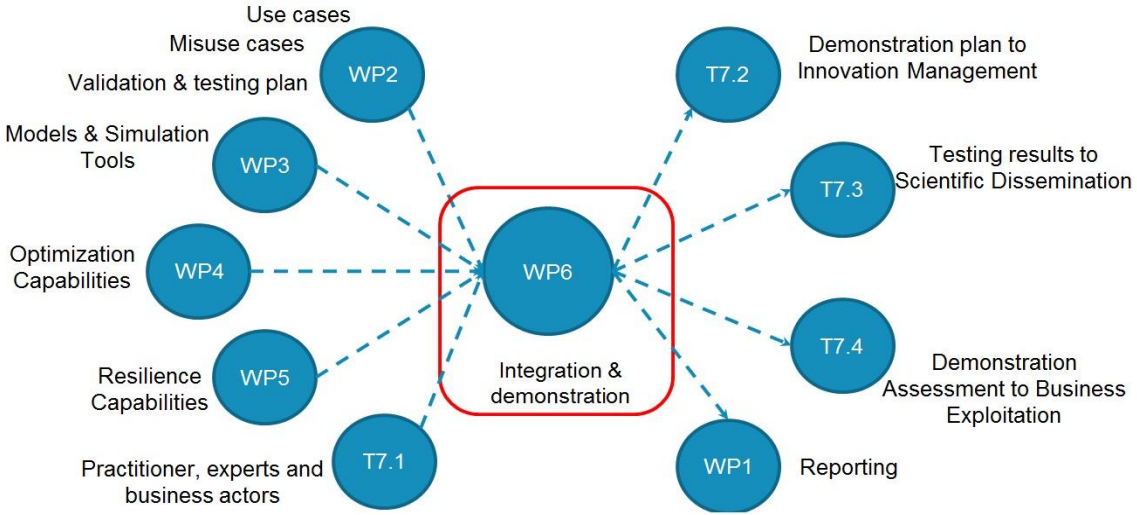
CYBERFACTORY NO.1

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

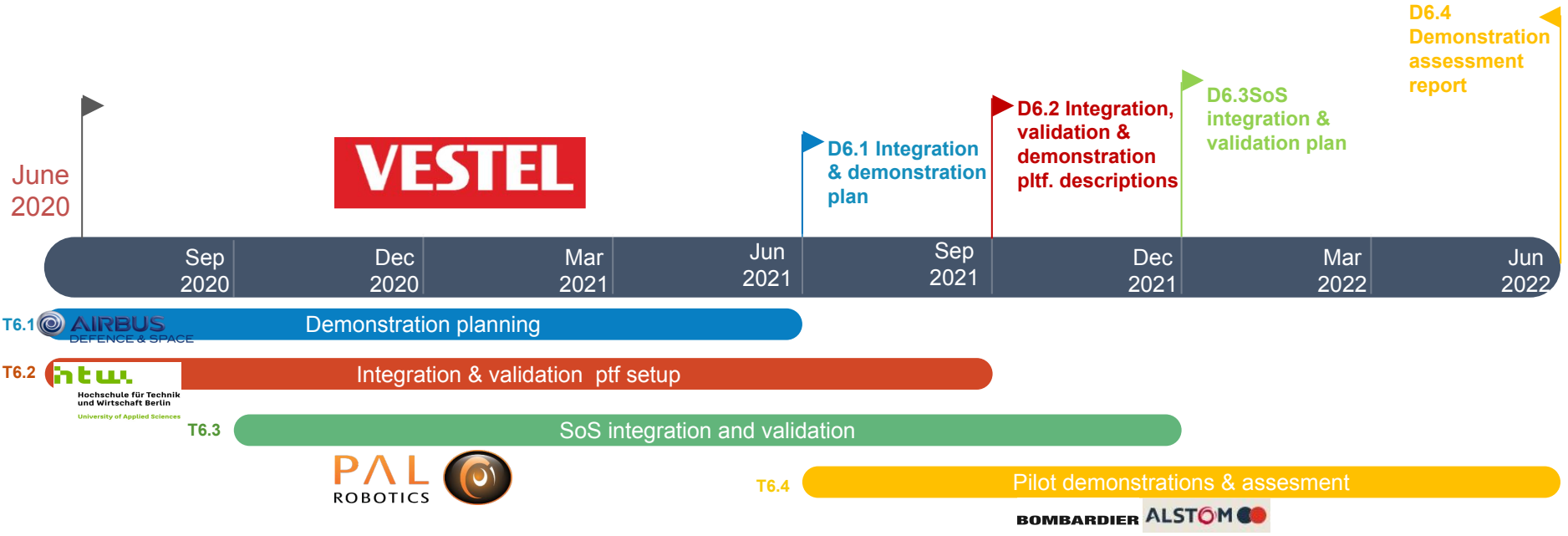
WP6 - Integration & Demonstration

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.

