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Big Data Pilot Demo Days
I-BiDaaS Application to the Manufacturing Sector

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The below-mentioned projects have been funded by the European Commission Horizon 2020
BigDataStack: grant agreement No 779747
I-BiDaaS: grant agreement No 780787
Track and Know: grant agreement No 780754
Policy Cloud: grant agreement No 870675

Webinar Speakers

Assistant Professor at the Department of Mathematics and Informatics, Faculty of Sciences, University of Novi Sad, Serbia

I-BiDaaS Scientific & Technical Manager.

Dr. Dušan Jakovetić
University of Novi Sad, Serbia

Flexible and Adaptive Systems Specialist at Factory Innovation Department, CRF, Italy

Giuseppe Danilo Spennacchio
CRF

Agenda

- Big Data Pilot Demo Days. A joint effort by BigDataStack, I-BiDaaS, Track & Know & Policy Cloud – Despina Kopanaki (FORTH)
- I-BiDaaS overview – Dusan Jakovetic (UNSPMF)
- CRF's Pitches: Setting the requirements – Giuseppe Danilo Spennacchio (CRF)
- I-BiDaaS architecture: Scientific & Technical view; how it addresses the requirements set by CRF – Dusan Jakovetic (UNSPMF)
- Step by Step demonstration of I-BiDaaS solution and its application to manufacturing sector – Giuseppe Danilo Spennacchio (CRF)
- Introduction to the next webinar-Track & Know Insurance Sector: Using mobility data to understand and mitigate risky driving behaviour - Leonardo Longhi (Sistematica, Track & Know)
- Questions & Answers

Questions

- **To which of our stakeholder types do you belong?**
  (Big Data Provider, Big Data Technology Provider, Manufacturing, Research & Academia, Standardisation Body, other)

- **Are you working with Big Data?**
  (Yes, No)

- **Are you interested in Big Data Technologies to optimize your customer experience?**
  (Yes, No, Maybe)

- **What is the main barrier or risk preventing you from implementing Big Data analytical solutions in your organization?**
  (Costs, Lack of expertise, Uncertain Value (ROI))

BDV PPP Summit 2020 went virtual

Why Big Data Pilot Demo Days?

- The new data-driven industrial revolution highlights the need for big data technologies to unlock the potential in various application domains.
- BDV PPP projects I-BiDaaS, BigDataStack and Track & Know and Policy Cloud deliver innovative technologies to address the emerging needs of data operations and applications.
- To fully exploit the sustainability of the developed technologies, the projects onboarded pilots that exhibit their applicability in a wide variety of sectors.
- In their third and final year, the projects are ready to demonstrate the developed and implemented technologies to interested end-users from industry as well as technology providers, for further adoption.
- The recently started Policy Cloud project will highlight the adoption of technologies developed by the more mature BDV PPP project BigDataStack, showcasing its application for the policy making sector

BDV PPP Projects Join Forces

Holistic stack for big data applications and operations

Industrial-Driven Big Data as a Self-Service Solution

Big Data for Mobility Tracking Knowledge Extraction in Urban Areas

Cloud for Data-Driven Policy Management

BDV PPP projects joining forces to showcase application of innovative technologies in a variety of domains, fostering futher adoption, contributing to Europe's digital future.

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Big Data Pilot Demo Days - A Series of Webinars

1. I-BiDaaS Application to the Financial Sector
2. BigDataStack Connected Consumer demo
3. A BigDataStack Seafarer's Tale on Real Time Shipping
4. I-BiDaaS Application to the Telecommunication Sector
5. Policy Cloud: Data Driven Policies against Radicalisation
6. Track & Know applied to the fleet management sector
7. I-BiDaaS Application to the manufacturing sector
8. Track & Know applied to the automotive insurance sector
9. Track & Know applied to patient mobility in the healthcare sector

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BigDataStack
Holistic stack for big data applications and operations

I-BiDaaS
Industrial-Driven Big Data as a Self-Service Solution

Policy Cloud
Cloud for Data-Driven Policy Management

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I-BiDaaS Overview

Dusan Jakovetic

Ass. Professor, University of Novi Sad, Faculty of Sciences, Serbia;
I-BiDaaS Scientific & Technical Manager

