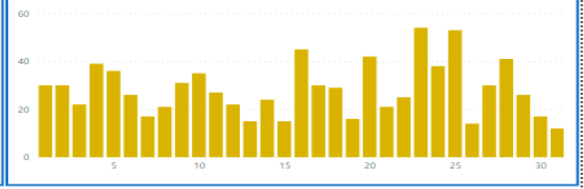


Parking Brake Violation Total: 515



Door Open Total: 861

E-Stop Activated Total: 883



Truck Late Start and Early Stop

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Date
19/09/2021

Transmission Start Time

Truck No	C	A	B
CT-02	00:00	08:02	16:34
CT-05	00:37	08:15	16:26
CT-06	00:28	08:23	16:59
TH601	00:00	09:50	16:47
TH602	00:00	08:00	16:00
TH603	00:12	08:06	16:47
TH604	01:08	08:44	17:04
TH605	00:53	08:16	16:44
TH607	00:19	08:59	17:11
TH608	00:03	09:04	16:34
TH609		09:08	16:43
TH610	00:15	10:24	17:41
TH612	02:07	09:13	18:03
TH613	00:00	09:15	16:46
TH614	00:09	09:14	16:56
TH615	05:24	08:29	17:43
TH616	00:48	09:07	16:58
TH617	00:05	08:31	16:41
TH618	00:04	09:18	16:57
TH619	01:40	09:27	16:51

Transmission End Time

Truck No	C	A	B
CT-02	07:46	13:47	23:22
CT-05	07:23	13:51	22:27
CT-06	06:23	13:59	21:53
TH601	07:41	14:49	21:48
TH603	07:12	15:03	23:50
TH604	07:53	15:28	22:30
TH605	06:50	15:17	22:57
TH607	06:38	15:19	22:16
TH608	06:45	14:35	22:40
TH609		15:57	23:51
TH610	01:37	13:48	17:43
TH612	05:55	15:09	23:50
TH613	06:15	14:35	23:50
TH614	07:43	15:05	22:34
TH615	07:32	15:43	22:50
TH616	06:25	14:40	22:30
TH617	06:25	14:32	23:53
TH618	07:10	14:42	23:44
TH619	07:16	15:55	23:27

Machine Running Start Time

Truck No	C	A	B
CT-01	07:51	08:08	
CT-02	00:33	08:00	16:00
CT-05	00:37	08:00	16:00
CT-06	00:00	08:07	16:00
TH601	00:00	08:37	16:45
TH602	00:00	08:00	16:00
TH603	00:11	08:06	16:47
TH604	01:06	08:42	17:03
TH605	00:50	08:16	16:26
TH607	00:19	08:59	17:06
TH608	00:03	09:02	16:33
TH609	07:08	09:07	16:00
TH610	00:13	10:23	17:40
TH612	02:06	09:10	16:33
TH613	00:00	09:11	16:45
TH614	00:09	09:13	16:53
TH615	05:23	08:27	17:43
TH616	00:48	09:03	16:57
TH617	00:05	08:31	16:40
TH618	00:03	09:13	16:53
TH619	01:39	09:19	16:50

Machine Running End Time

Truck No	C	A	B
CT-01		08:08	
CT-02	07:46	13:48	23:22
CT-05	07:24	13:51	22:27
CT-06	06:23	13:59	21:54
TH601	07:43	14:51	22:36
TH603	07:12	15:03	23:50
TH604	07:53	15:28	22:35
TH605	06:50	15:40	23:11
TH607	07:55	15:19	22:51
TH608	06:45	14:35	22:47
TH609	07:08	15:57	23:51
TH610	01:49	13:48	17:43
TH612	05:55	15:09	23:55
TH613	06:15	14:35	23:50
TH614	07:43	15:05	22:34
TH615	07:32	15:43	22:50
TH616	07:12	14:54	23:20
TH617	06:25	15:38	23:53
TH618	07:10	14:47	23:44
TH619	07:15	15:55	23:30

Truck Excessive Idling

HINDUSTAN ZINC

C
A
B

Date
19/09/2021

Truck-wise Excessive Idling

Truck No	Idle Count	Idle Time
CT-01	1	50
CT-02	1	25
CT-04	0	479
CT-05	1	36
CT-06	1	16
TH601	0	0
TH602	0	0
TH603	0	0
TH604	2	105
TH605	0	0
TH606	0	0
TH607	2	93
TH608	4	105
TH609	0	0
TH610	1	27
TH611	0	0
TH612	0	0
TH613	2	88
TH614	2	61
TH615	0	0
TH616	0	0
TH617	1	18
TH618	2	114
TH619	1	21
Total	21	1,238