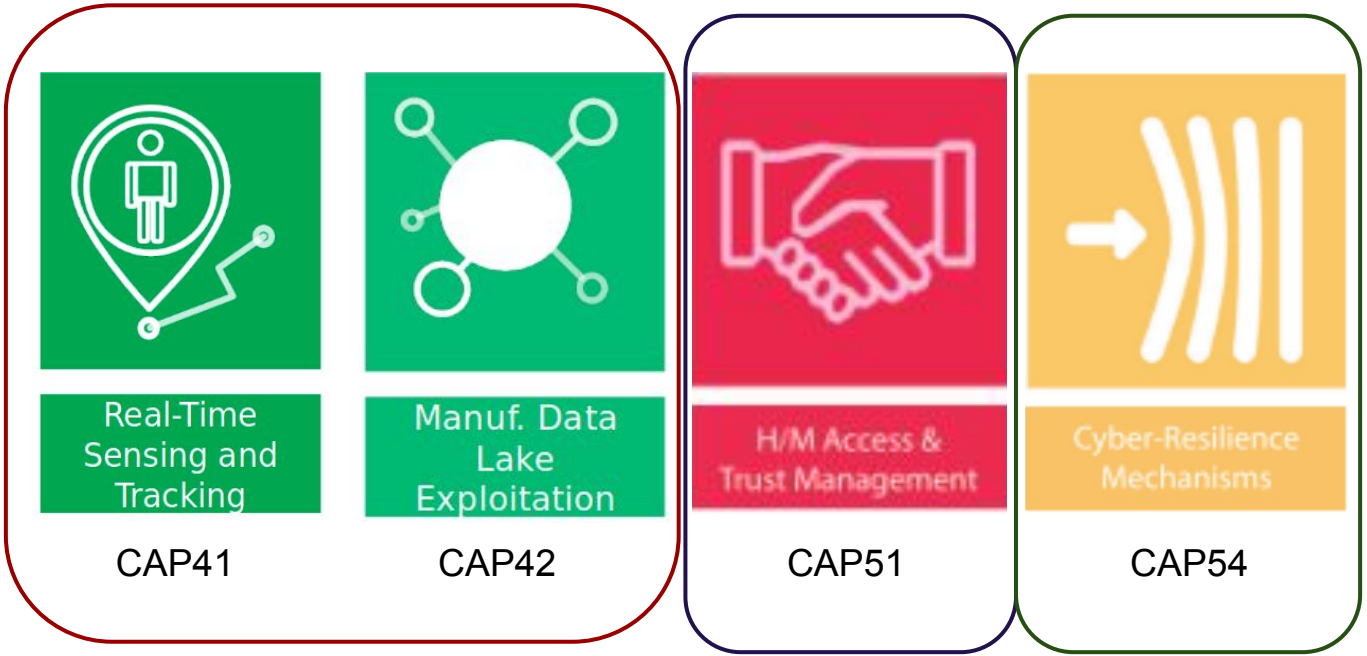


WP6 - Integration & Demonstration
Timeline & Roles



Secure and optimized factory information and logistic management
Turkish consortium

UC8 Owner: VESTEL



Partner responsible : VESTEL GMHM Embedded Intelligence Systems Lostar GÜVENLİ GÜNLER