I-BiDaaS Application to the Manufacturing Sector

Thursday, July 9, 2020 - 14:00-15:00 CEST

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Identity card

Project Consortium
13 partners

PROJECT NAME
Industrial-Driven Big Data as a Self-Service Solution

TOTAL BUDGET / TOTAL EC FUNDING
€ 4 997 035

PROJECT TYPE
RIA

START DATE
1 January 2018

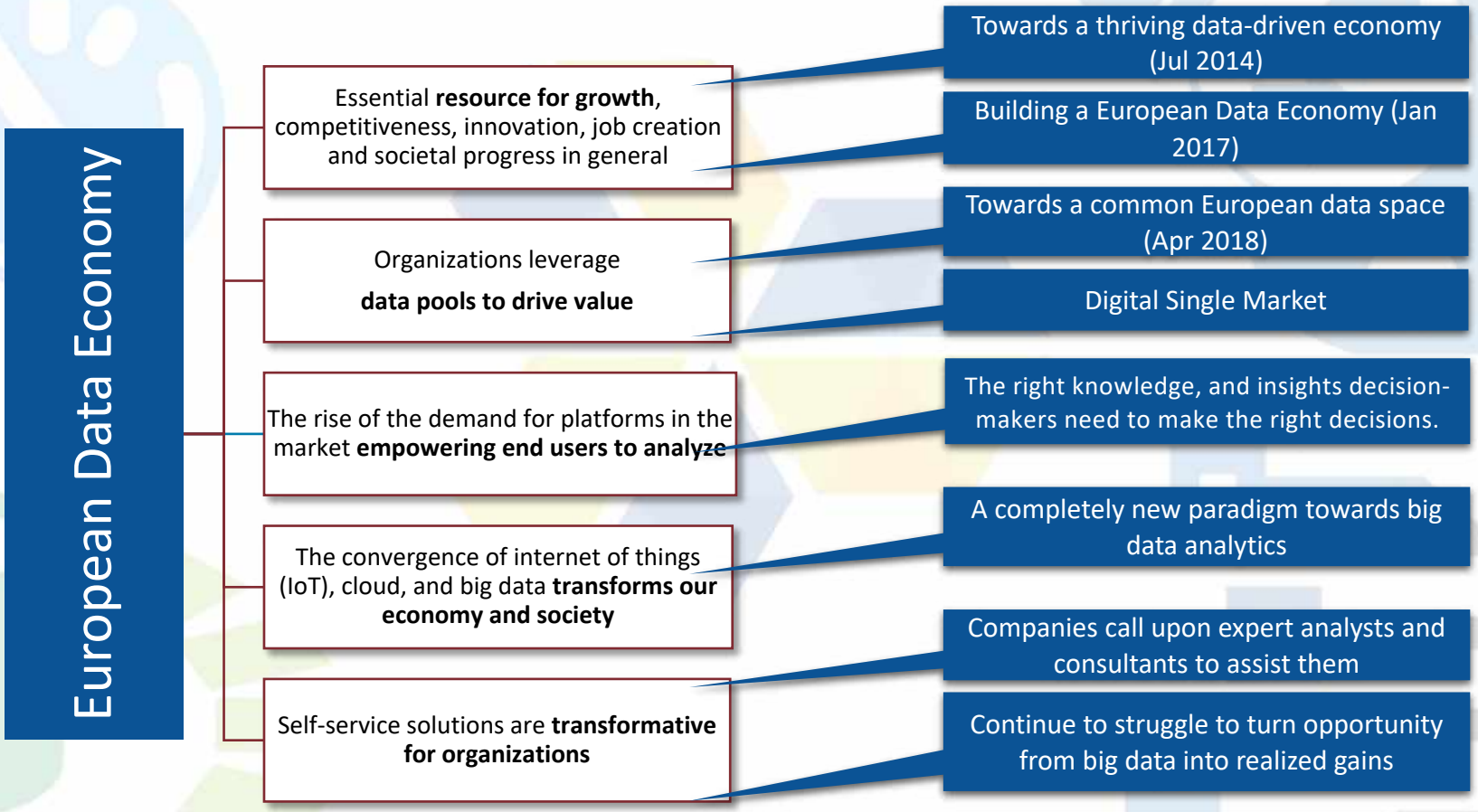
DURATION
36 months

http://www.ibidaas.eu/ @Ibidaas https://www.linkedin.com/in/i-bidaas/

I-BiDaaS Consortium

1. FOUNDATION FOR RESEARCH AND TECHNOLOGY HELLAS (**FORTH**)
2. BARCELONA SUPERCOMPUTING CENTER - CENTRO NACIONAL DE SUPERCOMPUTACION (**BSC**)
3. IBM ISRAEL - SCIENCE AND TECHNOLOGY LTD (**IBM**)
4. CENTRO RICERCHE FIAT SCPA (**CRF**)
5. SOFTWARE AG (**SAG**)
6. CAIXABANK, S.A (**CAIXA**)
7. THE UNIVERSITY OF MANCHESTER (**UNIMAN**)
8. ECOLE NATIONALE DES PONTS ET CHAUSSEES (**ENPC**)
9. ATOS SPAIN SA (**ATOS**)
10. AEGIS IT RESEARCH LTD (**AEGIS**)
11. INFORMATION TECHNOLOGY FOR MARKET LEADERSHIP (**ITML**)
12. University of Novi Sad Faculty of Sciences Serbia (**UNSPMF**)
13. TELEFONICA INVESTIGACION Y DESARROLLO SA (**TID**)

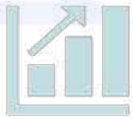
Motivation


European Data Economy
Essential **resource for growth**, competitiveness, innovation, job creation and societal progress in general
Towards a thriving data-driven economy (Jul 2014)
Building a European Data Economy (Jan 2017)
Organizations leverage **data pools to drive value**
Towards a common European data space (Apr 2018)
Digital Single Market
The rise of the demand for platforms in the market **empowering end users to analyze**
The right knowledge, and insights decision-makers need to make the right decisions.
The convergence of internet of things (IoT), cloud, and big data **transforms our economy and society**
A completely new paradigm towards big data analytics
Self-service solutions are **transformative for organizations**
Companies call upon expert analysts and consultants to assist them
Continue to struggle to turn opportunity from big data into realized gains

Our Vision

A **complete** and **safe environment** for methodological **big data experimentation**

Tool and services to **increase the quality** of data analytics



A Big Data as a **Self-Service solution** that helps breaking industrial data silos and boosts EU's data-driven economy

Tools and services for **fast ingestion and consolidation** of both realistic and fabricated data

Increases impact in research community and contributes to industrial innovation capacity

Tools and services for the management of **heterogeneous infrastructures** including elasticity

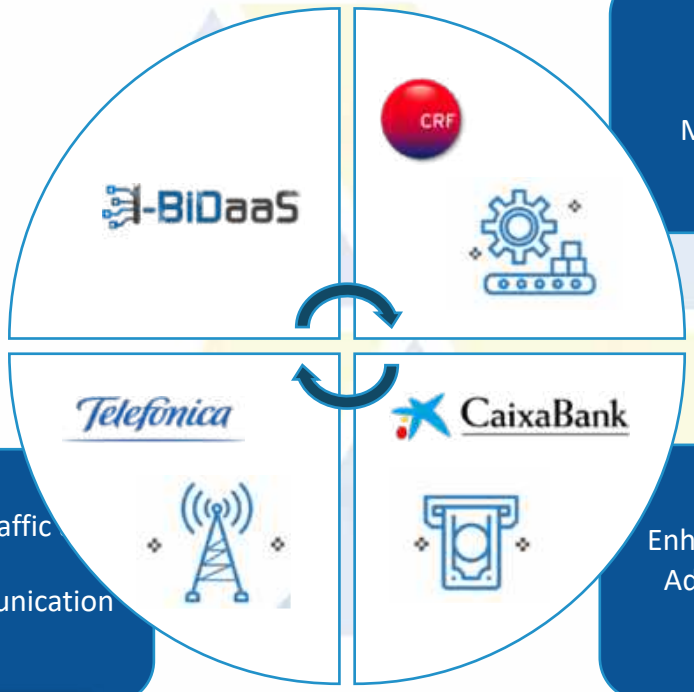
Project Statement

I-BiDaaS *aims to* ***empower*** *users to easily* ***utilize and interact*** *with* ***big data technologies****, by designing, building, and demonstrating, a* ***unified framework*** *that:*

significantly increases the ***speed of data analysis*** *while coping with the rate of* ***data asset growth****, and facilitates* ***cross-domain data-flow*** *towards a thriving* ***data-driven EU economy****.*

