



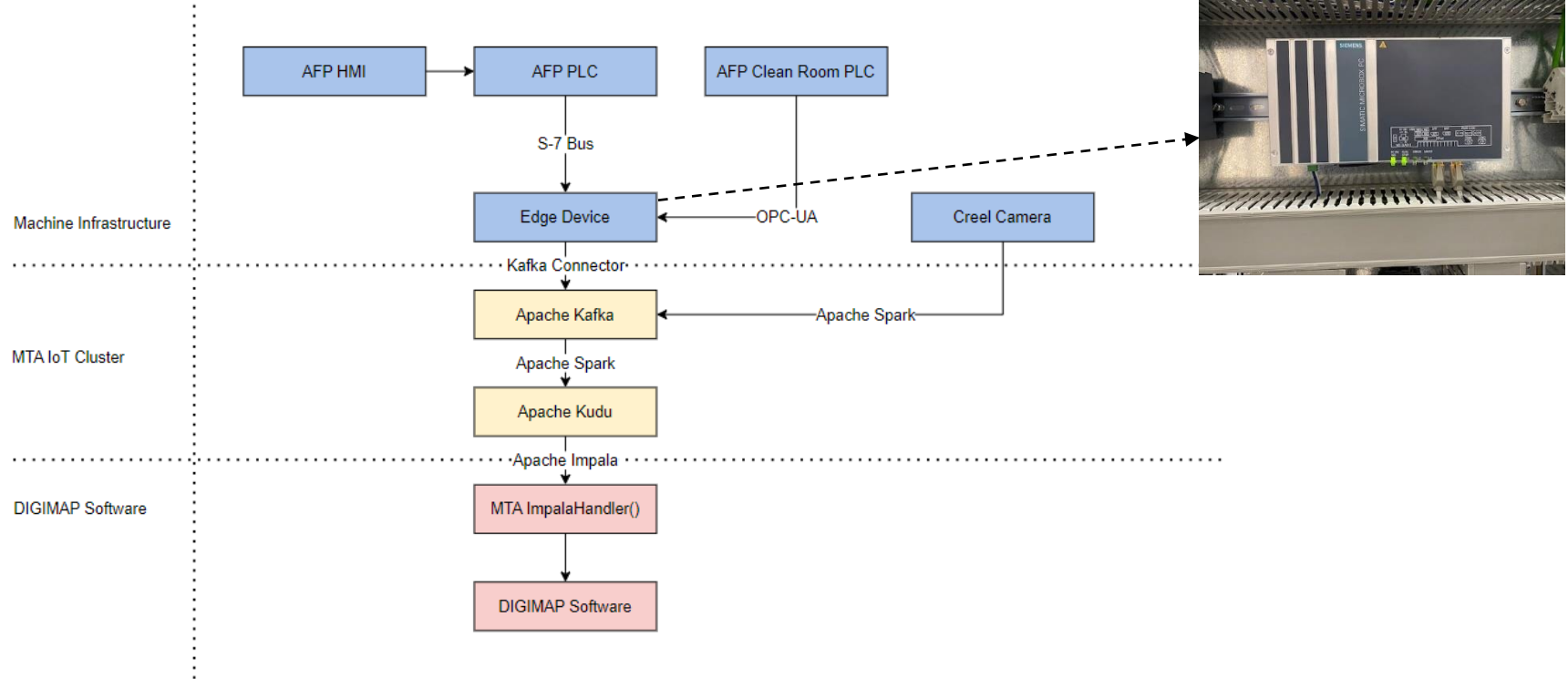
Classification: **Public**
© MT Aerospace AG