Secure and optimized factory information and logistic management

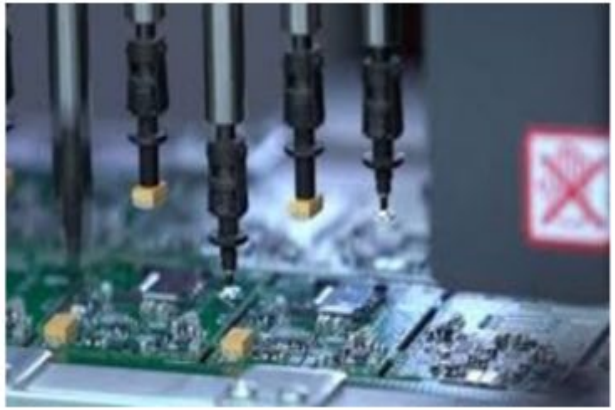
CAP41 - Real time sensing & tracking

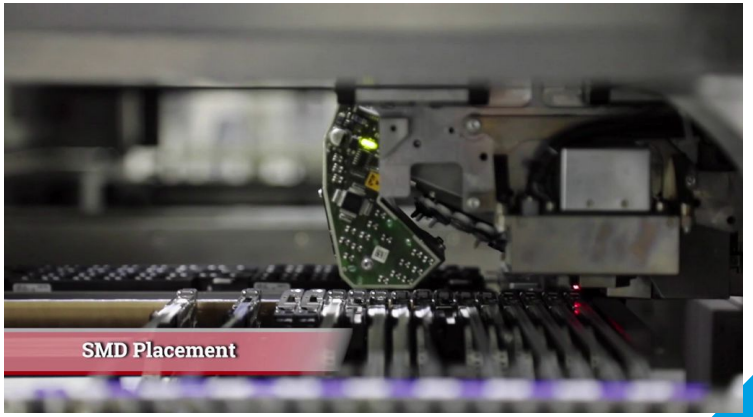
Real-Time Sensing and Tracking

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.





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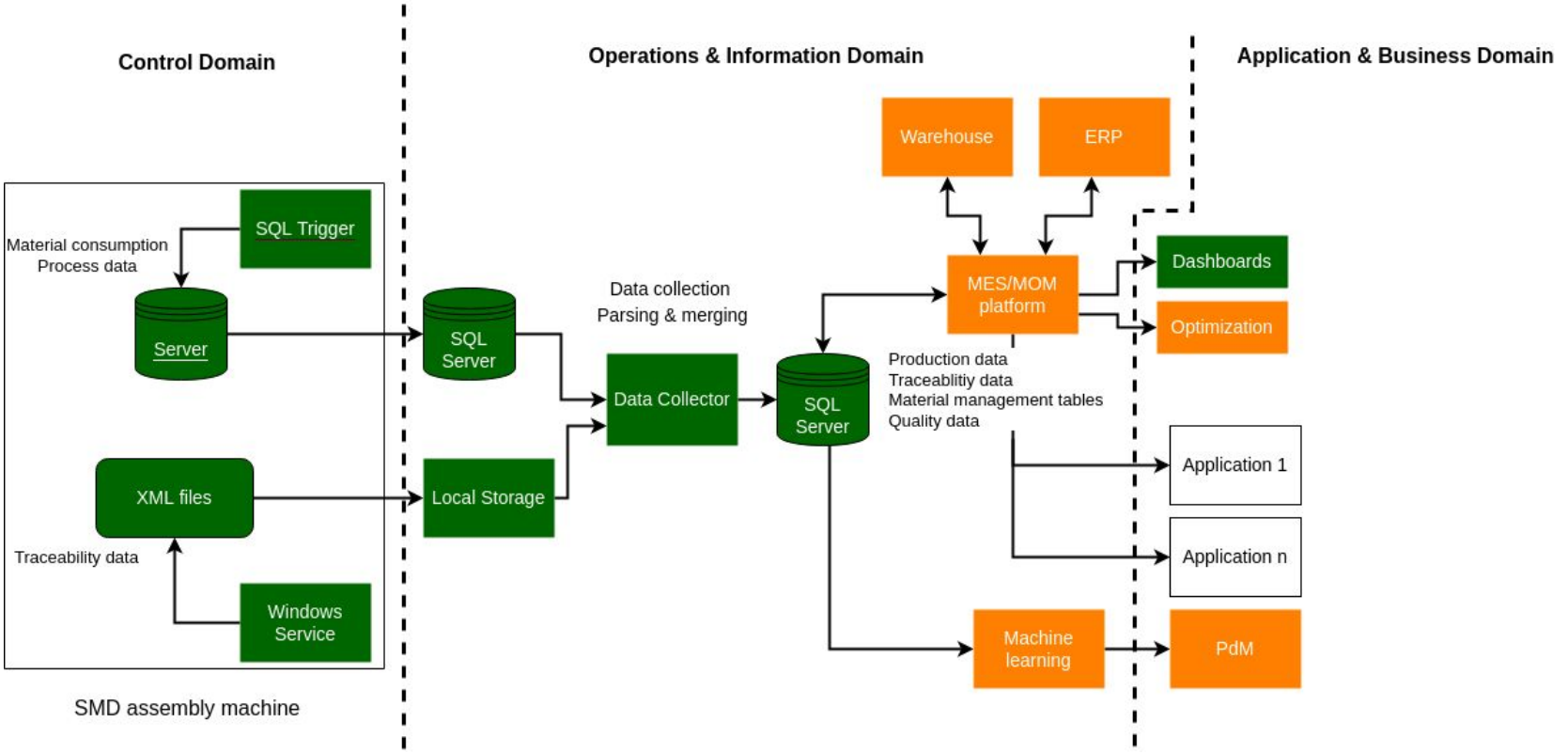
CAP41 - Real time sensing & tracking