I-BiDaaS will be tangibly validated by three real-world, ***industry-lead*** *experiments.*

Application / Experimentation



CRF

Production process of aluminium casting

Maintenance and monitoring of production assets

Manufacturing Industry

TID

Accurate location prediction with high traffic visibility

Optimization of placement of telecommunication equipment

Quality of Service in Call Centers

Telecommunications Industry

CAIXA

Enhance control of customers to online banking

Advanced analysis of bank transfer payment in financial terminal

Analysis of relationships through IP address

Banking/Finance Industry

I-BiDaaS application domains

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BigDataStack
Holistic stack for big data applications and operations

I-BiDaaS
Industrial-Driven Big Data as a Self-Service Solution

Policy Cloud
Cloud for Data-Driven Policy Management

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Setting the Pilot Requirements

Giuseppe Danilo Spennacchio

Flexible and Adaptive Systems Specialist at Factory Innovation Department, CRF, Italy

I-BiDaaS Application to the Manufacturing Sector

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CRF (Centro Ricerche Fiat)

- one of the main private research centers in Italy
- founded in 1978

900 Employees

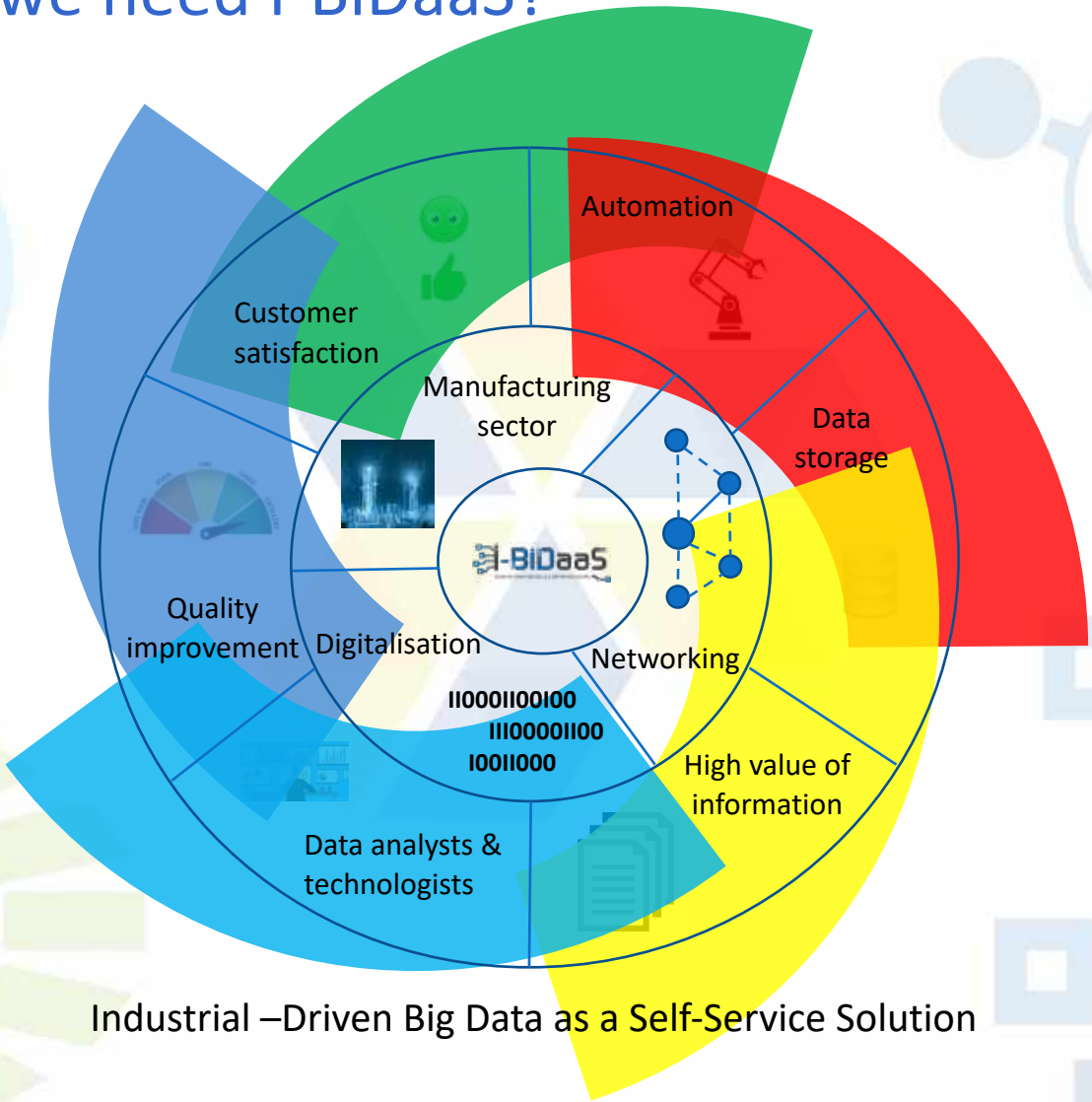
592 Inventions

2,573 Patents

The mission of CRF lies in three main goals:

1. to develop innovative power units, vehicle systems, materials, methods and processes to improve the competitiveness of FCA products
2. to represent FCA as part of European and national collaborative research, taking part in pre-competitive research projects and promoting the development of a network of contacts and partnerships on an international scale
3. to support FCA in enhancing the value of its intangible capital

Why do we need I-BiDaaS?



Industrial –Driven Big Data as a Self-Service Solution

Why do we need I-BiDaaS?