DIGIMAP_FP_0001_MTA

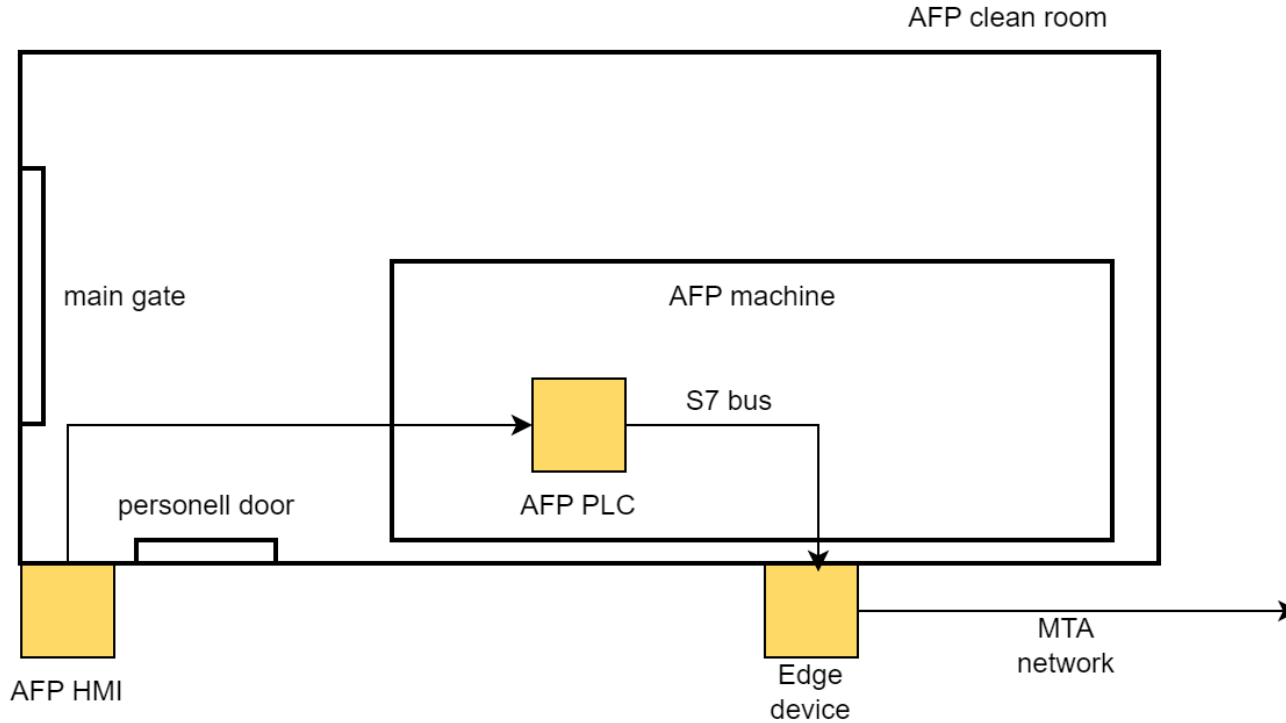
- ▶ Performed activities and main results
- ▶ Summary
- ▶ Outlook
- ▶ Discussion and next steps

- ▶ The DIGIMAP project team successfully...
 - Configured & implemented **data pipelines**
 - Established a **database** for AFP related data
 - **Automated build&deploy** of the developed software
 - Set up an environment for deploying the software on **IoT cluster server**
 - Configured the deploy for **test/productive** system
 - Developed a **platform** for deploying dashboards related to DIGIMAP use cases
 - Developed **solutions** for several use cases
 - Created software that is in use by **shop floor**
 - Developed a Proof-of-Concept for an **AI tool** for observation of the AFP machine's creel

