Reliability / Maintenance Improvement

SYS's Next Leap, Digitalization for Maintenance & Operation System

THAILAND

SIAM YAMATO STEEL

Presenters : Mr. Wanassapon Tepakhan
(Maintenance2 Engineer)
Mr. Tanawat Sudtanukurn
(Rolling Mill2 Engineer)
Company : Siam Yamato Steel (Thailand)

Company profile

SYS MAPTAPUT PLANT

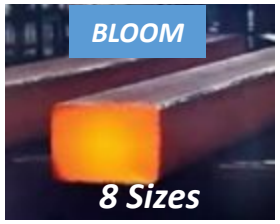
- Capacity: 600,000 ton per year
- Established: 1992
- Started Production: 1994
- Location: Maptaphut Industrial Estate, Thailand

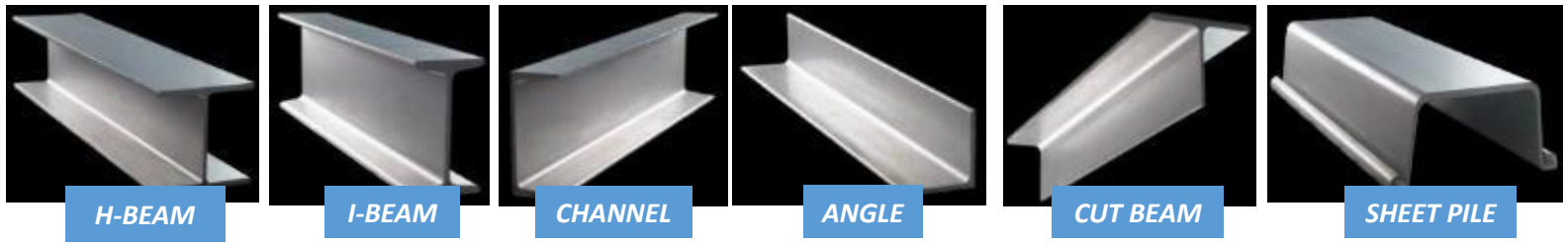
SYS HUAI PONG PLANT

- Capacity: 500,000 ton per year
- Established: 2006
- Started Production: 2010
- Location: WHA Eastern Industrial Estate, Thailand

THAILAND

"SYS Steel you can trust"





New-Gen SYS Team

Digital transformation is one of company policy to improve efficiency and fulfill customer need and expectation.
'New-Gen SYS' team' started to digitize maintenance and operation works by combining and centralizing the information with 25-year-old machines which is outdated, and different by technology and/or manufacturers.
The group successfully used the centralized information to analyze, visualize, and predict the process data to improve process efficiency.

"New-Gen SYS Team" consist of electrical and mechanical engineers from many departments. During the project, team members were equipped with new skills such as data science, data engineering, machine learning and other advanced analytics tools. Those trainings play an important role of driving the team forward to their goals.

May' 2019


Norachai S.
Scrum master


Anusorn B.
Team Leader

SYS Production Dep.

SYS Maintenance Dep.

SYS Engineering Dep.


Tanawat S.


Apirat H.


Wanassapon T.


Chanyuth M.


Anan K.


Narintorn S.

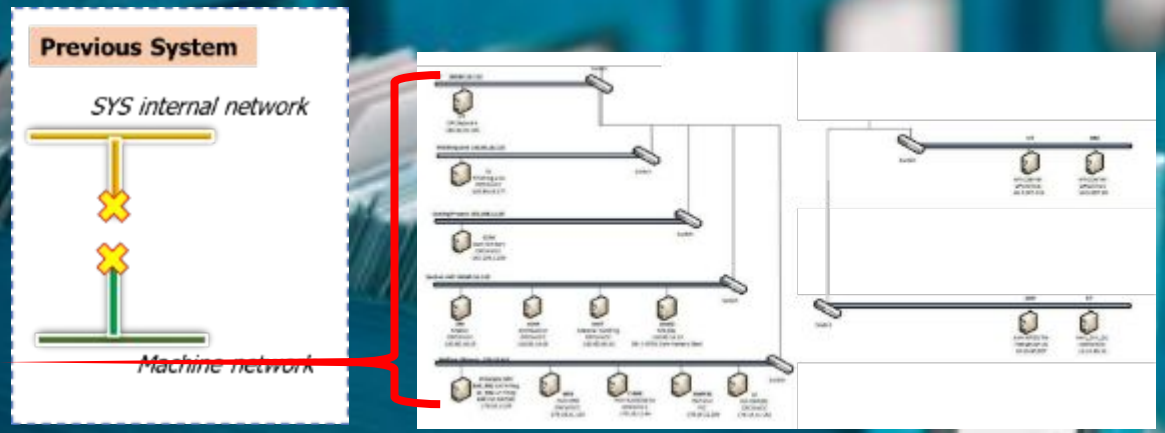

Noratap K.


Chanchanok C.


Auttawut H.

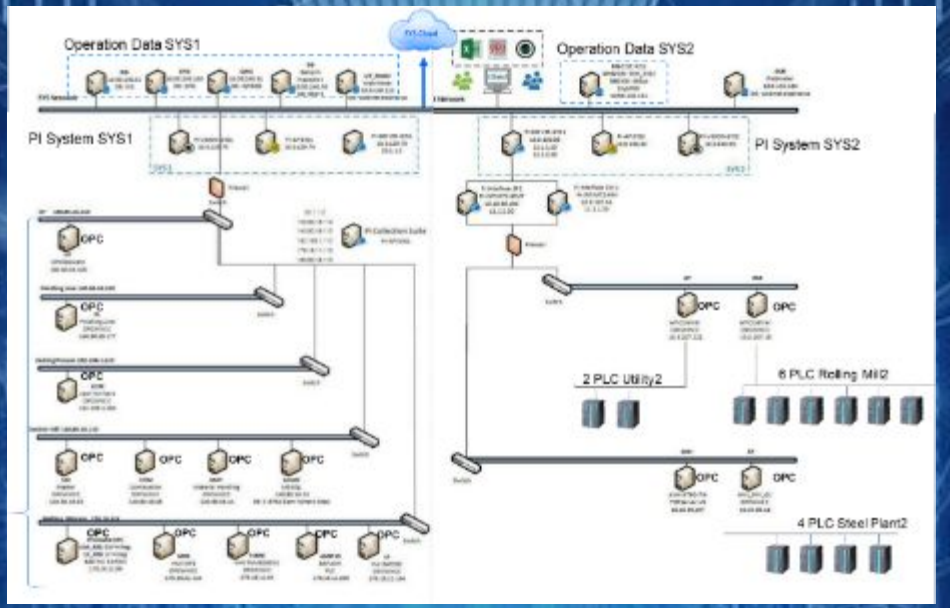

Suprawee S.

