

CYBERFACTORY NO.1

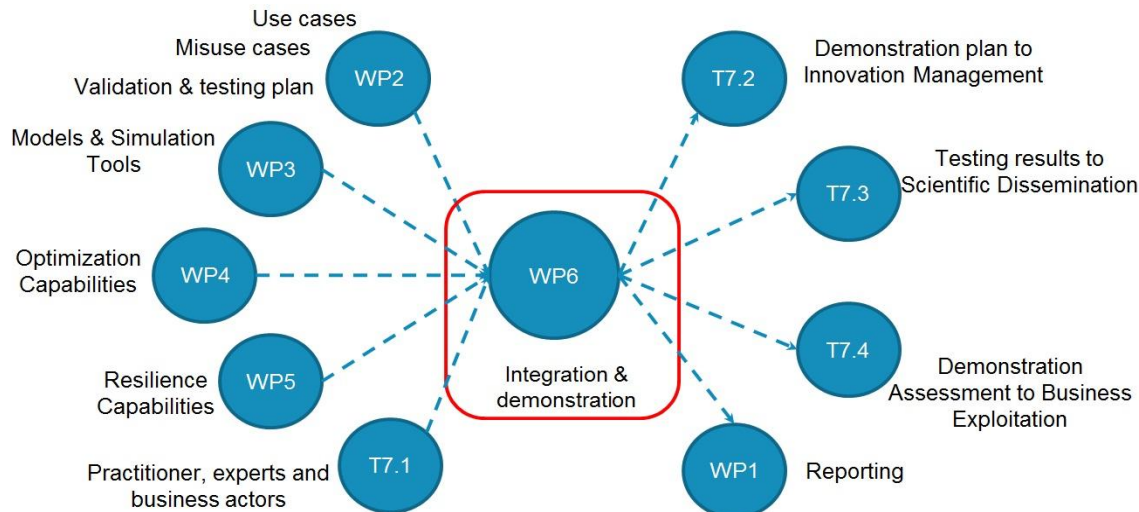
*Asset Tracking, Traceability, Predictive Maintenance
in Vestel's shop-floor by Ilhan Kaya, PhD.
WP6 leader*

The VESTEL logo is positioned in the bottom right corner. It consists of the word 'VESTEL' in a bold, white, sans-serif font, centered within a red rectangular background.

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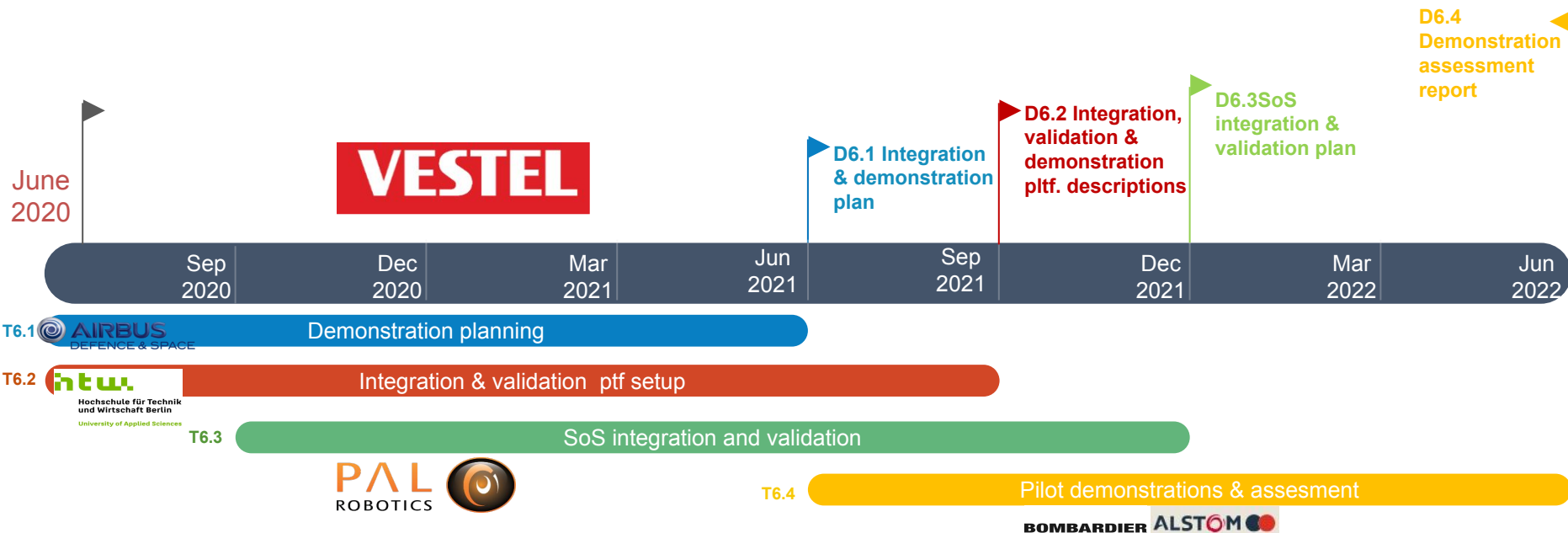
Goal