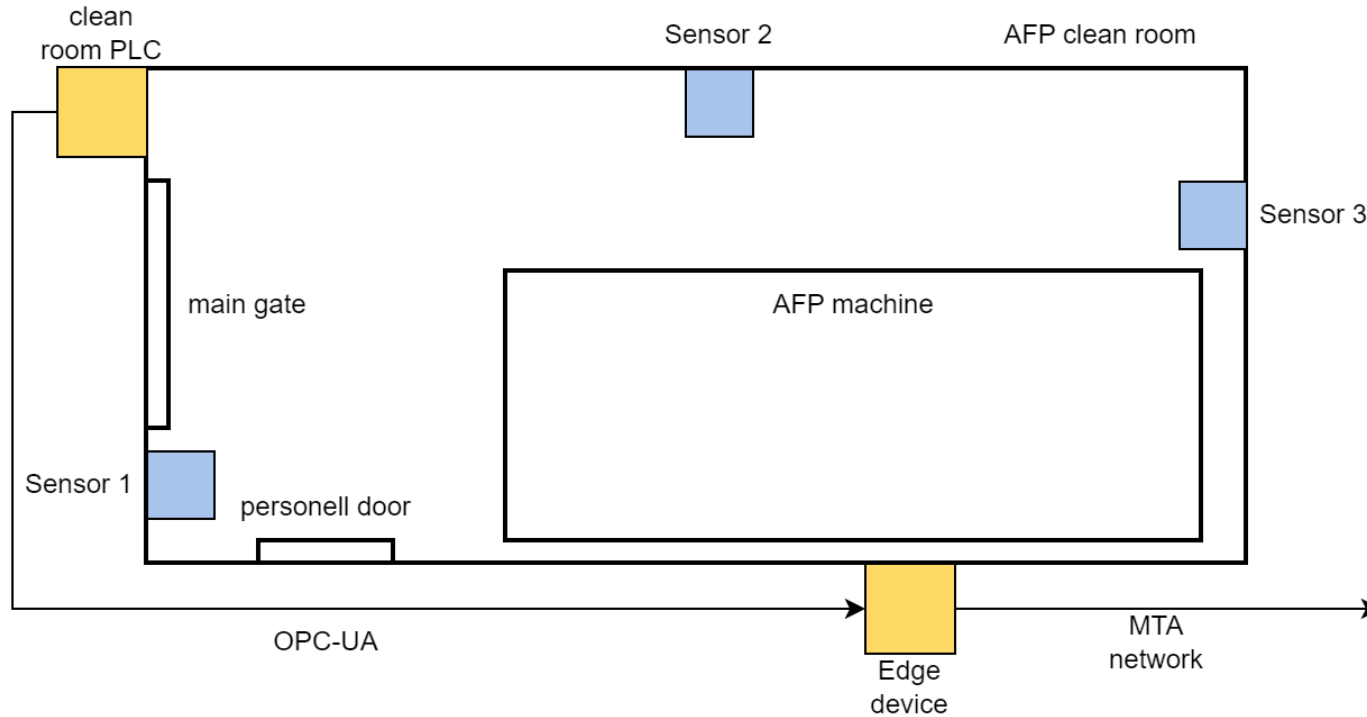
DATA PIPELINES: OVERVIEW



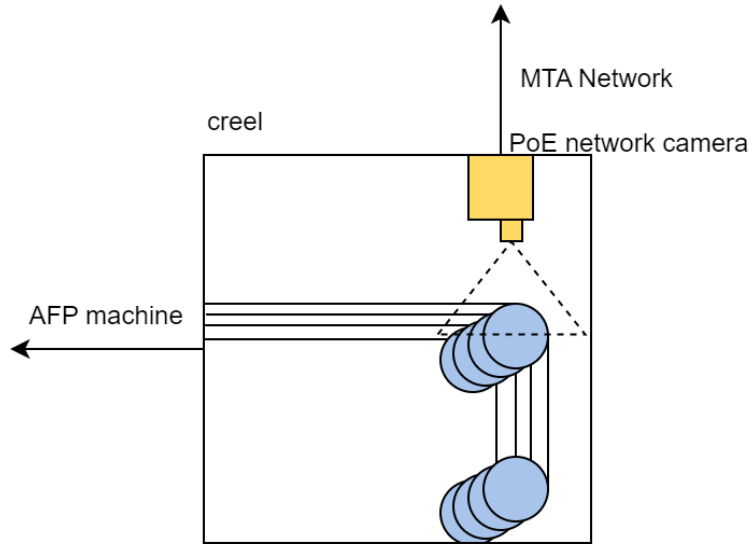
DATA PIPELINES: AFP MACHINE & PROCESS DATA