Improving the traceability of process, products and materials

MES/MOM Development

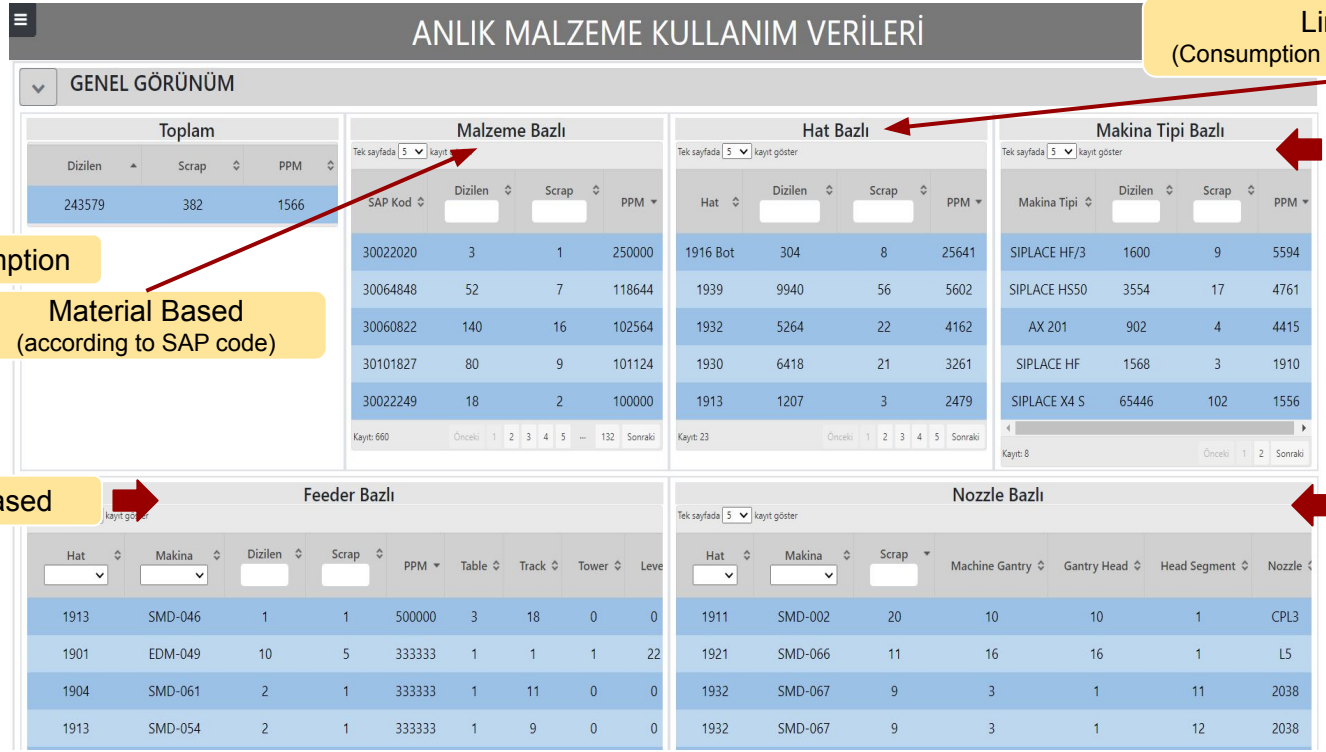
Two main screens in MES/MOM platform

Real Time Material Consumption Report Dashboard

Real Time Material Traceability Screen

Improving the traceability of process, product & materials

Real Time Material Consumption Report Dashboard



Line Based
(Consumption on manufacturing lines)

Machine Type Based

Total Consumption

Material Based
(according to SAP code)