- WP6 aims at **integrating and validating CyberFactory#1 capabilities** developed in WP3-4-5 into pilot environments and testing platforms for
 - demonstration of project results
 - assessment of value added innovations
 - validation of operational benefits by pilot users in relevant / whenever possible in real environments.



WP6 - Integration & Demonstration

Timeline & Roles



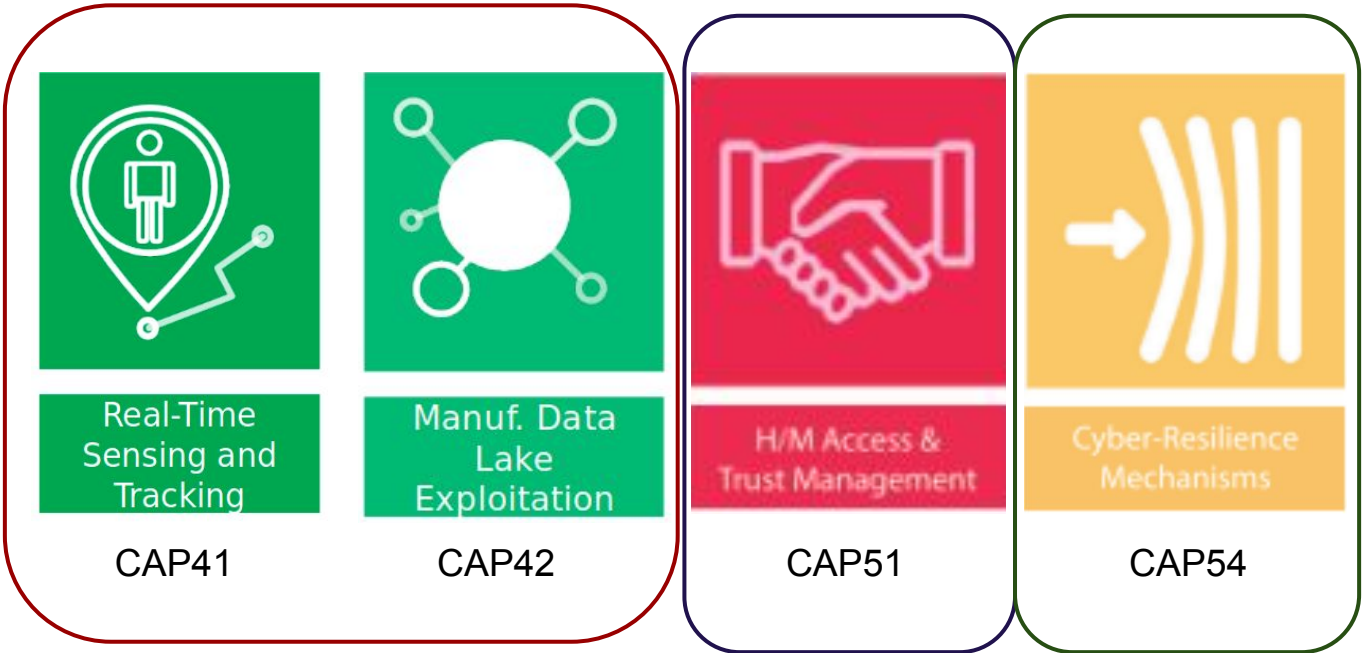
Secure and optimized factory information and logistic management