What we have



- Many data sources but not connected.
- Spot information.
- Take time & Hard to retrieve data.
- **Not timely to analyze** data for improvement.
- Manual & rekey record with human error.
- Hard to compare between Normal and Abnormal case.

What we need



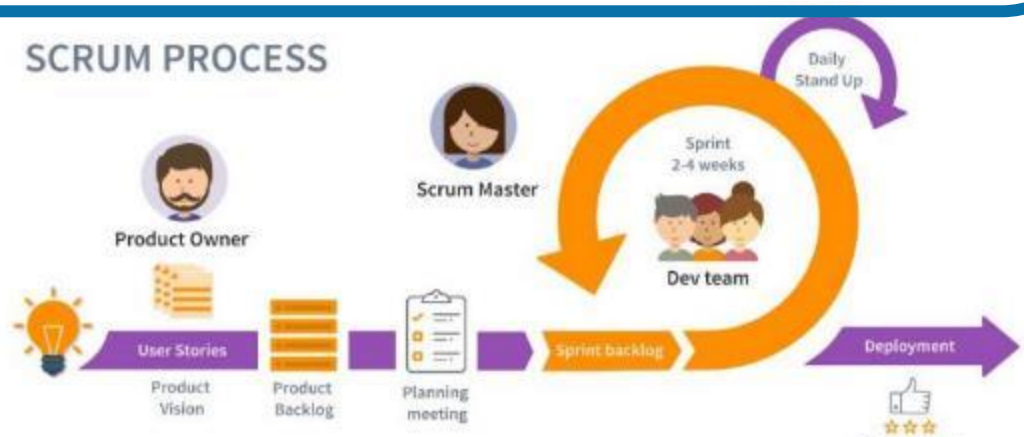
- **Real-time** monitoring and **notification.**
- Automated data recording & Centralization.
- Data warehouse.
- Visualization & Automatic Reports.
- Condition-based maintenance.
- Forecast & Prediction.
- Machine Learning.

Customer Need ?

- Managers
- Engineers
- Operators

Product Backlogs

SP	Task List PI Project	Data sour	S.P	V.F	BFTB	Ranki	Sprin
SP1,2	O2 Consumption	PLC	5	89	18	1	1
SP1,2	spray water cooling flow rate	PLC	5	89	18	1	1
RM1	Rolling gap	PLC	5	89	18	1	1
RM1	RHF temperature	PLC	5	89	18	1	1
MT1	CEMs RHF RM1	PLC	5	89	18	1	1
SP1,2	NG Consumption	PLC	5	89	18	1	2
RM1	Rolling parameter - temperature	PLC	5	89	18	1	2
SP1,2	Casting Speed	PLC	5	89	18	1	2
MT1	Skid pipe condition	PLC	5	89	18	1	2
RM1	Rolling parameter - load cell	PLC	5	89	18	1	2
SP1	Spray water temperature	PLC	5	89	18	1	3
SP1	Mold level	PLC	5	89	18	1	3
SP1	Power off time	PLC	8	89	11	11	3
SP1	Mold water temperature	PLC	8	89	11	11	3
SP1	Power on time	PLC	8	89	11	11	4
SP1	Turn around time	PLC	8	89	11	11	4
RM1	RSM - Load cell	PLC	8	89	11	11	4
SP1	Tap to Tap time	PLC	8	89	11	11	5
SP1	เวลา เปิด-ปิด Roof	PLC	8	89	11	11	5
RM1	Rolling parameter - current	PLC	8	89	11	11	5
RM1	Rolling parameter - torque	PLC	8	89	11	11	5
RM1	Rolling time & Productivity	PLC	13	89	7	21	5
RM1	RSM - Productivity (Pcs/hr)	PLC	5	34	7	23	5
MT1	Motor HYD - Section mill	PLC	5	34	7	23	5
MT1	Motor HYD - EAF	PLC	5	34	7	23	5



Sprint1
5 topic.

Sprint2
5 topic.

Sprint3
4 topic.

Sprint4
3 topic

Sprint5
14 topic.

Tanawat S.

Tools for Achieving our Target

Data Engineer. Data Scientist. -Data Analytic. -Business.

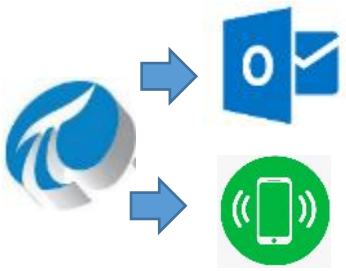
SAM YAMATO STEEL

Automated data recording & Centralization, Data warehouse

Real-time monitoring

Visualization & Automatic Reports

Real-time notification



Condition-based maintenance

Forecast & Prediction

Tanawat S.

Sprint(Action) Follow up

SAM YAMATO STEEL

Trello

Smart plant Information

Product Backlog

การประชุมวันที่ 31/10/62 Sprint 5 develop หน้า ปริมาณการใช้ไฟฟ้า SP2&RM2 ให้เร็วขึ้น และ ทำ slide SCG Award

1

การประชุมวันที่ 17/10/62 sprint 4&5 Back software และ การคำนวณค่าไฟฟ้า

+ เพิ่มการ์ดอีกใบหนึ่ง

To Do

OEE (Q) Loss sprint 6

Loadcell BD,UR,UF Mill

1

Simplify

SP2 Data Tracking (SPIS)

Simplify

RM1 Data Tracking

1

Cost sprint 6

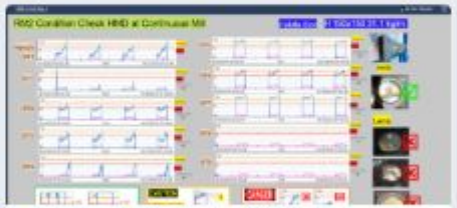
Tag เก็บอายุกระบอก Hyd RM1 เป็น Meter based และ นำมาเพิ่มเติมกำหนดอายุในการเปลี่ยน

Cost sprint 6

Tag เก็บอายุกระบอก Hyd SP1 เป็น Meter based และ นำมาเพิ่มเติมกำหนดอายุในการเปลี่ยน

+ เพิ่มการ์ดอีกใบหนึ่ง

In Progress



OEE (A) Sprint 5 Simplify

การตรวจสอบ condition HMD RM2

31 ตุลา 1

agile system Sprint 5

Training section manager

17 ตุลา

OEE (A) Sprint 4

Preventive Maintenance Server SYS2

ช.วนัสพล ท.

20 กันยา

OEE (A) Sprint 4

Preventive Maintenance Server SYS1

ช. ธีรวุฒิ ศ.