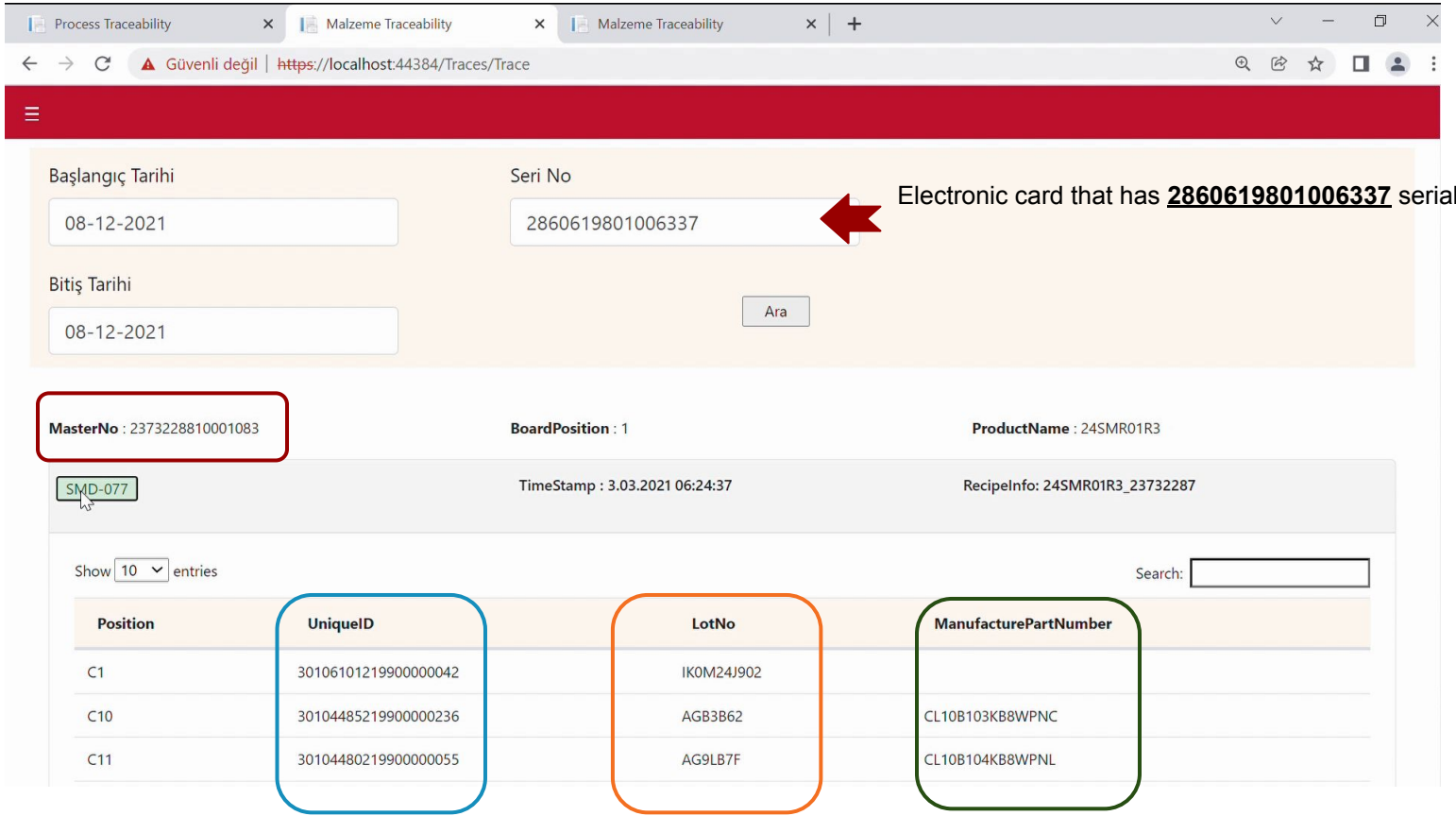
Feeder Based

Nozzle Based

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

Improving the traceability of process, products and materials

Material Traceability Screen



Secure and optimized factory information and logistic management

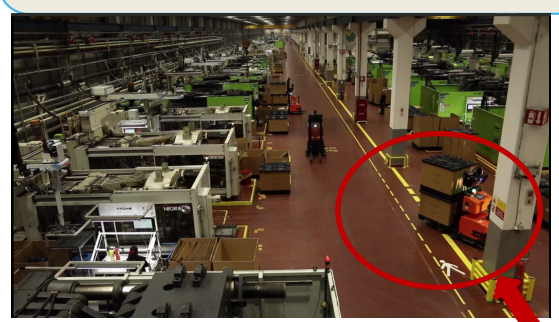
CAP42 - Manufacturing Data Lake Exploitation

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

Manuf. Data Lake Exploitation

Vestel focuses on plastic injection machines

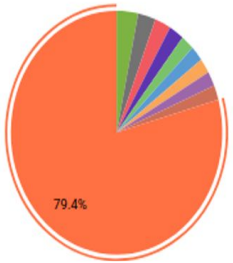
- ✔ **collecting sensor and process data** from plastic injection machines
- ✔ **train failure prediction models** with data
- ✔ Producing real time machine failure predictions
- ✔ **Integrating predictions on MOM** for maintenance tasks