Turkish consortium



UC8 Owner:

VESTEL



Partner responsible :

VESTEL



Secure and optimized factory information and logistic management

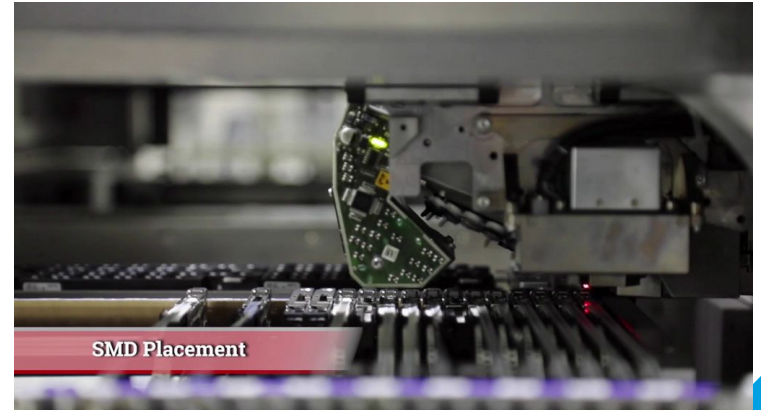
CAP41 - Real time sensing & tracking



UC8.R01: Improve the traceability of process, product & materials from the shop-floor