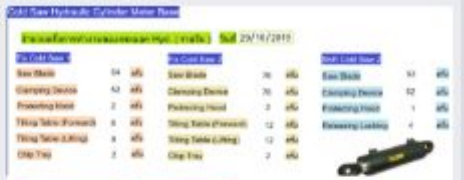
+ เพิ่มการ์ดอีกใบหนึ่ง

Done (waiting for Approve)

Cost Energy saving sprint 6

Monitor Heavy load SP2

21 พฤศจิกา 1



Cost sprint 6

Tag เก็บอายุกระบอก Hyd RM2 เป็น Meter based และ นำมาเพิ่มเติมกำหนดอายุในการเปลี่ยน

29 พฤศจิกา 1

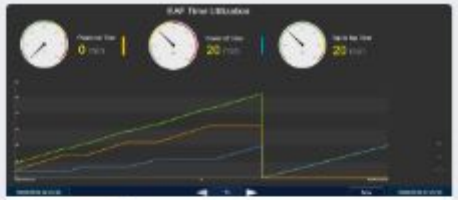
+ เพิ่มการ์ดอีกใบหนึ่ง

Finish

OEE (P)

EAF time utilize SP2

20 กันยา 1



OEE (P)

EAF time utilize SP1

20 กันยา 1 1

+ เพิ่มการ์ดอีกใบหนึ่ง

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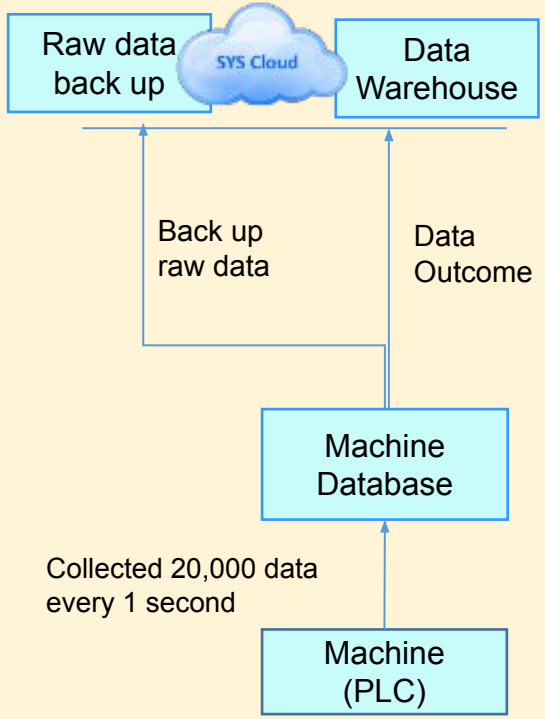
Connection & Collection Data