- Data are strictly **confidential**
- Computerized production lines store **large amounts of complex structured/unstructured data**

- **Lack of time** to extract and analyse data due to **fast rhythms of production**
- **Fast** internal **changes** due to **rescheduling** production **quantities** and component **variations**
- **Slowdown of data sharing** due to security procedures

Requirements:

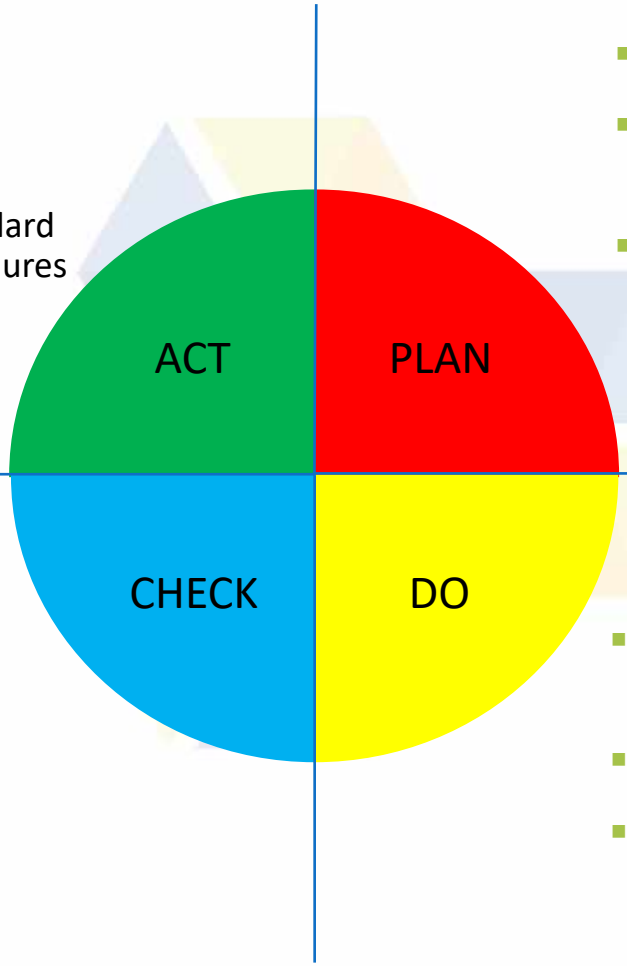
- **Data privacy**: *Anonymise data that can not be accessed or shared with external*
- **Data cleaning**: *Identify incomplete, inaccurate and irrelevant parts of the data – dataset generation*
- **Data analysis and advanced visualisation tools**: *empower data providers decisions*

Objective:

- **Quality Improvement and PM**: *Exploit the I-BiDaaS platform to develop a methodology for quality and process improvement and for Predictive Maintenance*

Why do we need I-BiDaaS?

- Implement the plan:
  - Develop a methodology
  - Update the standard operating procedures



- Identify 2 use cases
- Define the steps we need to take
- Enter in the I-BiDaaS project

- Analyse the results
- Verify that we have improved the plan

- Define the identified use cases
- Provide data
- Carry out the plan in the I-BiDaaS Platform

Why do we need I-BiDaaS?

- **Breaking data silos while complying Regulation**
  - *Integrate data from different sources/ levels*
  - *External/ internal departments*
  - *Data and method management (complex, huge)*
  - *Technical and business demonstration of data sharing between company owning the data, company performing the analysis (CRF) and consortium partners*

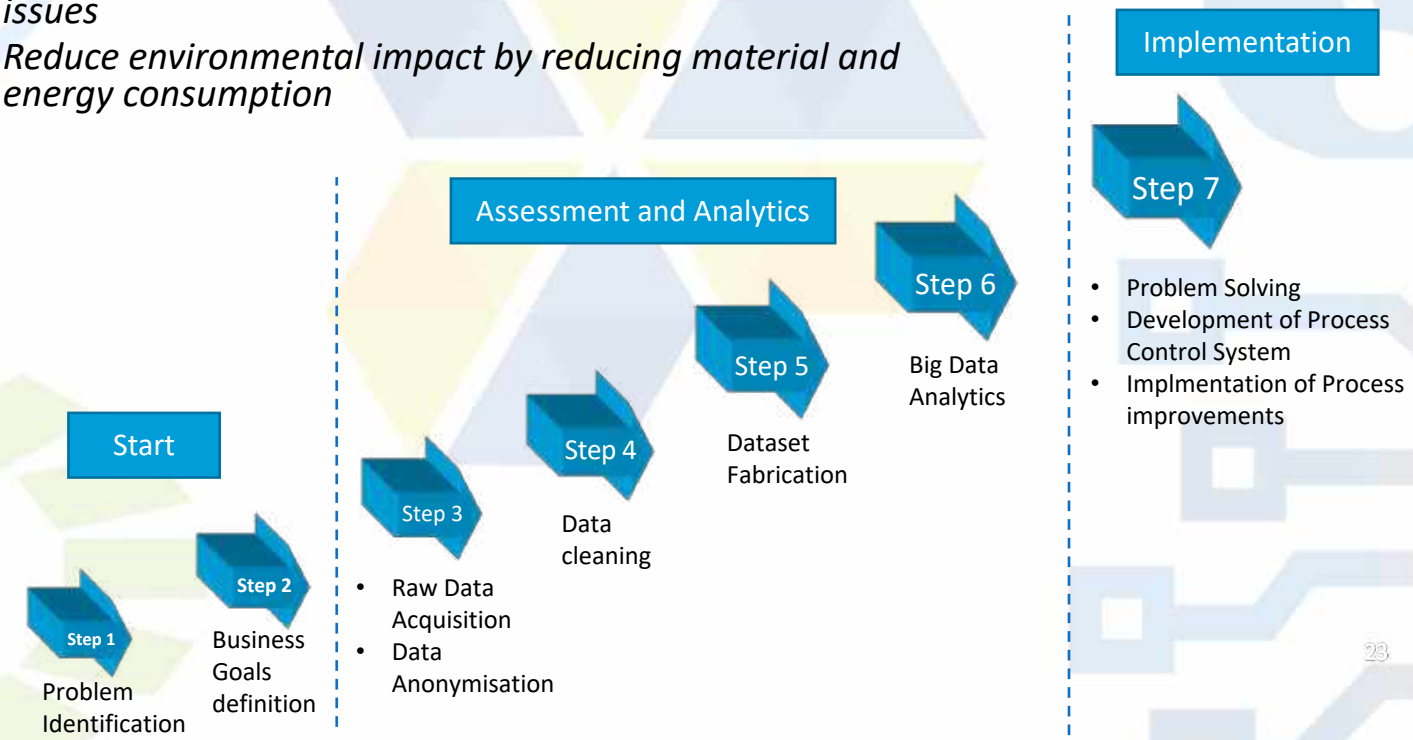
- **As-a-Service**
  - *Empower expert/ non expert usage of huge quantities of data*
  - *Include new competences in data analysis/ update automatically (SMEs, partners)*

Break inter and intra-sectorial data-silos, and support data sharing, exchange, and interoperability

Support methodical big data experimentation by putting in place a safe data processing environment

Why do we need I-BiDaaS?