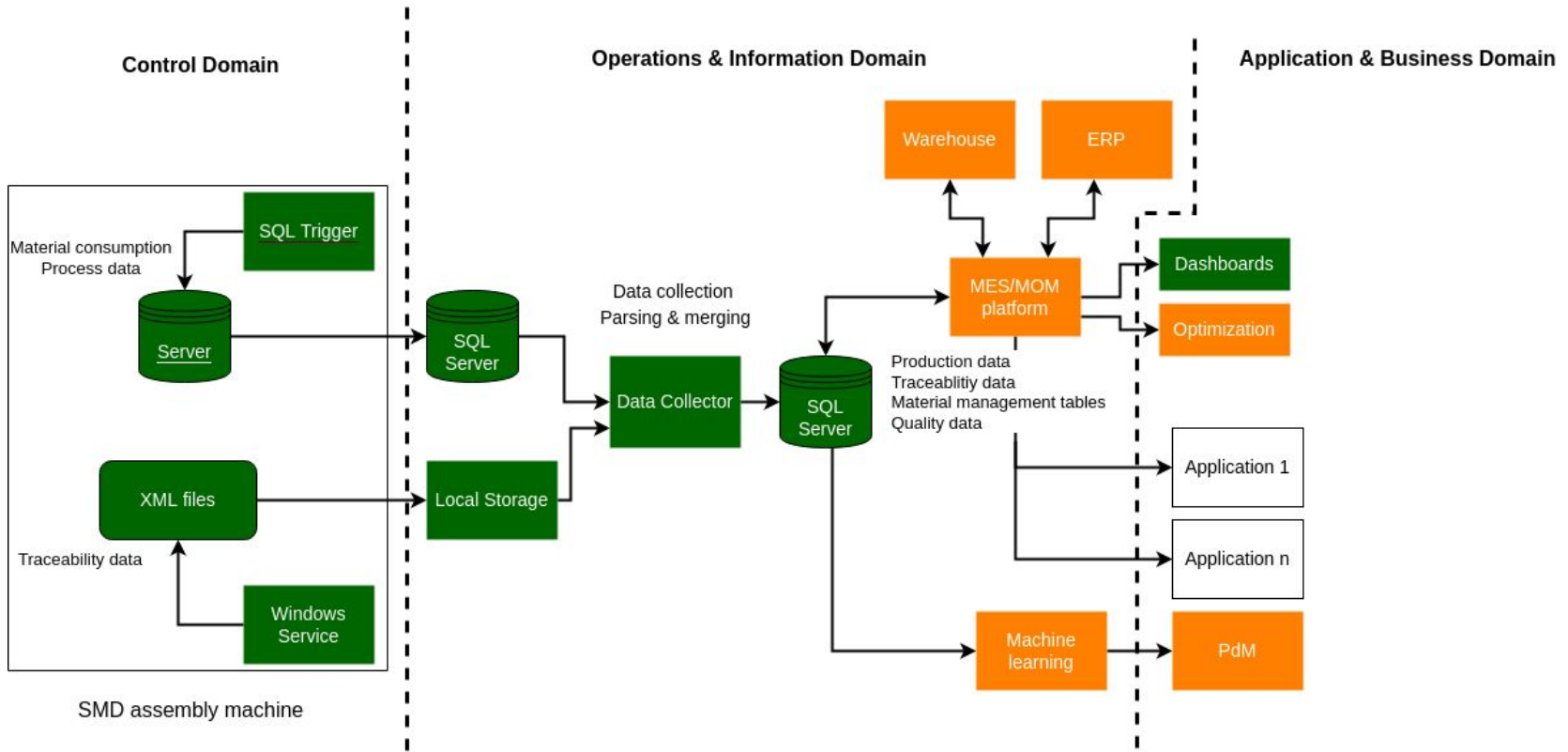
Vestel focuses on *collecting data in real time* from PCB Assembly machines (SMD type) and uses this data to,

- Analyze **material consumption** (scraps etc.),
- Track and trace materials used on PCBs** (position, time, supplier id of materials...)
- Optimize material traffic** inside the factory (AGVs material transportation)
- Visualize data** in the dashboards on MES system.



Secure and optimized factory information and logistic management

CAP41 - Real time sensing & tracking



Improving the traceability of process, products and materials

MES/MOM Development



Two main screens in MES/MOM
platform



Real Time Material Consumption Report Dashboard
Real Time Material Traceability Screen

Improving the traceability of process, product & materials

Real Time Material Consumption Report Dashboard



ANLIK MALZEME KULLANIM VERİLERİ

GENEL GÖRÜNÜM

Toplam			Malzeme Bazlı			Hat Bazlı			Makina Tipi Bazlı					
Dizilen	Scrap	PPM	SAP Kod	Dizilen	Scrap	PPM	Hat	Dizilen	Scrap	PPM	Makina Tipi	Dizilen	Scrap	PPM
243579	382	1566	30022020	3	1	250000	1916 Bot	304	8	25641	SIPLACE HF/3	1600	9	5594
			30064848	52	7	118644	1939	9940	56	5602	SIPLACE HS50	3554	17	4761
			30060822	140	16	102564	1932	5264	22	4162	AX 201	902	4	4415
			30101827	80	9	101124	1930	6418	21	3261	SIPLACE HF	1568	3	1910
			30022249	18	2	100000	1913	1207	3	2479	SIPLACE X4 S	65446	102	1556

Feeder Bazlı									Nozzle Bazlı						
Hat	Makina	Dizilen	Scrap	PPM	Table	Track	Tower	Level	Hat	Makina	Scrap	Machine Gantry	Gantry Head	Head Segment	Nozzle
1913	SMD-046	1	1	500000	3	18	0	0	1911	SMD-002	20	10	10	1	CPL3
1901	EDM-049	10	5	333333	1	1	1	22	1921	SMD-066	11	16	16	1	L5
1904	SMD-061	2	1	333333	1	11	0	0	1932	SMD-067	9	3	1	11	2038
1913	SMD-054	2	1	333333	1	9	0	0	1932	SMD-067	9	3	1	12	2038