Three important systems on Machines

- ❑ Hydraulic Systems
- ❑ Mechanical closure Systems
- ❑ Plasticization Systems

Machine Failures Distribution



47 Machines

18,4 Avg. Age

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

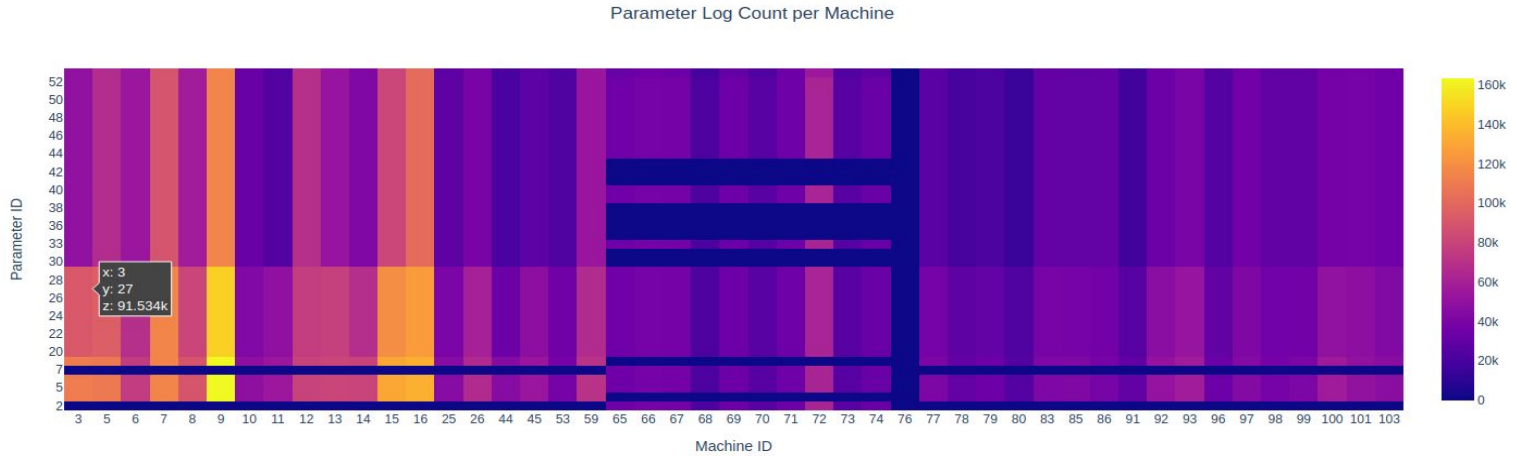
Secure and optimized factory information and logistic management data acquisition

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**.