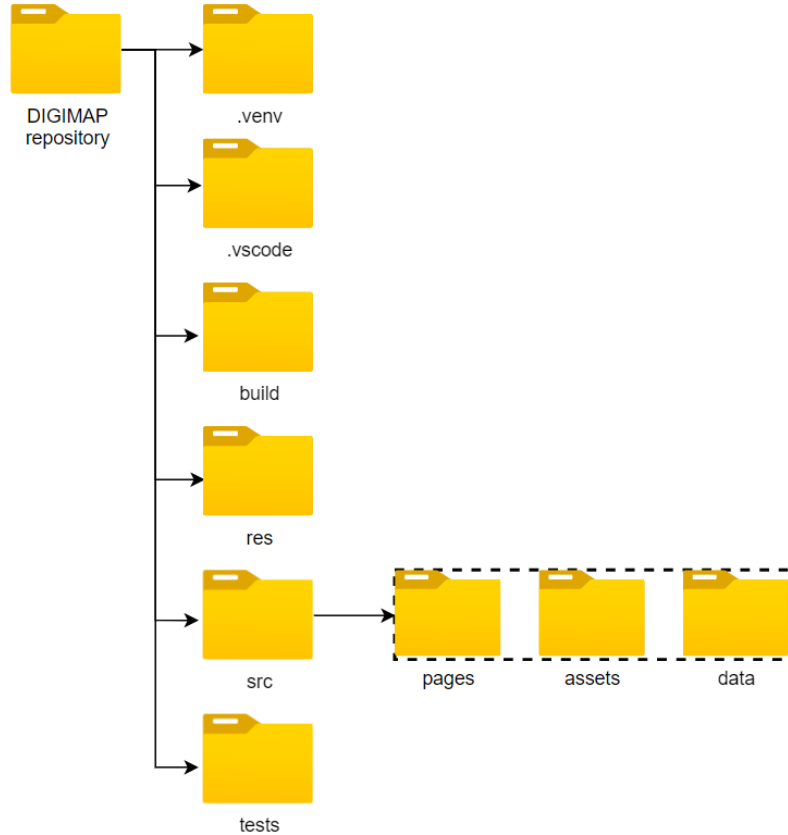
DATA PIPELINES: AFP CLEAN ROOM DATA



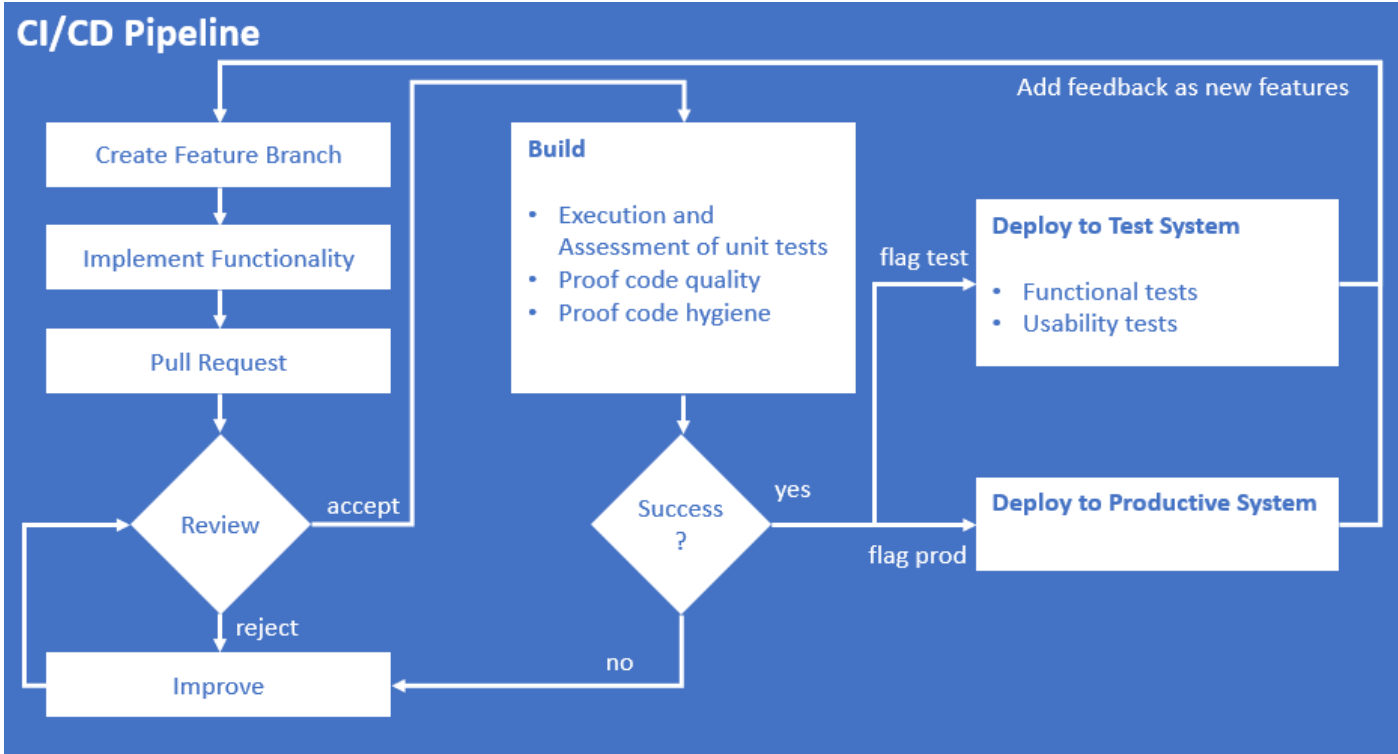
DATA PIPELINES: CREEL OBSERVATION



SOFTWARE OVERVIEW



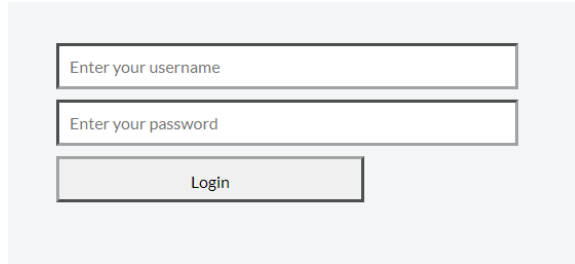
- ▶ Lines of code: **7538**
- ▶ Non-comment lines of code: **4275**
- ▶ Number of commits: **240**
- ▶ Files: **35**
- ▶ Classes: **35**
- ▶ Tests: **976**
- ▶ Unit test coverage: **93%**



► Objectives

- Automating building, testing and deployment of the software
- Ensuring robustness of the software product
- Assuring Software Product Quality
- Enabling Configuration Management

▶ Login-function:

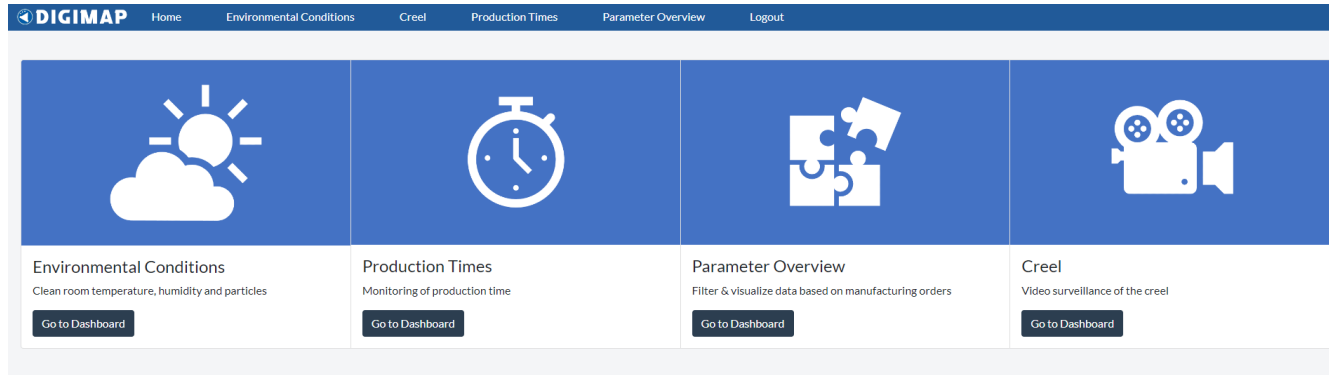


Enter your username





Enter your password

Login

▶ Navigation via menu & home-page:



DIGIMAP Home Environmental Conditions Creel Production Times Parameter Overview Logout

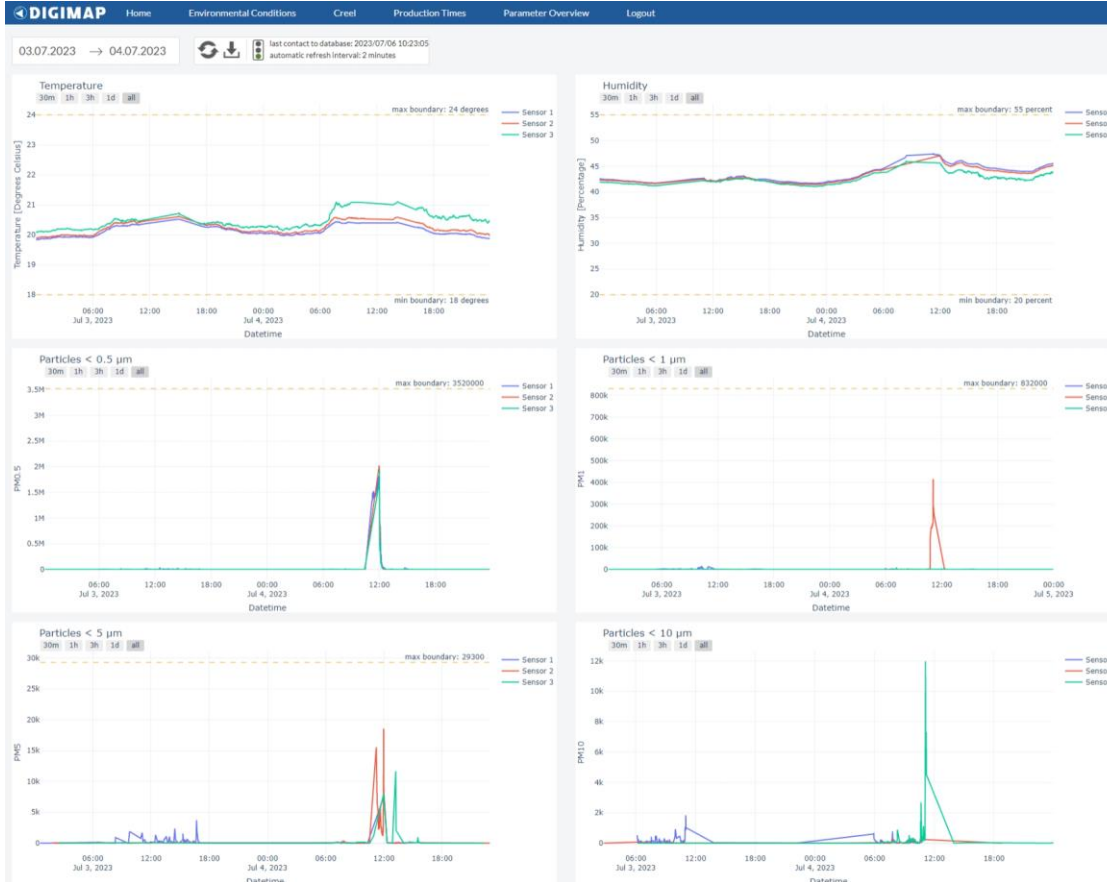
			
Environmental Conditions Clean room temperature, humidity and particles Go to Dashboard	Production Times Monitoring of production time Go to Dashboard	Parameter Overview Filter & visualize data based on manufacturing orders Go to Dashboard	Creel Video surveillance of the creel Go to Dashboard