Line Based
(Consumption on manufacturing lines)

Machine Type Based

Total Consumption

Material Based
(according to SAP code)

Feeder Based

Nozzle Based

- Real Time Data Streaming
- Data refresh time : 45s

Improving the traceability of process, products and materials

Material Traceability Screen



Process Traceability x Malzeme Traceability x Malzeme Traceability x +

Güvenli değil | https://localhost:44384/Traces/Trace

Başlangıç Tarihi: 08-12-2021

Seri No: 2860619801006337

Bitiş Tarihi: 08-12-2021

Ara

Electronic card that has **2860619801006337** serial number

MasterNo : 2373228810001083

BoardPosition : 1

ProductName : 24SMR01R3

SMD-077

TimeStamp : 3.03.2021 06:24:37

RecipelInfo: 24SMR01R3_23732287

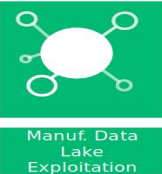
Show 10 entries

Search:

Position	UniqueID	LotNo	ManufacturePartNumber
C1	30106101219900000042	IK0M24J902	
C10	30104485219900000236	AGB3B62	CL10B103KB8WPNC
C11	30104480219900000055	AG9LB7F	CL10B104KB8WPNL

Vestel focuses on plastic injection machines

UC8.R02: The system should support the decision making (maintenance for machine).



- ✓ collecting sensor and process data from plastic injection machines
- ✓ train failure prediction models with data
- ✓ Producing real time machine failure predictions
- ✓ Integrating predictions on MOM for maintenance tasks



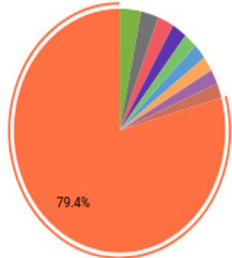
Three important systems on Machines

- Hydraulic Systems
- Mechanical closure Systems
- Plasticization Systems

Machine Failures Distribution

47 Machines

18,4 Avg. Age



- HEP3258
- HEP3207
- HEP3286
- HEP3288
- HEP3228
- HEP3227
- HEP3283
- HEP3292
- HEP3287
- others



Ton	Pcs	Age
600	13	22,2
700	9	22,4
900	9	24,0
1200	1	23,0
1300	2	5,0
1500	9	10,9
2000	3	3,7
2700	1	17,0