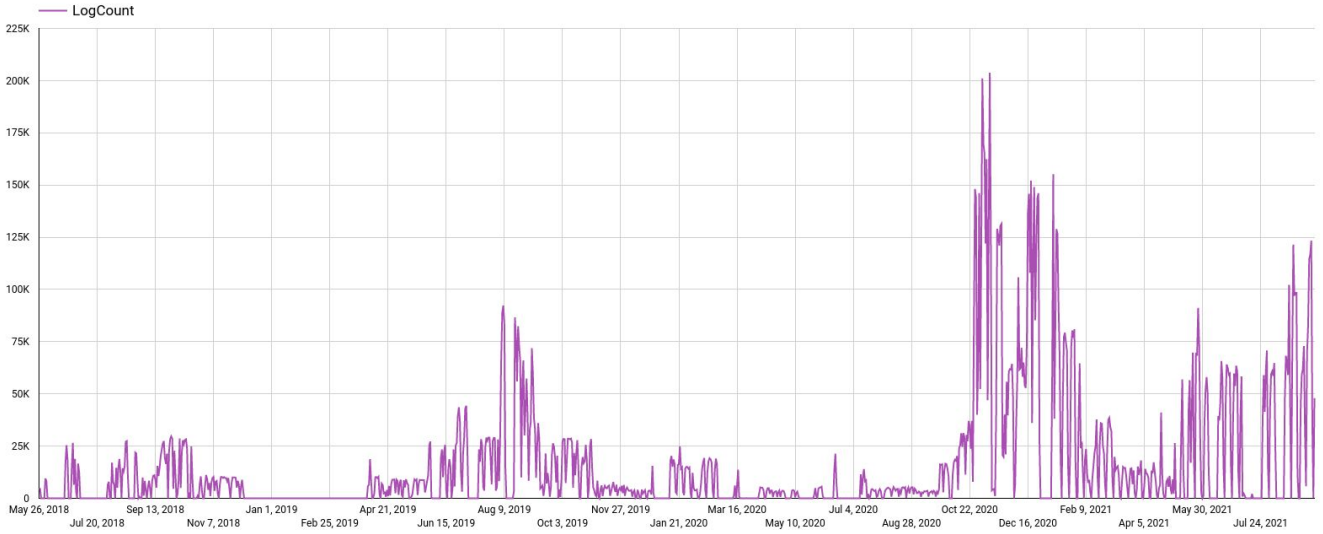


Sample data

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



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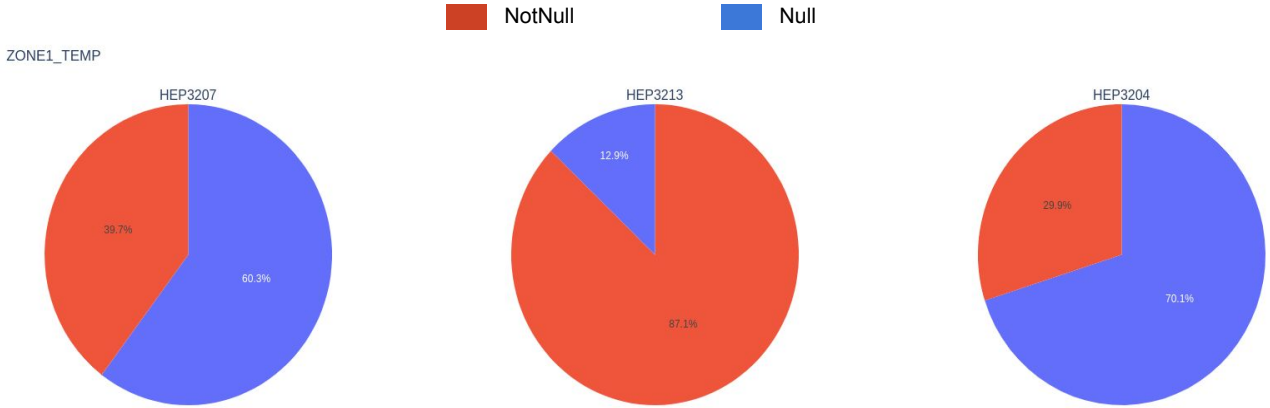
Data transformation & Handling null data

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
...	...	...	...	...	...

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			4
HEP3204	40.0	5765.0	72.0	...	2019-06-27 13:33:22 UTC	1
HEP3204	43.1	5719.1	71.1	...	2019 13:3	2
HEP3204	40.0	5765.0	72.0	...	2019-06-29 13:35:22 UTC	1
...	...	...	...	...	...	
Malfunction at 20						0

Four days to Machine's malfunction

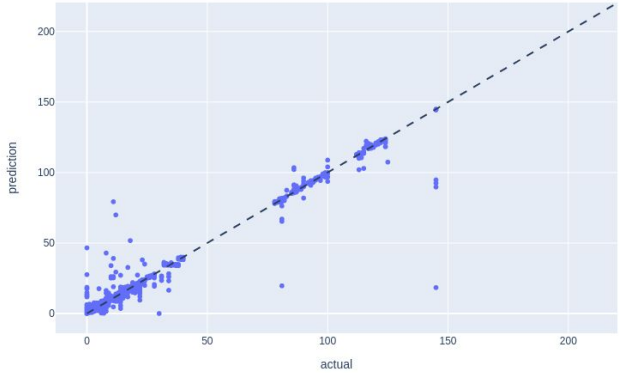
One day to Machine's malfunction

Same Parameter Values = Same Label

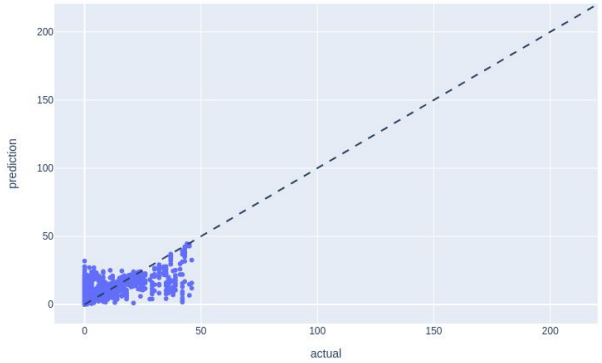
Malfunction occurred on HEP3204 machine at 30 June 2019.

Coming data from the machine till malfunction has been labelled.

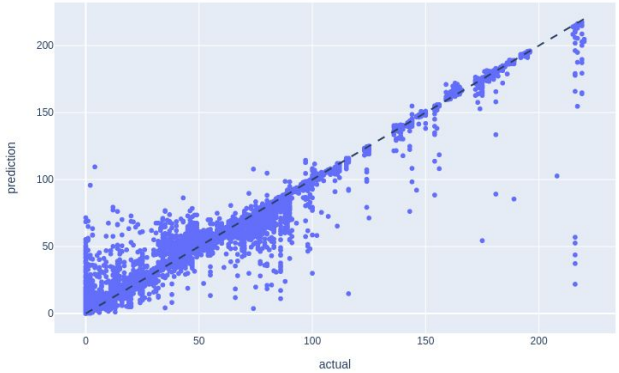
Actual vs Predicted Values with Random Forest Regression