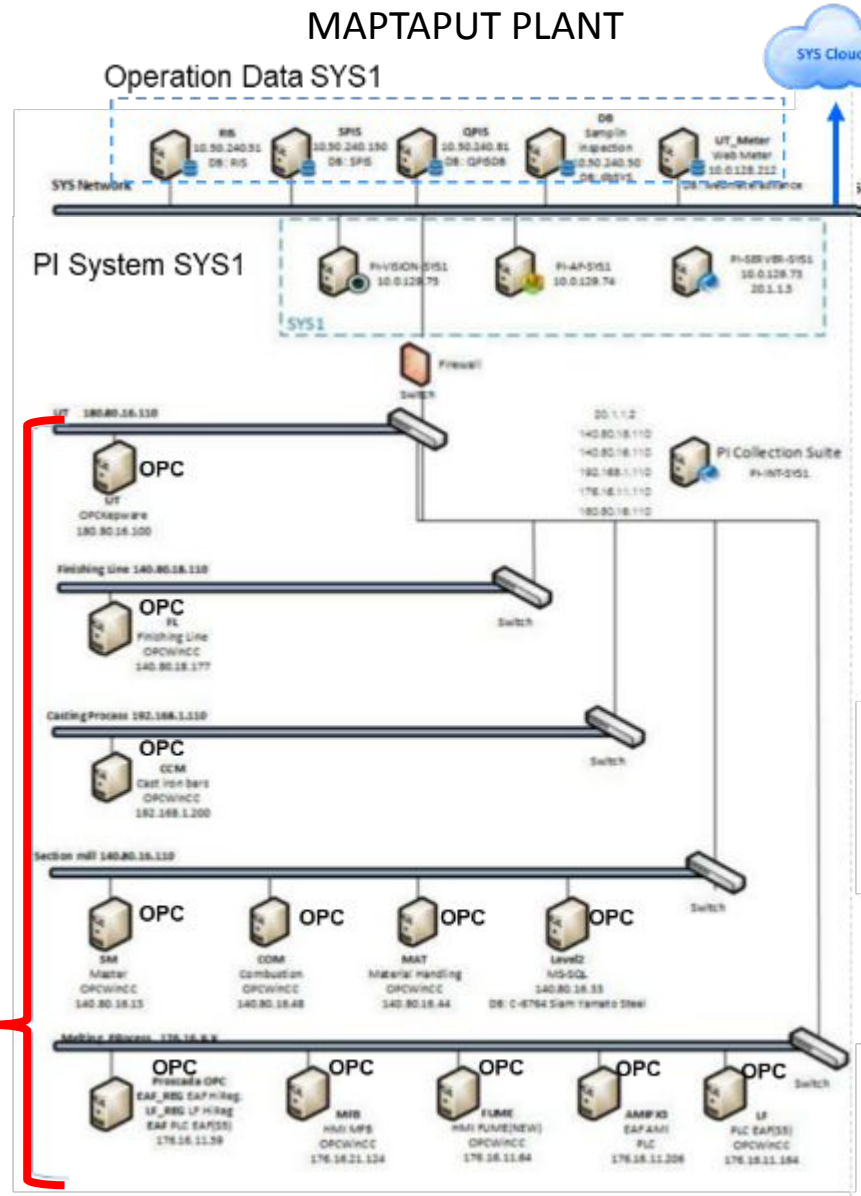
Implementation machine data



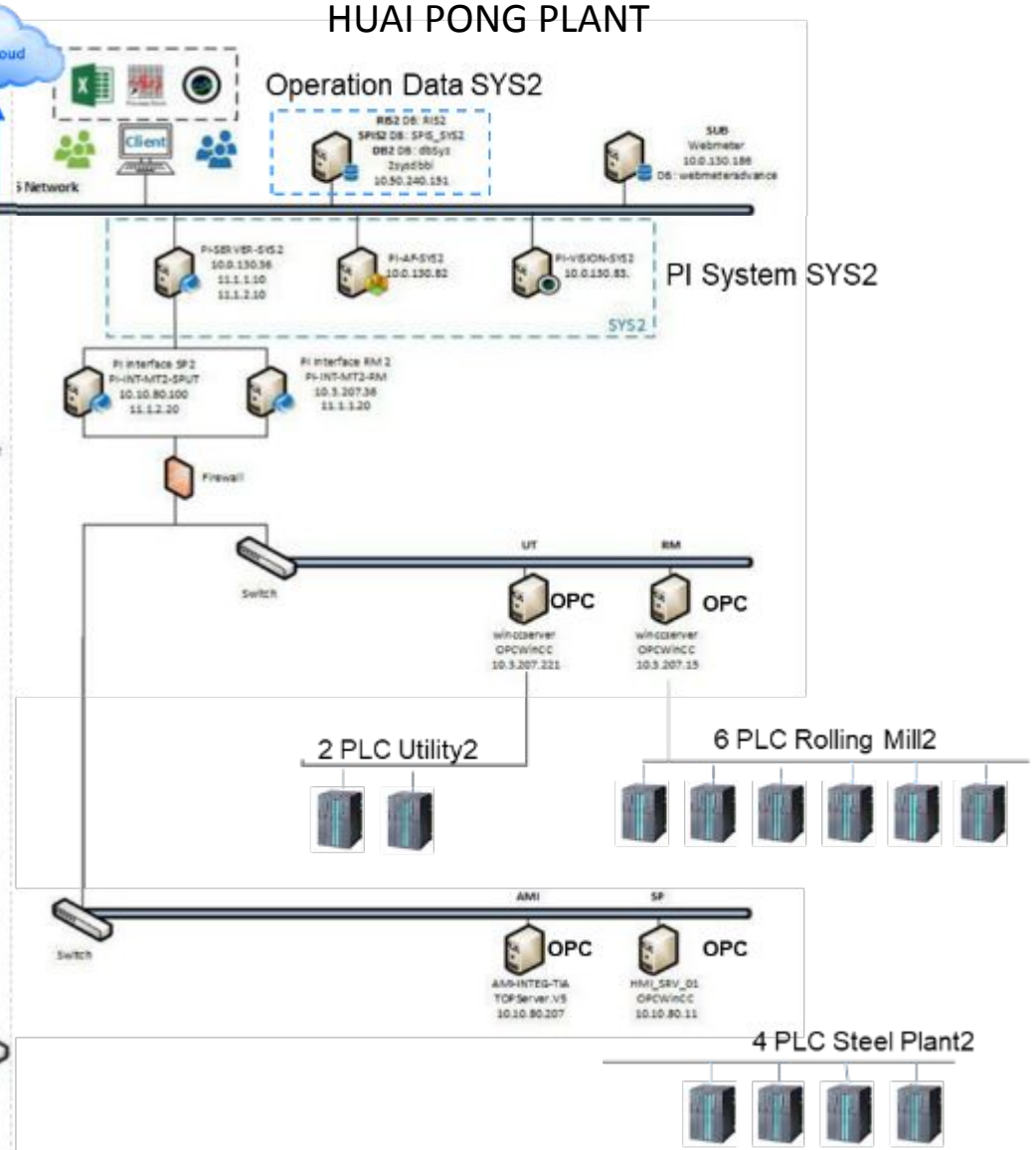
Rockwell Automation, SIEMENS, EMERSON, Schneider Electric, Honeywell, ABB, YOKOGAWA

25-year-old machines which is outdated.

SIAM YAMATO STEEL
MAPTAPUT PLANT



SIAM YAMATO STEEL
HUAI PONG PLANT



Wanassapon T.

Results Stories

1 SYS's Data Warehouse

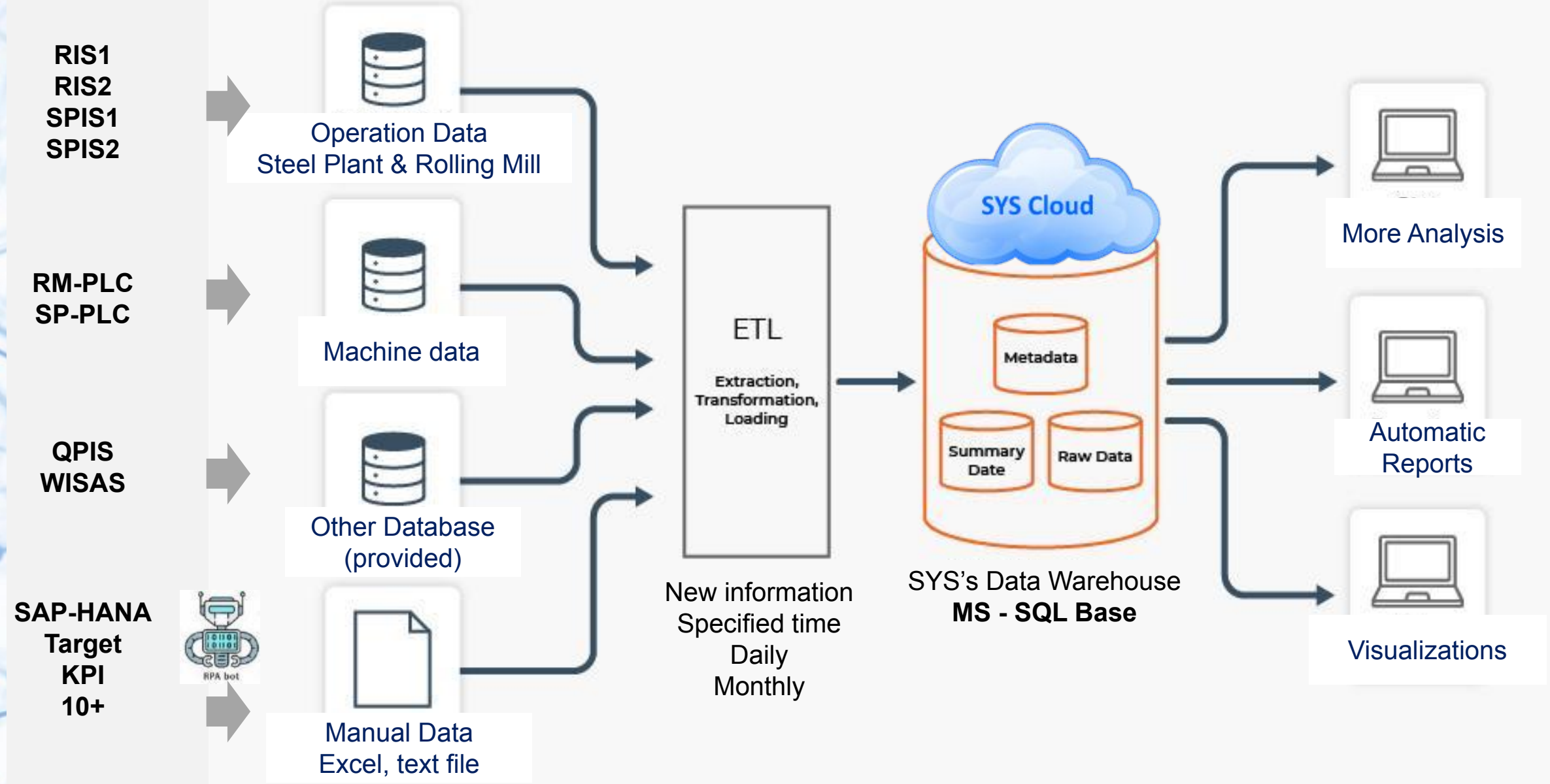
2 Automatic report.