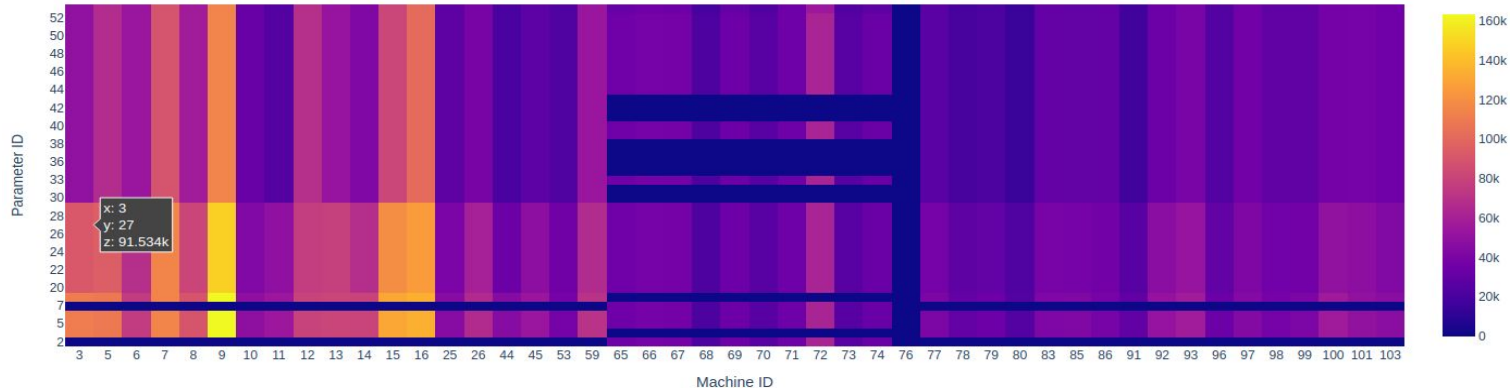
Server 1

- Includes logs from **54 unique machines** and **7 unique parameters**.
- Contains **71,342,444 logs** (rows).
- Contains logs between dates **22.02.2018** and **10.01.2021**.

Server 2

- Includes logs from **47 unique machines** and **38 unique parameters**.
- Contains **72,729,489 logs** (rows).
- Contains logs between dates **26.06.2019** and **16.02.2021**.

Parameter Log Count per Machine



Secure and optimized factory information and logistic management

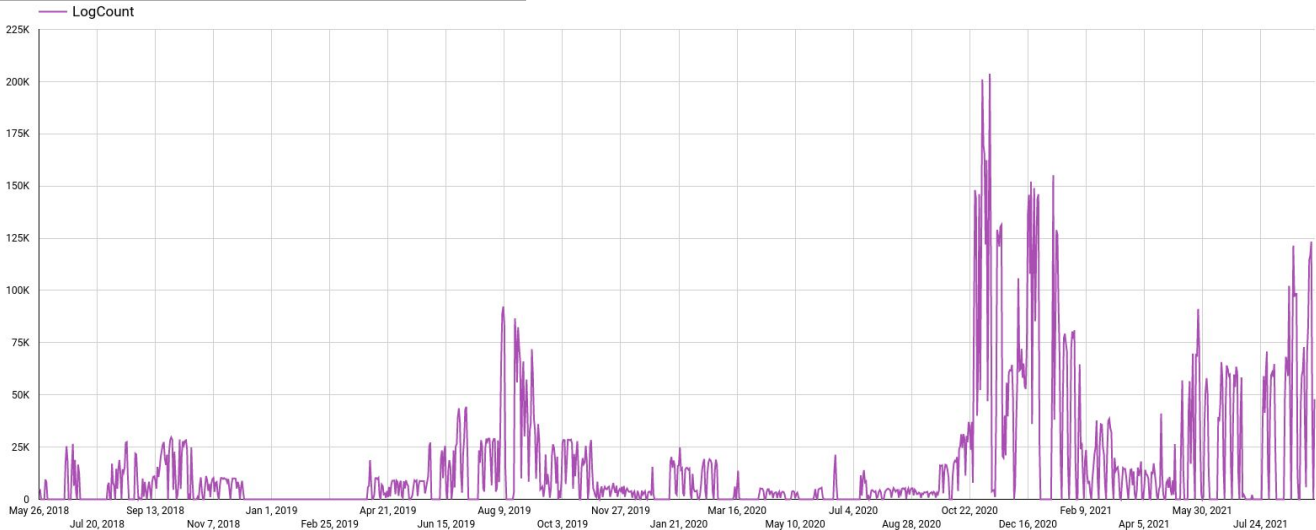


Sample data

Sample Data

Machine	Parameter	SensorValue	Timestamp
HEP3204	OIL_TEMPERATURE	40.6	2019-06-26 13:32:22 UTC
HEP3204	CLAMPING_FORCE_ACT	5711.0	2019-06-26 13:32:22 UTC
HEP3204	HYDR_HOLD_PRESS	71.1	2019-06-26 13:32:22 UTC
HEP3204	CLAMPING_FORCE_SET	5500.0	2019-06-26 13:32:22 UTC
...	...		