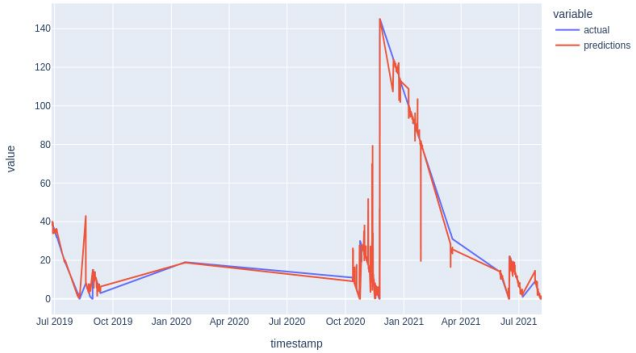
HEP3204

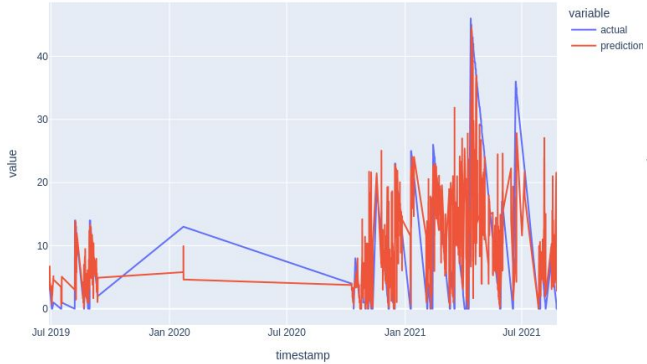


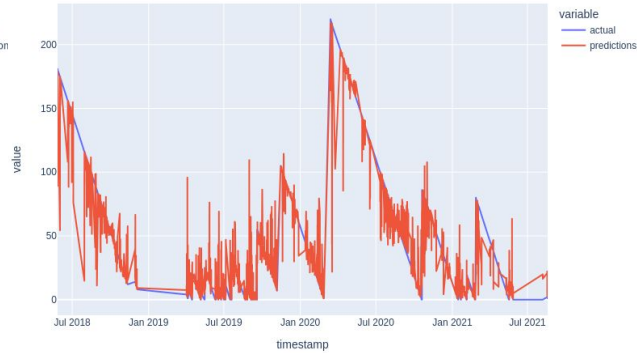
HEP3207



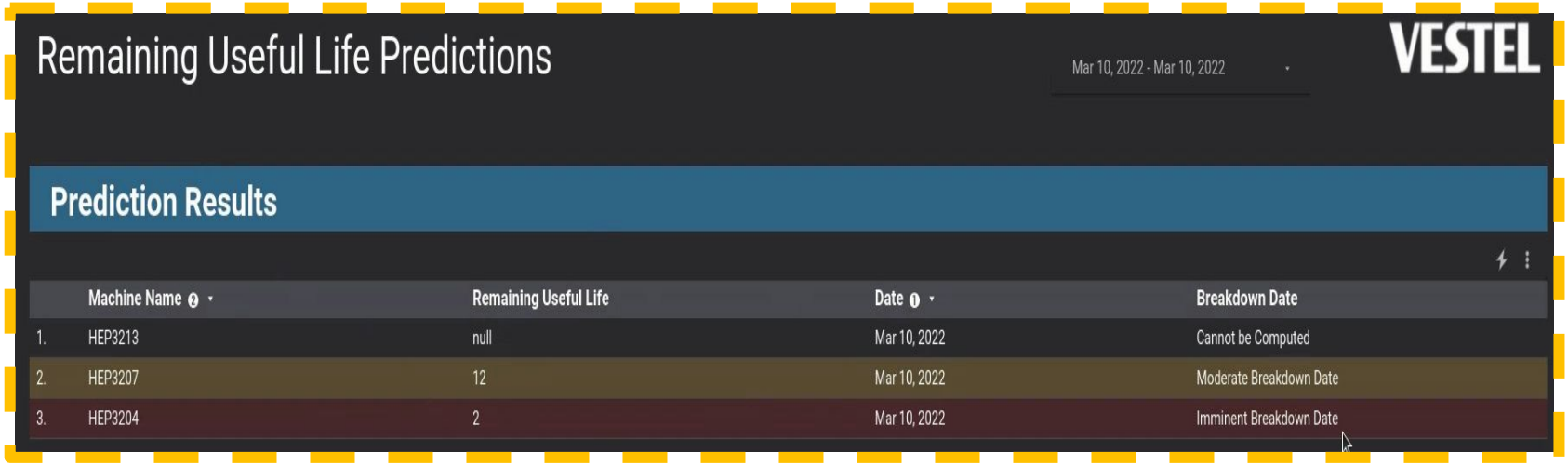
HEP3213







Sample output



	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