- **Competitiveness & Innovation**
  - *Enable WCM (World Class Manufacturing) strategies*
  - *Enable real time or near real time data transfer/ data analysis / internal procedures update*
- **Efficiency**
  - *Reduce manufacturing costs due to quality and maintenance issues*
  - *Reduce environmental impact by reducing material and energy consumption*



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Big Data Architecture

Dusan Jakovetic

Assistant Professor, University of Novi Sad, Serbia;
I-BiDaaS Scientific & Technical Manager

I-BiDaaS Application to the Manufacturing Sector

July 9, 2020

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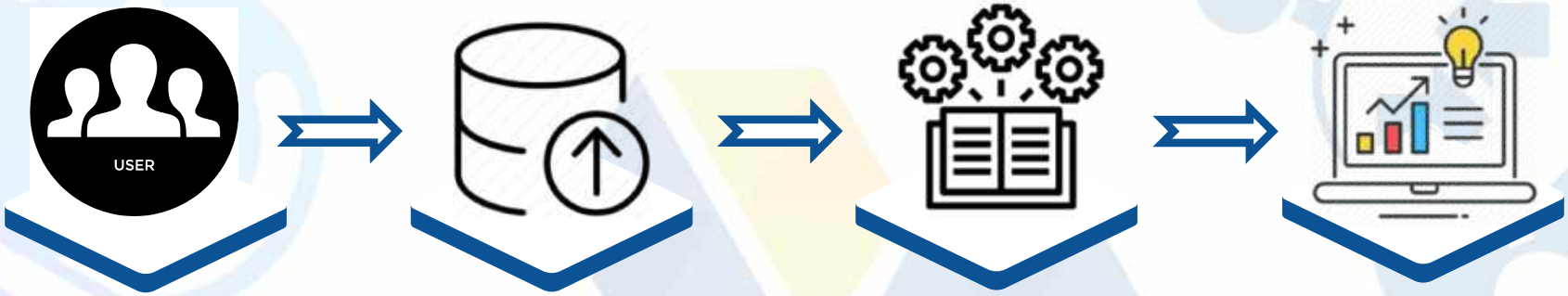
The I-BiDaaS Solution: Front-end



Users

- Expert mode
- Self-service mode
- Co-develop mode

Data

- Import your data
- Fabricate Data
- Tokenize data

Analyze your Data

- Stream & Batch Analytics
- Expert: Upload your code
- Self-service: Select an algorithm from the pool
- Co-develop: custom end-to-end application