Data - Log Count Histogram



Data transformation & Handling null data

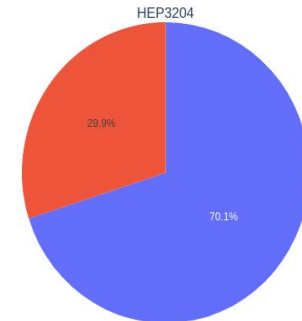
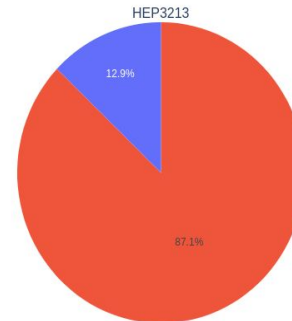
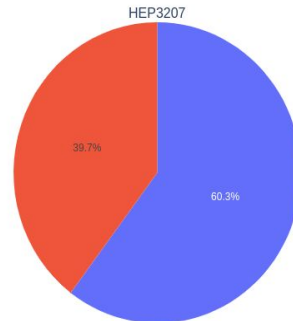
Machine	OIL TEMPERATURE	CLAMPING_FORCE_ACT	HYDR_HOLD_PRESS	...	Timestamp
HEP3204	40.6	5711.6	71.6	...	2019-06-26 13:32:22 UTC
HEP3204	40.0	NULL	70.0	...	2019-06-26 13:33:22 UTC
HEP3204	43.1	5719.1	NULL	...	2019-06-26 13:34:22 UTC
HEP3204	40.0	5765.0	72.0	...	2019-06-26 13:35:22 UTC
...

■ NotNull ■ Null

ZONE1_TEMP

If a column (parameter) has more than **%40** NULL values, it is **dropped** for the machine.

Else, empty values are filled using **interpolation technique**.



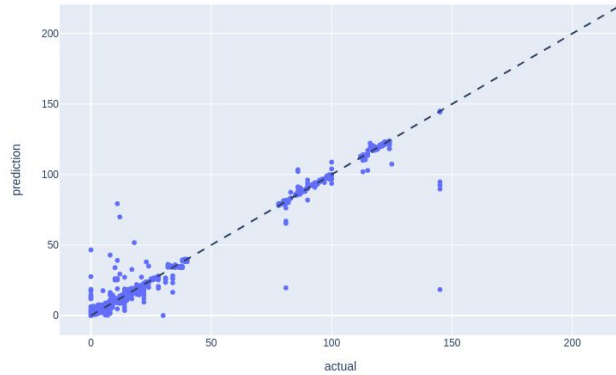
Secure and optimized factory information and logistic management data labeling

Machine	OIL TEMPERATURE	CLAMPING_FORCE_ACT	HYDR_HOLD_PRESS	...	Timestamp	LABEL Remaining Useful Life
HEP3204	40.6	5711.6	71.1	...		4
Four days to Machine's malfunction						→
HEP3204	40.0	5765.0	72.0	...	2019-06-27 13:33:22 UTC	1
HEP3204	43.1	5719.1	71.1	...	2019-06-28 13:33:22 UTC	2
HEP3204	40.0	5765.0	72.0	...	2019-06-29 13:35:22 UTC	1
...	0
Malfunction at 2019-06-30 00:00:00						

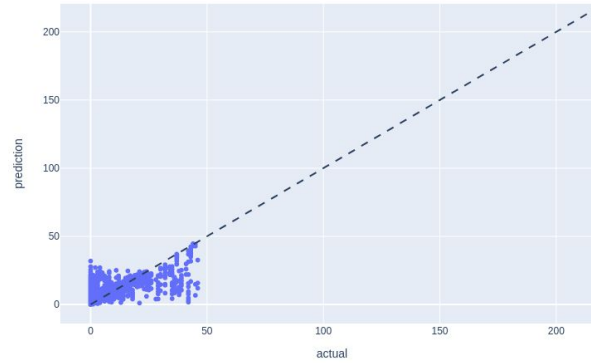
Same Parameter Values = Same Label

Malfunction occurred on HEP3204 machine at 30 June 2019.
 Coming data from the machine till malfunction has been labelled.