3 Machine monitoring and Real time control chart

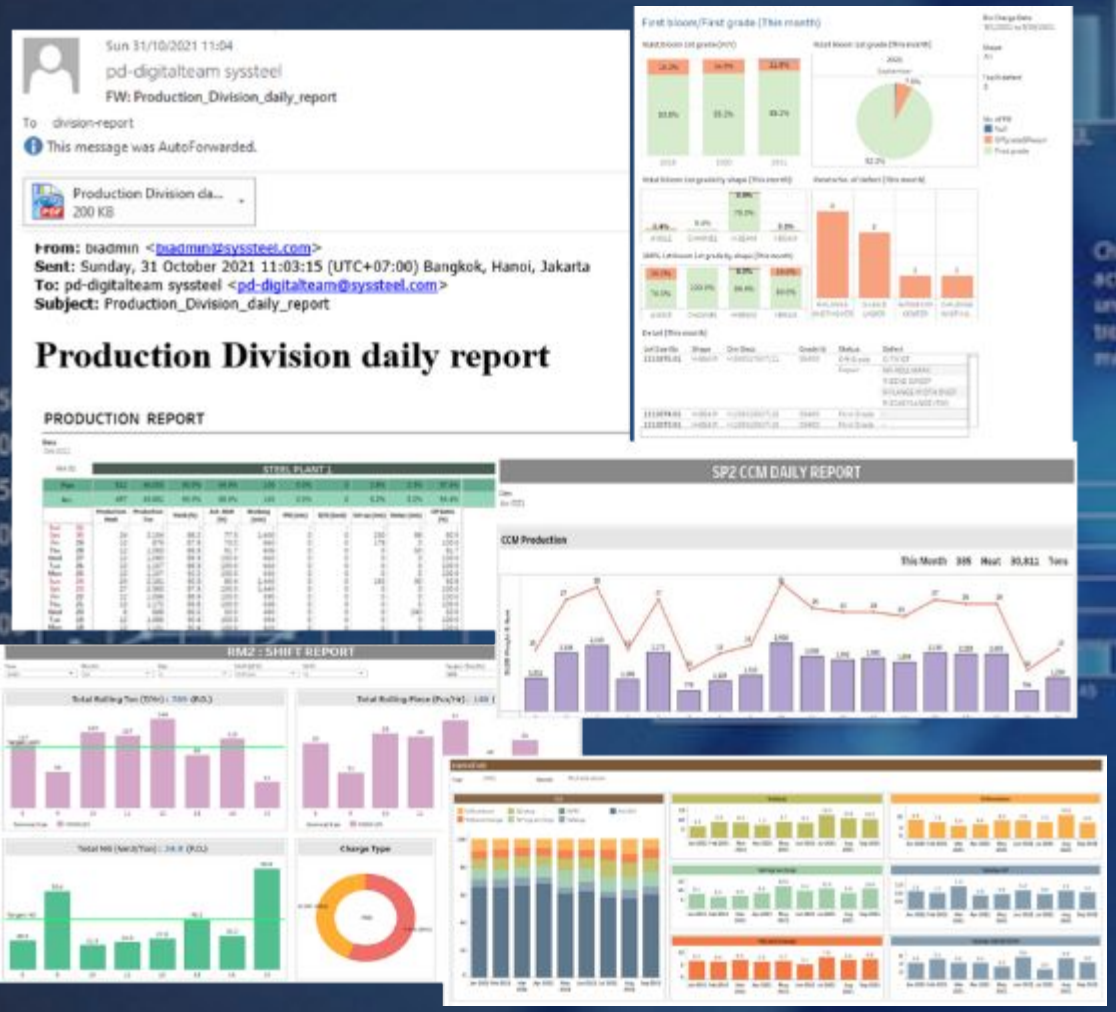
4 Predictive Analytic

- Main motor overload problem prediction.

1. SYS's Data Warehouse



2. Automatic & Interactive Reports



- **> 40 reports** are **automated**
- **More times** to concentrate control of core works
- Reduce Human error & Always on time

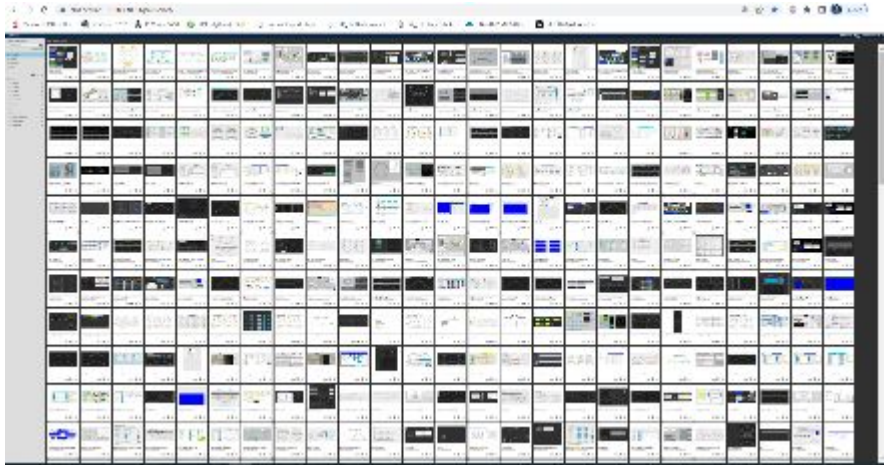
3. Machine Monitoring & Real time Control Chart

- **Reduce variation of Operation**
- **Control Chart & Dashboard Designed by ourselves**
- **Automatic UCL,LCL adjustment size by size**

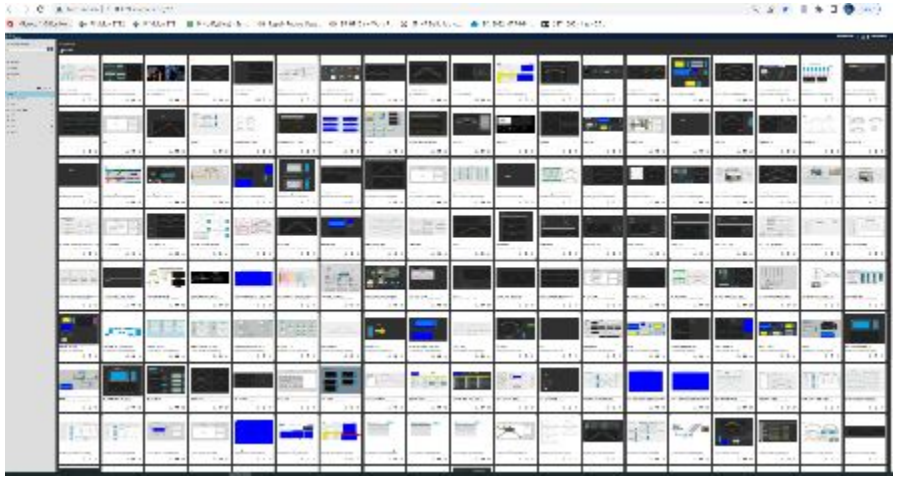
Tanawat S.