MTA USE CASE – ENVIRONMENTAL CONDITIONS

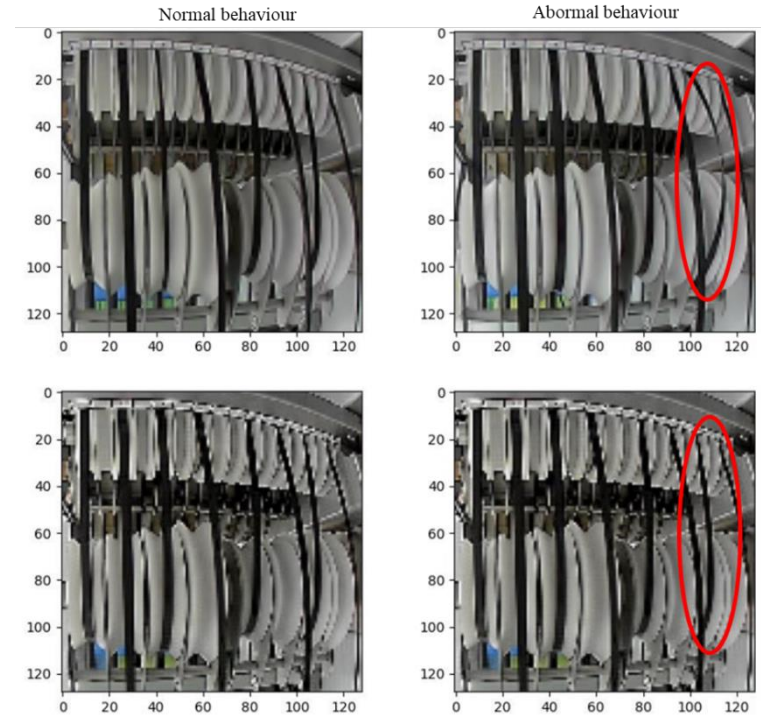
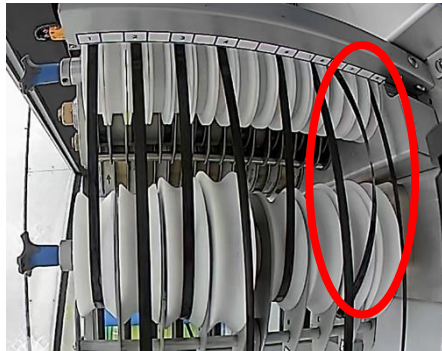


MT AEROSPACE

An OHB Company



MTA USE CASE – CREEL OBSERVATION



▶ **Before**

- No check of real production times (including plant downtimes, manual production steps)
- No database for the calculation and estimation of the plant's productivity

▶ **After**

- Continuous tracking of the production times and machine productivity for the manufactured parts based on machine data
- Monitoring application integrated into the IoT platform developed within DIGIMAP
- Integrated into MTA Dashboard for easy access

▶ **Benefits & opportunities**

- Real production times are tracked and can be visualised by workers/managers
- Database for predicting the production times of future parts

Selected Parts for Visualization

CAD/VNCK file import

Home Environmental Conditions Order Data Creel Production Times

AFP Production Time Monitoring

Produced parts
Please select one produced part from the database

CATFiber production times
Please import a csv, xlsx or html file

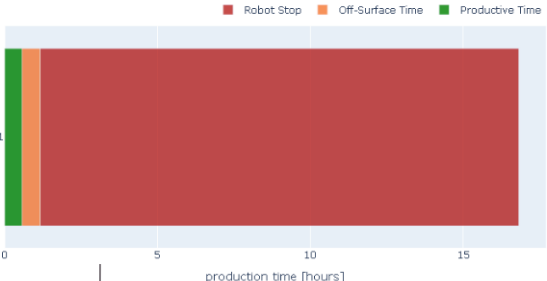
Drag and Drop or Select Files

The manufacturing order contains productive times!

StatReport_Ply.xlsx imported successfully!