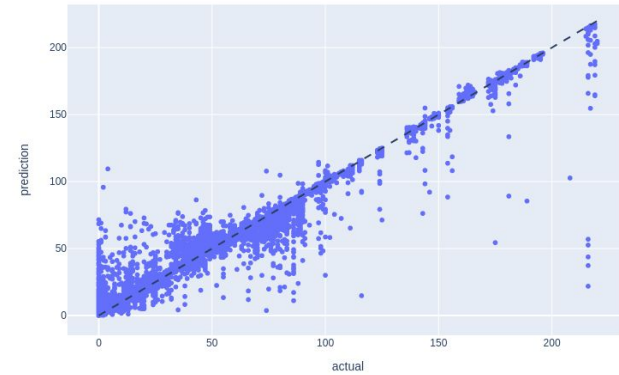
Actual vs Predicted Values with Random Forest Regression



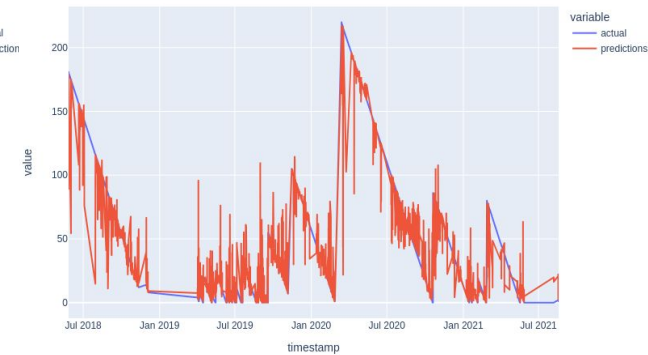
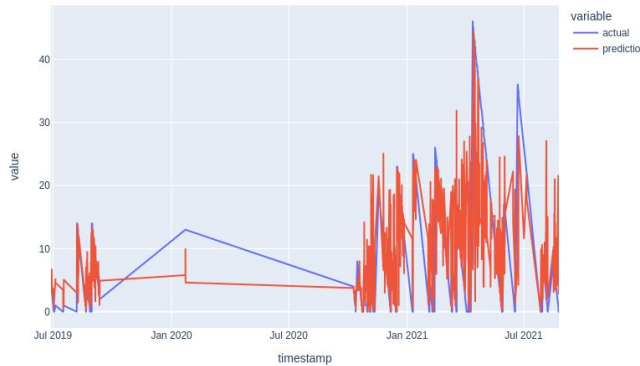
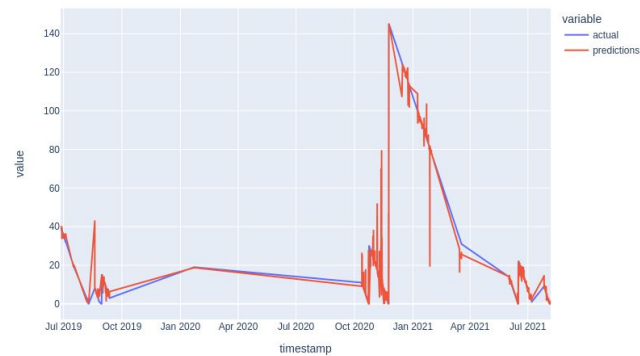
HEP3204



HEP3207



HEP3213





Sample output

Remaining Useful Life Predictions

Mar 10, 2022 - Mar 10, 2022

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Prediction Results

Machine Name	Remaining Useful Life	Date	Breakdown Date
1. HEP3213	null	Mar 10, 2022	Cannot be Computed
2. HEP3207	12	Mar 10, 2022	Moderate Breakdown Date
3. HEP3204	2	Mar 10, 2022	Imminent Breakdown Date