Other an Example dashboard

HP-Plant : >120 Dashboard



MTP-Plant : > 100 Dashboard

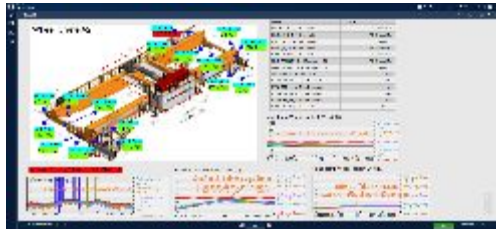


EAF Power Cable.

Monitoring and Replacement plan

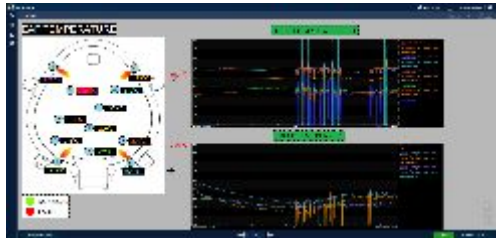
Over head Crane A2

Monitoring and Replacement plan



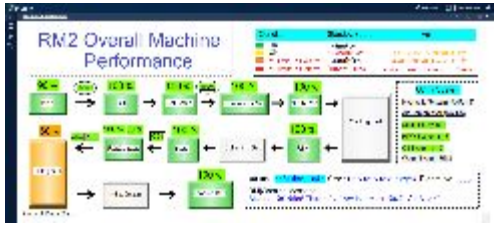
EAF Temperature

Monitoring and Replacement plan



Rolling Mill Overall Machine Performance

Monitoring and condition alarm



Overall Rolling Mill Process control.

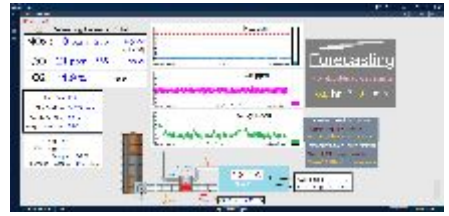
Monitoring and condition alarm

Overall Fume Plant

Monitoring and Replacement plan

CEMs Reheating Furnace

Monitoring and condition alarm



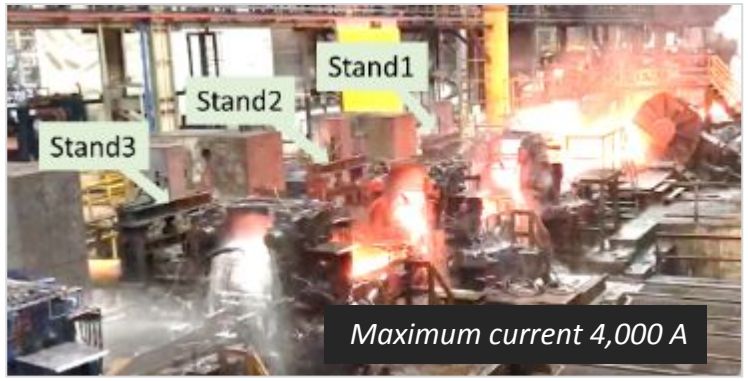
Overall Water Plant

Monitoring and Replacement plan

Wanassapon T.

Predictive Analytic : Continuous Mill Stand 1,2,3 Overcurrent Prediction

Trouble *, Motor drive units of continuous mill strand tripped with overcurrent with no obvious cause. This kind of event happened 10 times with average recovery cost of 14,000 USD/time and approximately 800 minutes of downtime.*



31 Parameters relate to this machine

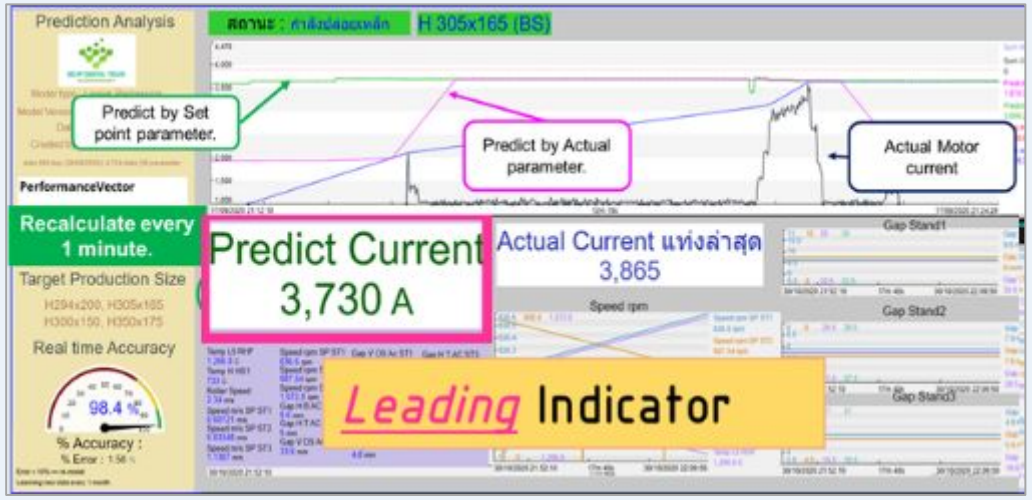
1. Production
Production Size
RHF Discharge temperature
Product temperature Front BD
Product temp Behind BD
Product temp HS1

2. Rolling Gap
Horizontal Gap Stand1
Horizontal Gap Stand2
Horizontal Gap Stand3
Vertical Gap Stand1
Vertical Gap Stand2
Vertical Gap Stand3