Real Production Times

Robot Stop Off-Surface Time Productive Time

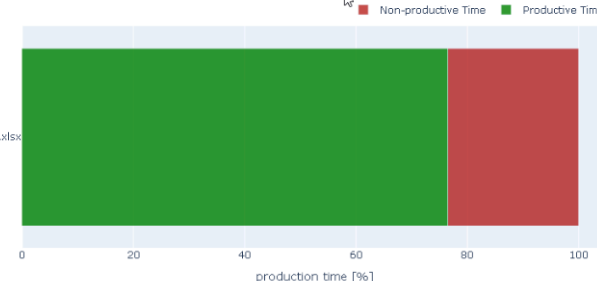


Category	Time [hours]
Productive Time	~0.5
Off-Surface Time	~0.5
Robot Stop	~14.0

CATFiber Production Times

StatReport_Ply.xlsx

Non-productive Time Productive Time



Category	Time [%]
Productive Time	~75
Non-productive Time	~25

Data Visualization

▶ **Before**

- No traceability of machine parameters for the manufactured parts
- Process errors are documented manually during the lay-up and subject to mistakes or incompleteness

▶ **After**

- Automated traceability of process parameters and machine errors
- Cloud storage of data
- 3D visualization of collected data within the Nebumind software with several filter possibilities

▶ **Benefits & opportunities**

- Better and more accurate process traceability
- Database for the AFP process analysis, understanding and improvement

► **Challenge**

- Up to 10.000 parameters from machine PLC + external sensors (e.g. machine environment)
- Export not suitable for usage regarding
 - Process robustness, understanding
 - Part quality
 - Correlation of several parameters
 - Product twin regarding machine parameters

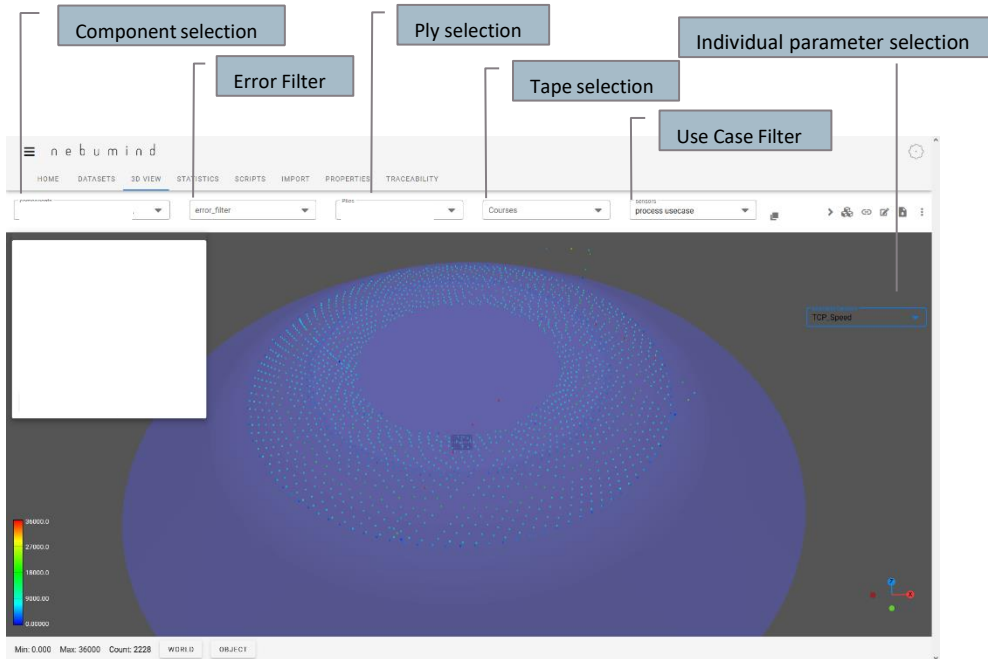
► **Motivation**

- Point out correlations and dependency of different parameters on component (Ply, Tape) level

► **Goal**

- Clustering of parameters into specific use cases
- Define needed parameters
- Define useable and flexible visualization