Excessive Idling Start-Stop

TH614

Truck No
TH614

S.No.	Idling Start	Idling Stop	Idle Time
1.00	01:13	01:28	16
2.00	05:30	06:14	45

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Customized dashboards and report generation on PowerBI

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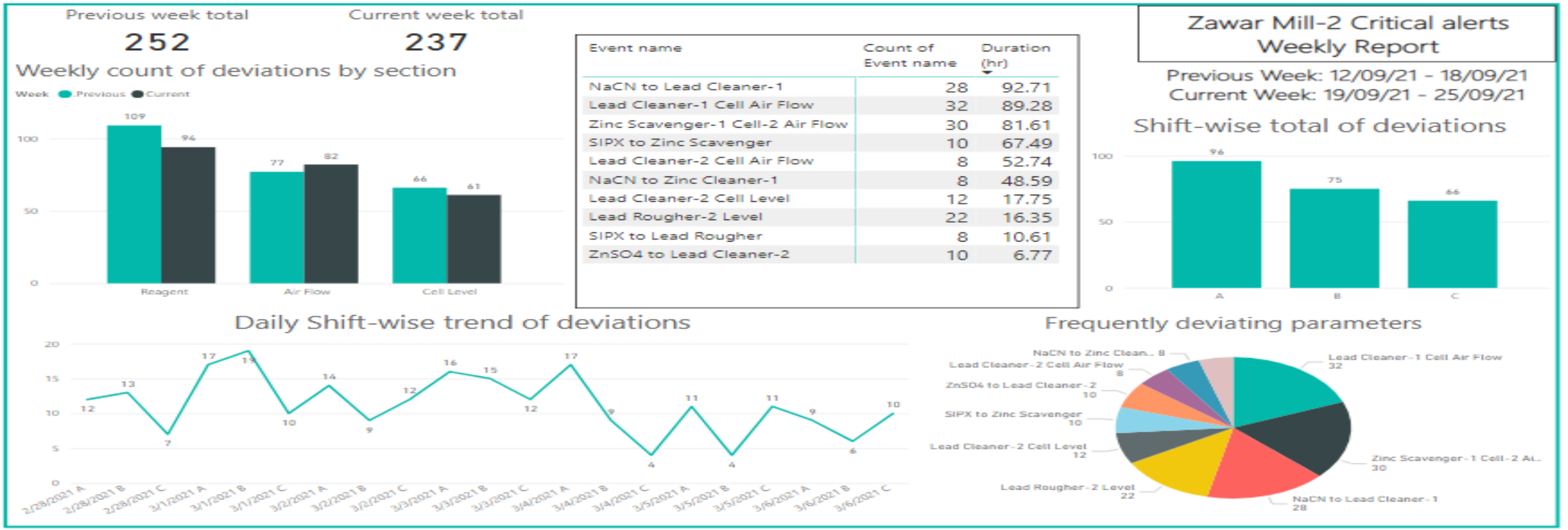

Weekly Process Deviation Report

- The process deviations are being tracked in Pi System by configuring eventframe analyses, which are then analyzed on PowerBI to determine the frequently deviating parameters and root cause of the deviation.