3. Production speed
Roller Speed Actual
Roller Speed Set point

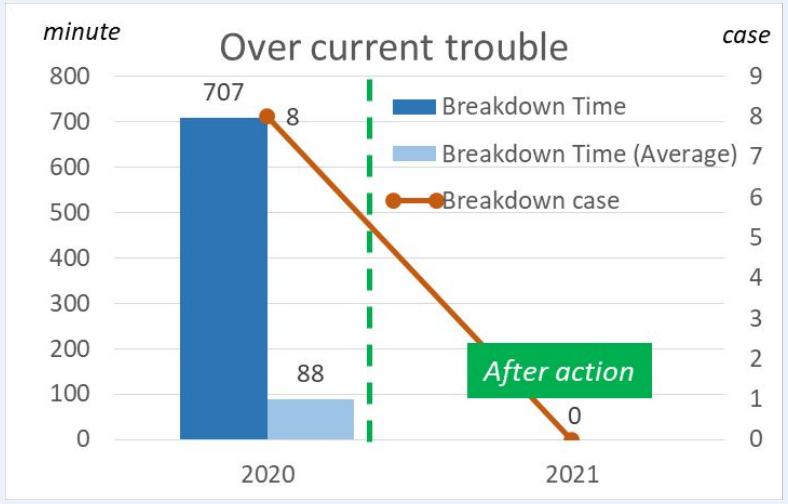
4.Main Motor
Motor Speed ST1
Motor Speed ST2
Motor Speed ST3
Motor Torque ST1
Motor Torque ST2
Motor Torque ST3
Winding Temp ST1
Winding Temp ST2
Winding Temp ST3

Predictive Analytic,
When explore the record, we end up with dataset of 31 parameters for 2 year period.



The first model to predict peak current was finished with only 61-65% accuracy.
As PDCA cycle continuously rolling, Model accuracy getting higher and higher. The final model is able to predict peak current with accuracy of 93-99%.

Most of relevant parameters are related to setup process. The model deployed to help operators verified their setup. As setup completed, the model will predict the peak current likely to happen before rolling start, If this current is more than 4000 A, operator will stop and recheck.



Wanassapon T.

Predictive Analytic : Continuous Mill Stand 1,2,3 Overcurrent Prediction

SAM YAMATO STEEL

Observation data

31 Parameters relate to this machine

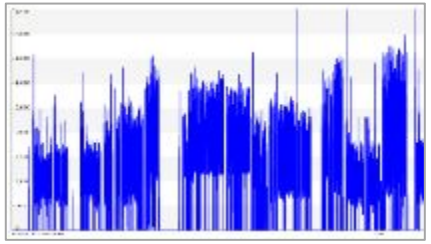
1. Production
Production Size
RHF Discharge temperature
Product temperature Front BD
Product temp Behind BD
Product temp HS1

2. Rolling Gap
Horizontal Gap Stand1
Horizontal Gap Stand2
Horizontal Gap Stand3
Vertical Gap Stand1
Vertical Gap Stand2
Vertical Gap Stand3

3. Production speed
Roller Speed Actual
Roller Speed Set point

4.Main Motor
Motor Speed ST1
Motor Speed ST2
Motor Speed ST3
Motor Torque ST1
Motor Torque ST2
Motor Torque ST3
Winding Temp ST1
Winding Temp ST2
Winding Temp ST3

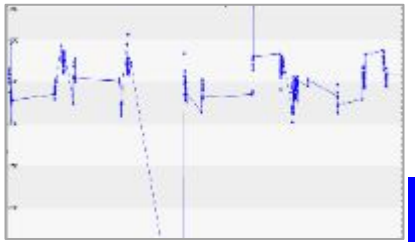
SYS Collection data every 1 second.



1 month Raw data collection(1 parameter)

3,637,800 data

Data cleansing



1,150 data

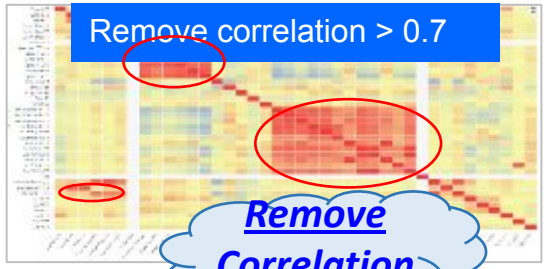
After data exploration. Only peak current of each product is required. So 1,150 data points were recorded in 1 month. As a result, analyzes record of 31 parameters for 2 years become much more easier.

Predictive Analytic

Collecting data 31 parameters (2 year.)

31 parameter

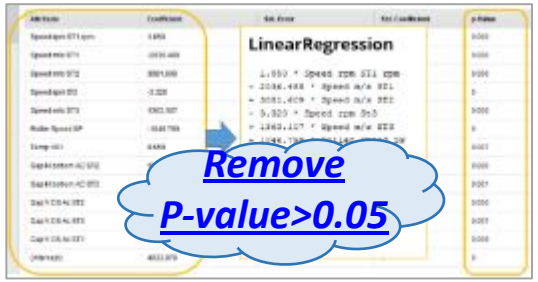
Make data cleaning by remove interdependent parameter(high correlation).



Remove Correlation

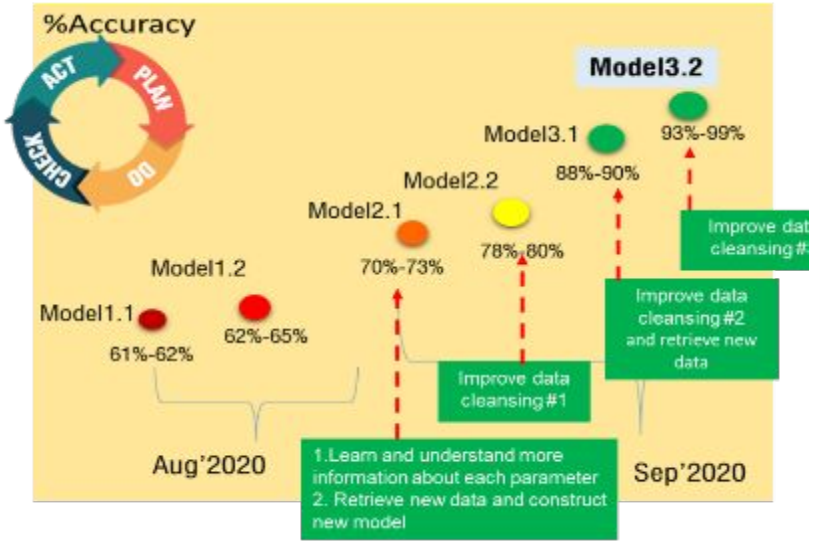
19 parameter

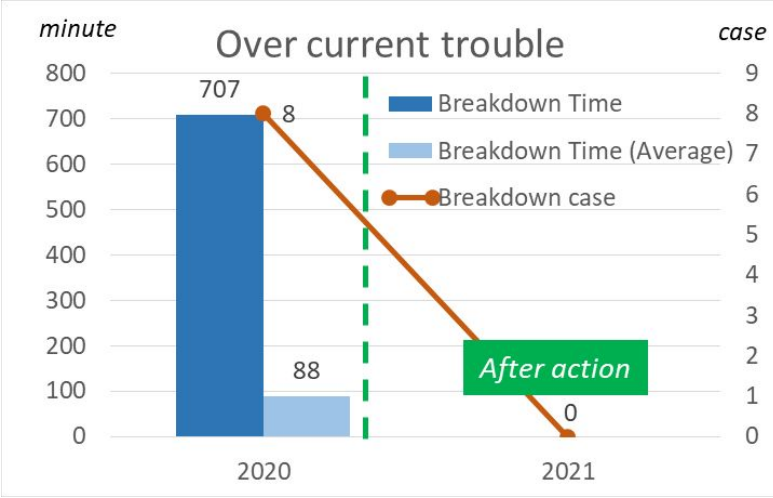
Remove insignificant parameters (P-value>0.05)