IGCV USE CASE – DATA VISUALIZATION FOR PRODUCT TWIN



© Nebumind Software

Specific Use-cases

▶ Process

- Velocity of TCP, compaction pressure, tool depth, temperature, pyrometers

▶ Process environment

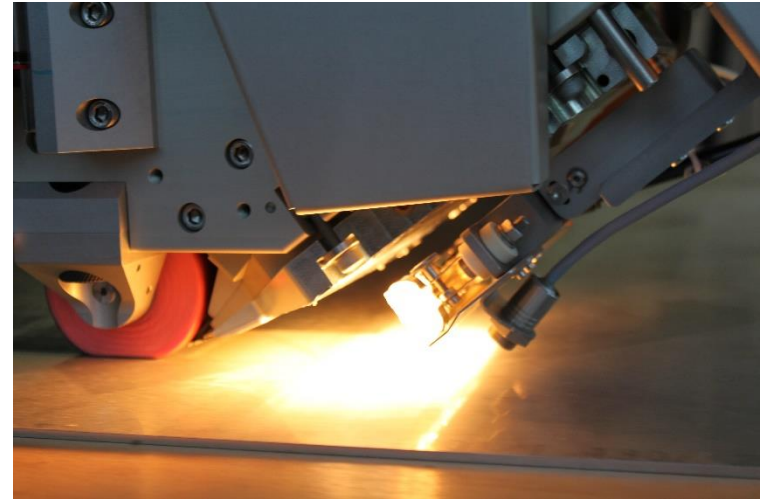
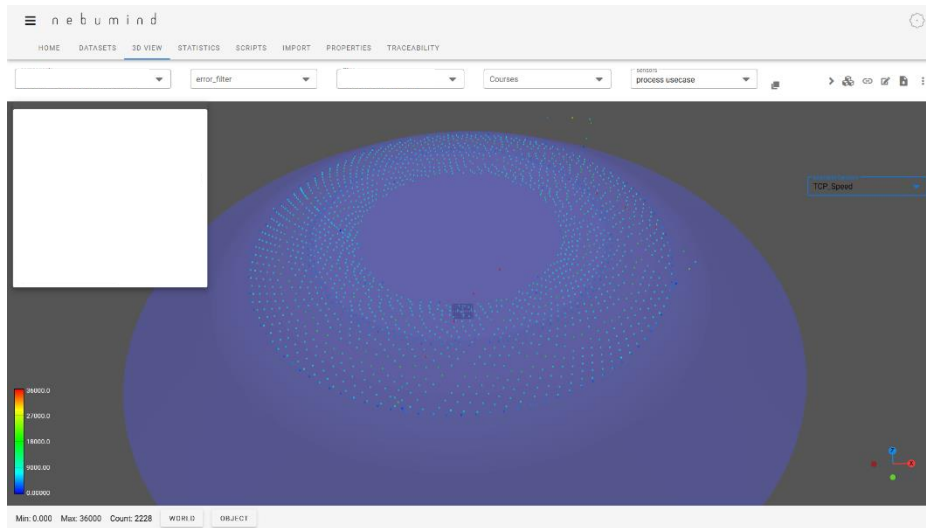
- Head, tube, creel conditions (humidity, temperature)

▶ Machine environment

- Particles, humidity temperature

▶ Machine errors

- Rotation Fault, Spool Overload
- Manually Specified Errors (e.g. temperature range) regarding process boundaries



© Nebumind Software

Use Case Process

(1) Tool Depth, (2) Compaction Force, (3) Velocity, (4) Pyrometer Temperature

→ Check process window, Process understanding, evaluate cause of error or layup defect, check tooling/substrate surface (tool depth and target path)

Next steps

- Continuation and expansion of the activities in potential subsequent projects including the field of NDI
- Expansion and usage of the gained know-how in the industrial environment at MTA and Fraunhofer IGCV

Background and justification

- Automated Fiber Placement (AFP) as a highly automated and complex composite process gives the opportunity to use vast amounts of data to optimize the process in several aspects like cost, quality, robustness and efficiency
- Potential needs and challenges within AFP have been discovered, which can be improved using digital applications

Objectives

- The focus of the project was data acquisition and the possibility to use the generated data to develop a digital process and product twin
- The goal was to set up a digital environment that fits the needs of the end users and show an enhancement in productivity, quality and process understanding without disturbing the running processes

DIGIMAP

< DIGIMAP Home Environmental Conditions Order Data Creel Logout

Benefits

- Faster accessibility of data: operators / engineers can observe and evaluate process holistically
 - Creation of a QA tool: check if required environmental conditions are in range
- Establishment of a foundation and build up of expertise regarding the digitalization of further machines and production processes

Achievements and status

- Integration of an edge device and edge management system into the machine and IT infrastructure, to collect, store and process data
- Several applications and a corresponding dashboard were developed and integrated into an industrial environment to get immediate feedback to the machine operators and engineers: e.g. observation of environmental conditions in AFP cell, observation of material flow through a camera system, storage and observability of process and machine data, evaluation of theoretical and actual production time

Environmental Conditions
Clean room temperature, humidity and particles

Production Time
Monitoring of production time

Order Data
Part data, filtered by manufacturing order

Creel
Video surveillance of the creel



GERMANY

MT Aerospace AG

Franz-Josef-Strauß-Straße 5
86153 Augsburg
Germany
+49 (0)821 505-01
info@mt-aerospace.de

FRENCH GUIANA

MT Aerospace Guyane S.A.S.

Résidence Mme Paille
25-27, rue Branly
97319 Kourou
Cedex/France
+594 (0)594 3275 90