KPIs Impacted : Better decision making, Improved Process Stabilization

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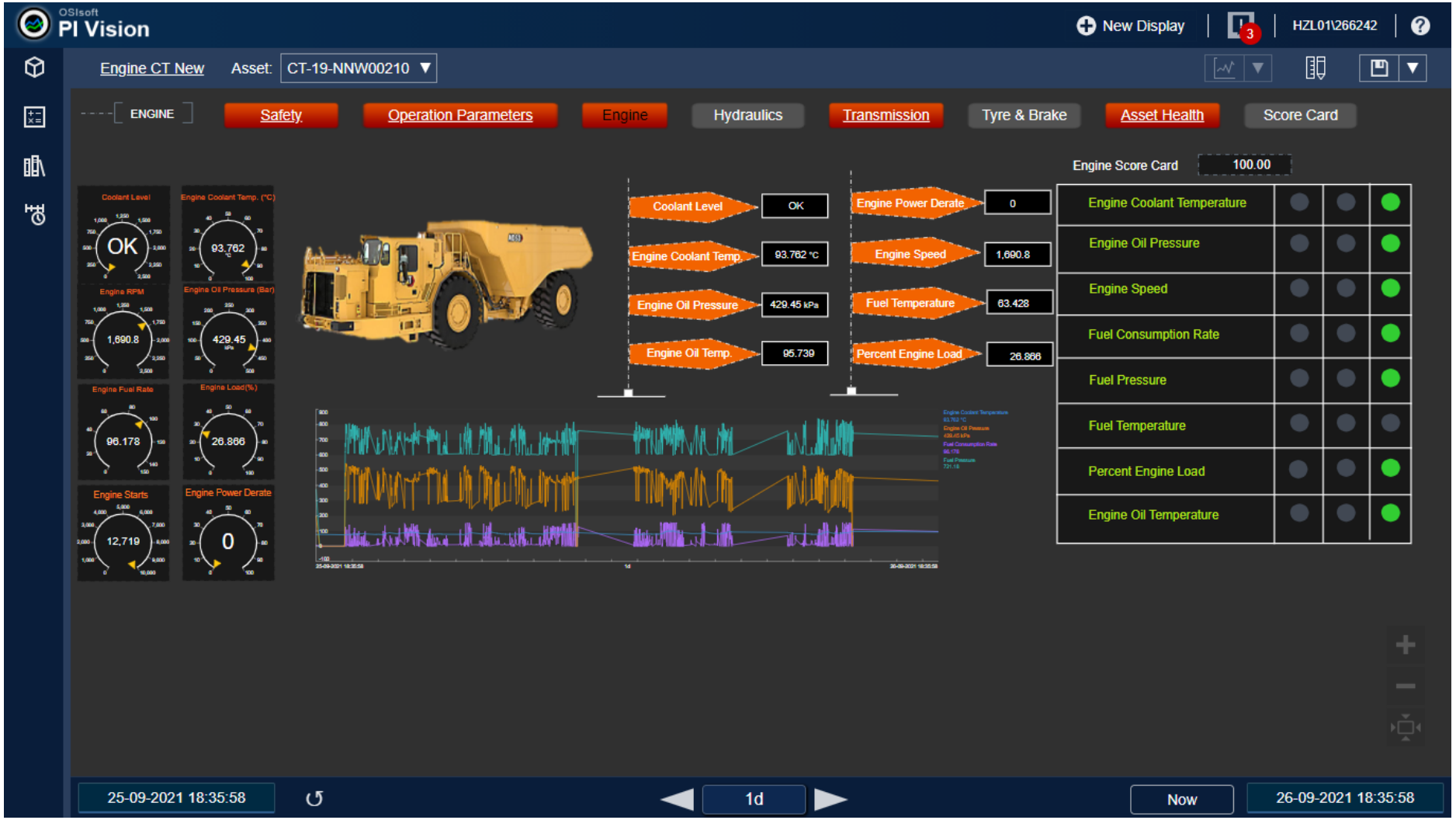
Real time Health Monitoring for UG Fleet : CBM



- **Enabled to track comprehensive KPI and compare different assets**
- **Condition based sequencing of fleet for maintenance resulting in effective use of maintenance bay and improved productivity**
- **Historical data of asset health and maintenance helps in component replacements**

Impact Savings

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Through digital transformation Industry can target benefits

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5-10%	10-15%	85%	10-15%	10-15%
Efficiency	Productivity	Forecasting accuracy	COP reduction	OEE improvement

- Grinding media optimization
- Man hour saving
- OEE improvmnt 3%
- Reagents optimization

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Future expectations from OSIsoft PI System development

Capabilities OSIsoft PI System should have

Android, IOS and windows based App development

Notification counter

Automated reports of PI Vision display & Provision to convert the display in pdf

Pareto capability in PI Vision

In built Analytical Engine

Pradeep Mahajan

Principal Architect – Digital Smart Manufacturing

- Hindustan Zinc Limited, part of Vedanta Resources Plc
- pradeep.mahajan@vedanta.co.in

Shrenik Shah

Vice President Sales & Marketing

- Ecubix (owned by VCS)
- shrenik.shah@ecubix.com

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linkedin.com/company/aveva

@avevagroup

ABOUT AVEVA

AVEVA, a global leader in industrial software, drives digital transformation for industrial organizations managing complex operational processes. Through Performance Intelligence, AVEVA connects the power of information and artificial intelligence (AI) with human insight, to enable faster and more precise decision making, helping industries to boost operational delivery and sustainability. Our cloud-enabled data platform, combined with software that spans design, engineering and operations, asset performance, monitoring and control solutions delivers proven business value and outcomes to over 20,000 customers worldwide, supported by the largest industrial software ecosystem, including 5,500 partners and 5,700 certified developers. AVEVA is headquartered in Cambridge, UK, with over 6,000 employees at 90 locations in more than 40 countries. For more details visit: www.aveva.com

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