Remove P-value>0.05

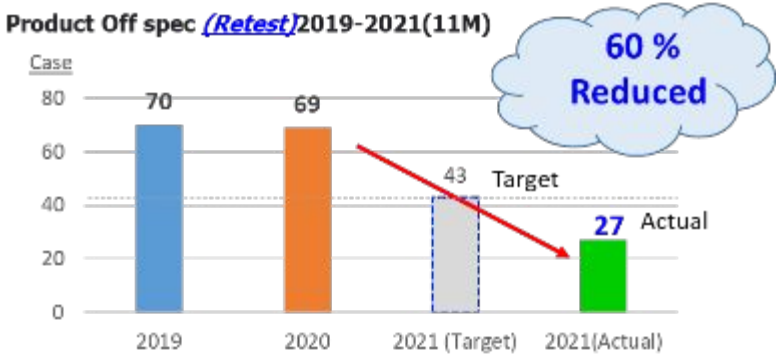
12 parameter

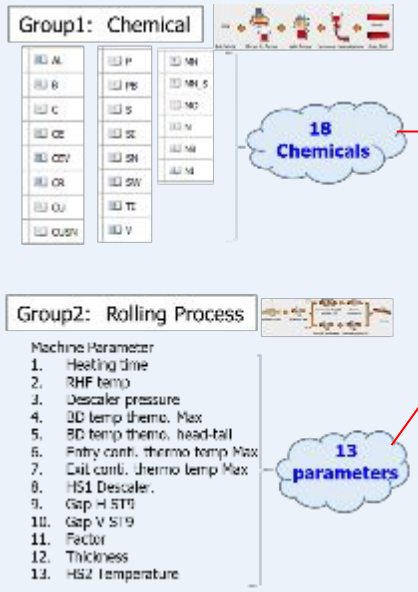


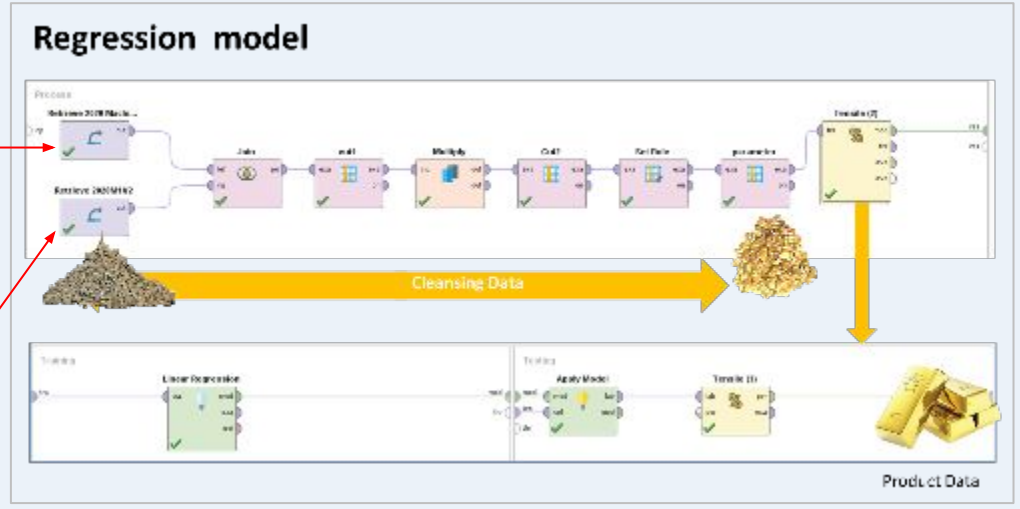


Mechanical Properties Prediction

An example of data analysis with Predictive Analytic is the use of machine data in production at Rolling Mill and chemical value data at Steel Plant to create predictive equations as well RapidMiner software in order to Predict mechanical properties, To adjust the production in the rolling mill production process to achieve the least negative effect, such as adjusting Thickness, Discharge Temperature, Rolling speed, Heating time.

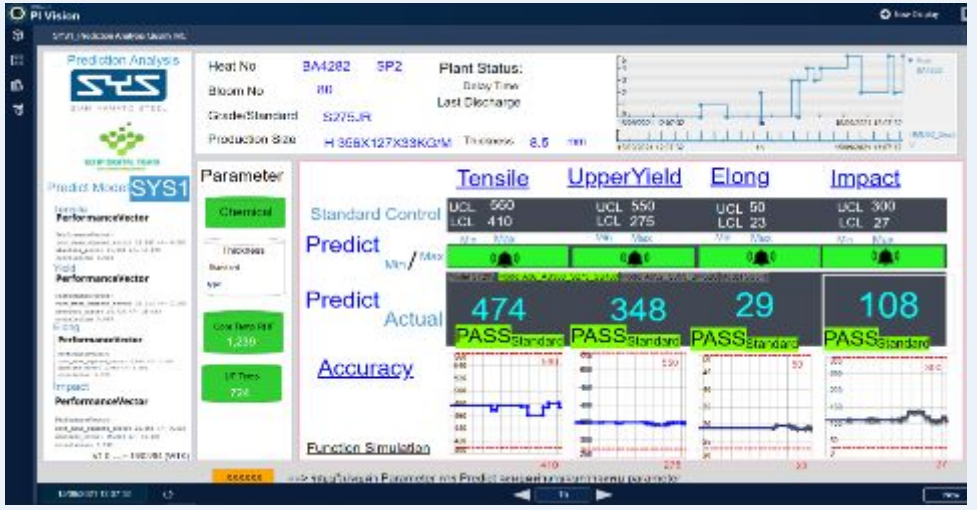






RapidMiner Studio

RapidMiner is a program that helps us create predictive equations. The resulting prediction equation was implemented on PI-AF and displayed on PI-Vision



Pi-Vision

Tanawat S.

Siam Yamato Steel

Thank you

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