Results

- Visualize the results
- Share models

Benefits of using I-BiDaaS

Do it yourself
In a flexible manner

Break data silos

Safe environment

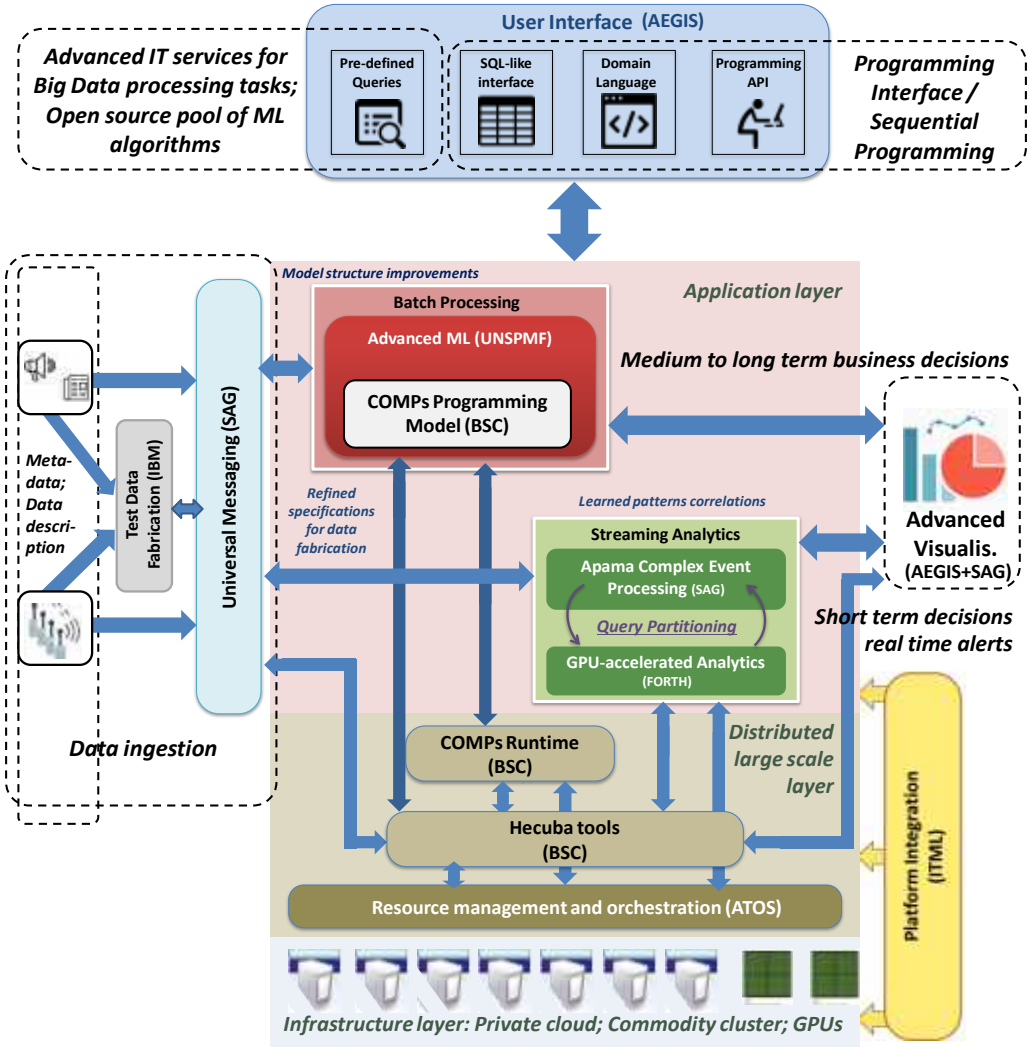
Interact with Big Data technologies

Increase speed of data analysis

Intra- and inter-domain data-flow

Cope with the rate of data asset growth

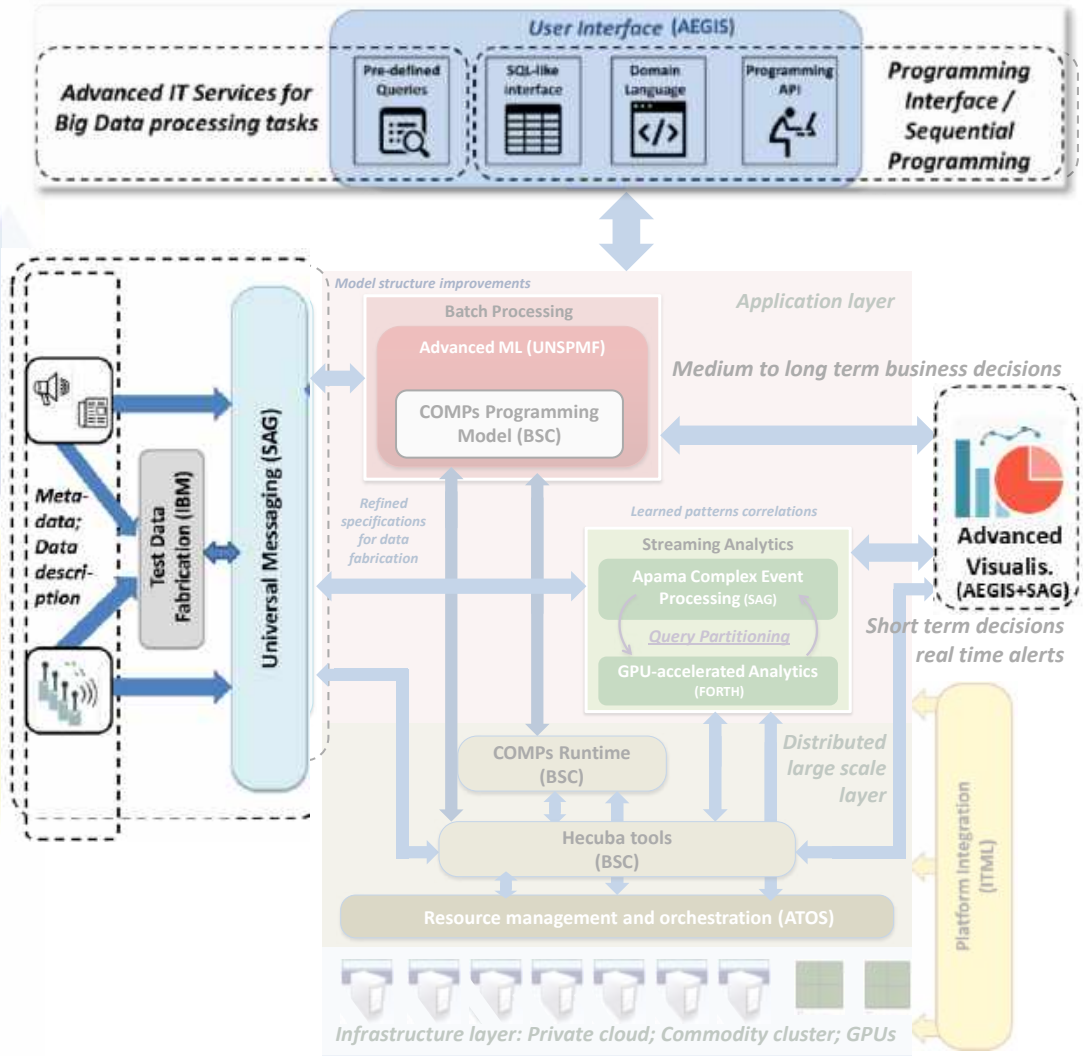
The I-BiDaaS Solution: Architecture/back-end



WP2:
Data, user interface, visualization

Technologies:

- IBM TDF
- SAG UM
- AEGIS AVT

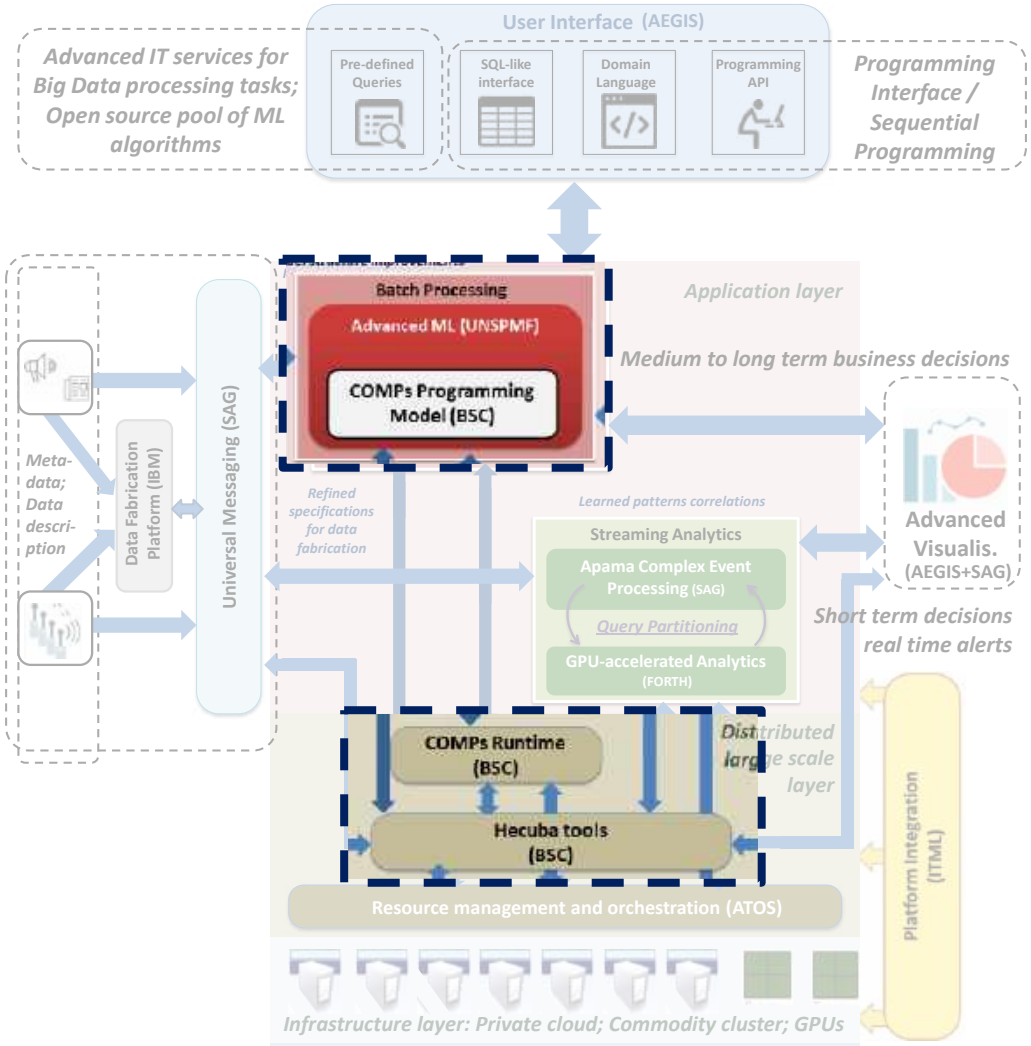


http://ibidaas.eu/tools

WP3:
Batch analytics

Technologies:

- BSC COMPSs
- BSC Hecuba
- BSC Qbeast
- Advanced ML (UNSPMF)



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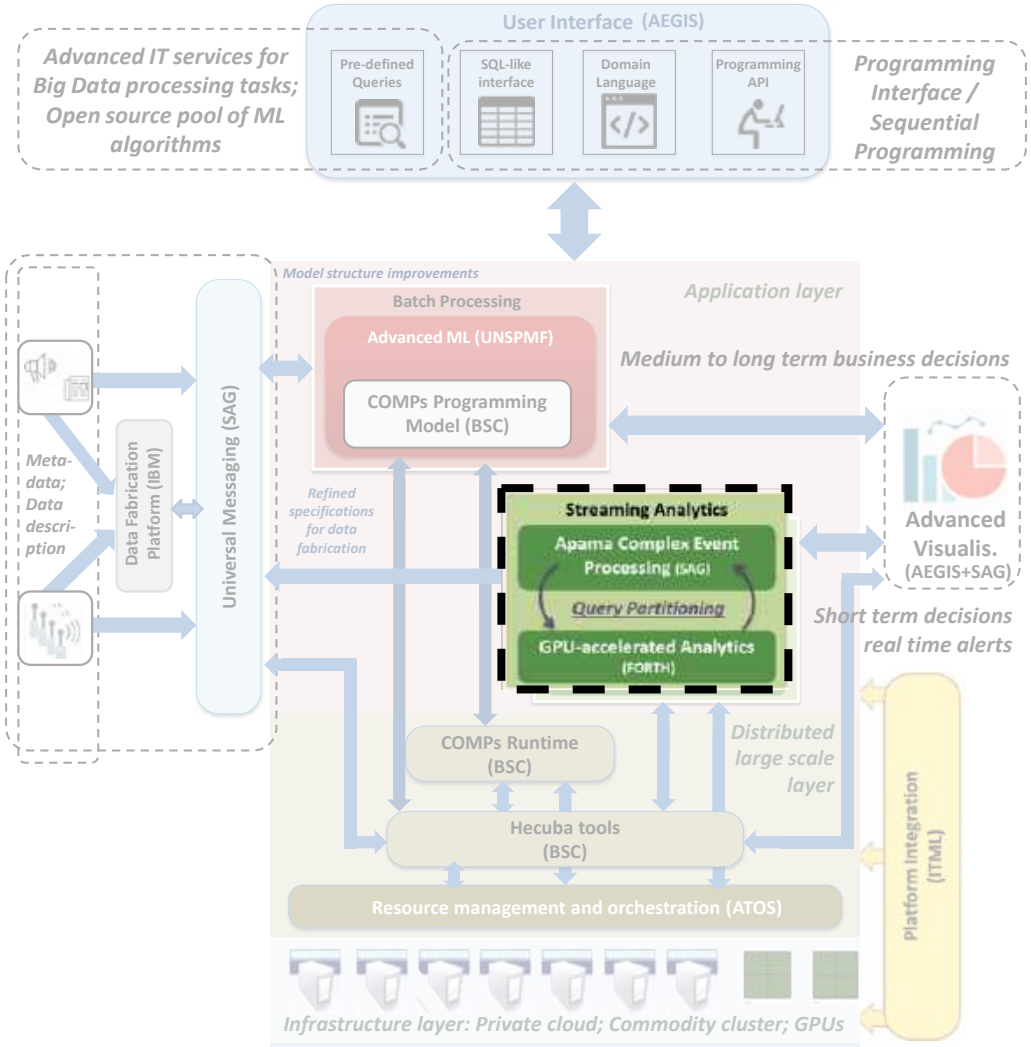
WP4:
Streaming analytics

Technologies:

- SAG Apama CEP
- FORTH GPU-accel. analytics



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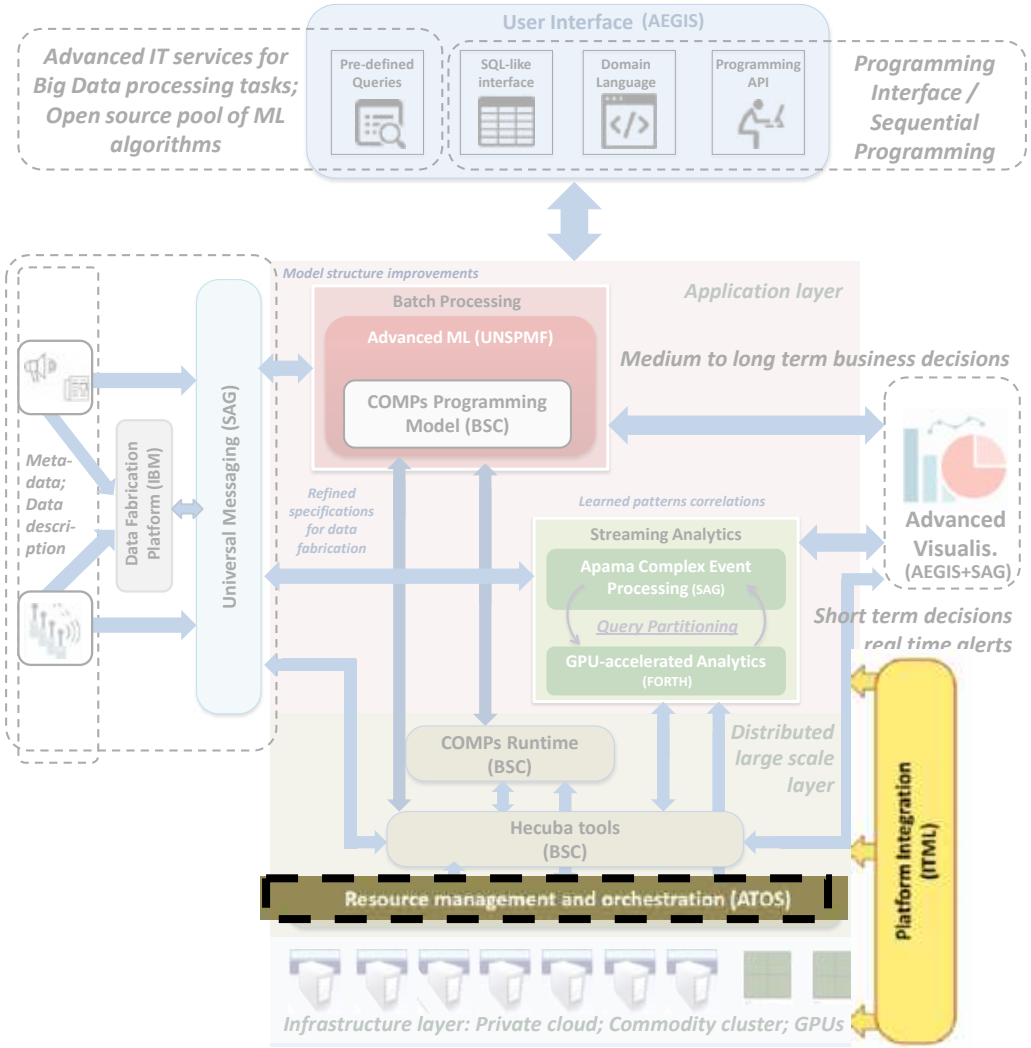
WP5:

Resource mgmt & integration

Technologies:

- ATOS Resource mgmt
- ITML integration services



http://ibidaas.eu/tools

Key Features & Innovations

- Data fabrication capabilities
- Solution flexibility
- Easy to code programming paradigm
- High code reusability

https://www.ibidaas.eu/deliverables

Key Features & Innovations (Cont'd)

- GPU-accelerated analytics; Synergy of CEP and GPU-accelerated analytics for streaming data
- Feedback from analytics to data fabrication
- Feedback from analytics to problem modelling
- Demonstrated on use cases across 3 different data providers and 3 different industries

https://www.ibidaas.eu/deliverables

I-BiDaaS applied to CRF use cases

- **Production Process of Aluminium Die Casting**
  - During the casting process of the engine blocks, molten aluminium is injected into the die cavity
  - Can we classify the quality levels of the engine block correctly when they are produced?
  - Can we improve the production process, by increasing the number of high quality engine blocks and decreasing the number of lower quality engine blocks?

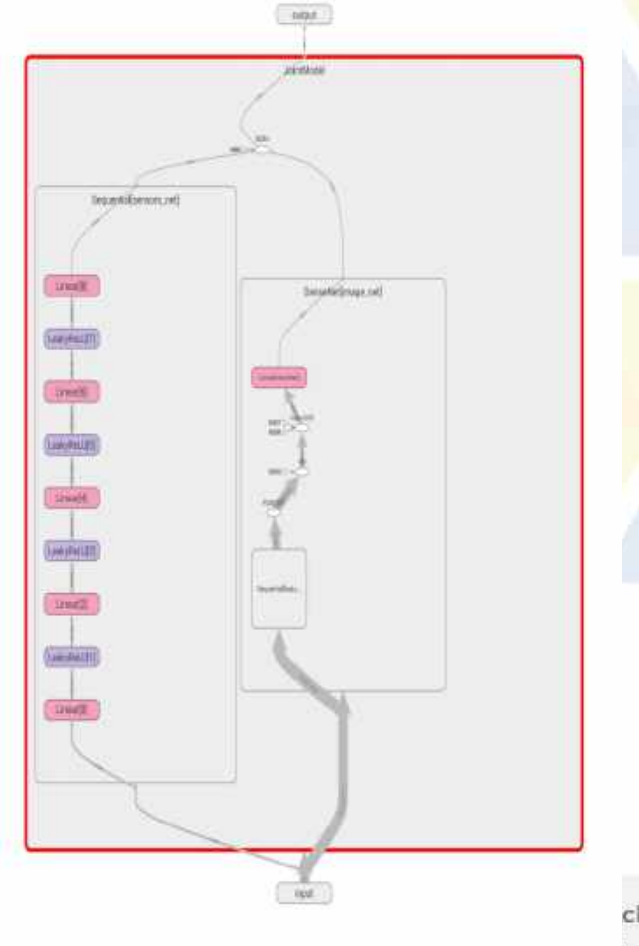
Production process of aluminium die casting

- **Challenges**
  - High volume dataset
  - Unbalanced dataset
  - Single model for two source of data
    - Thermal images
    - Sensor (tabular) data (piston speed, intensification pressures etc.)

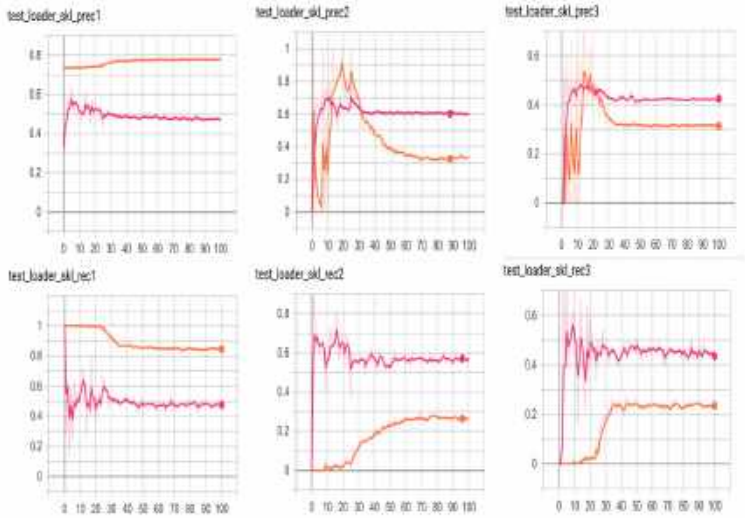
- **I-BiDaaS approach**
  - Joint neural network model with CNN and FCNN (PyTorch)
    - CNN with 201 layers (DenseNet201) for images – pretrained & non-trained model
    - Fully Connected NN with 7 layers for sensor data
  - Random under-sampling to produce a balanced dataset

Production process of aluminium die casting

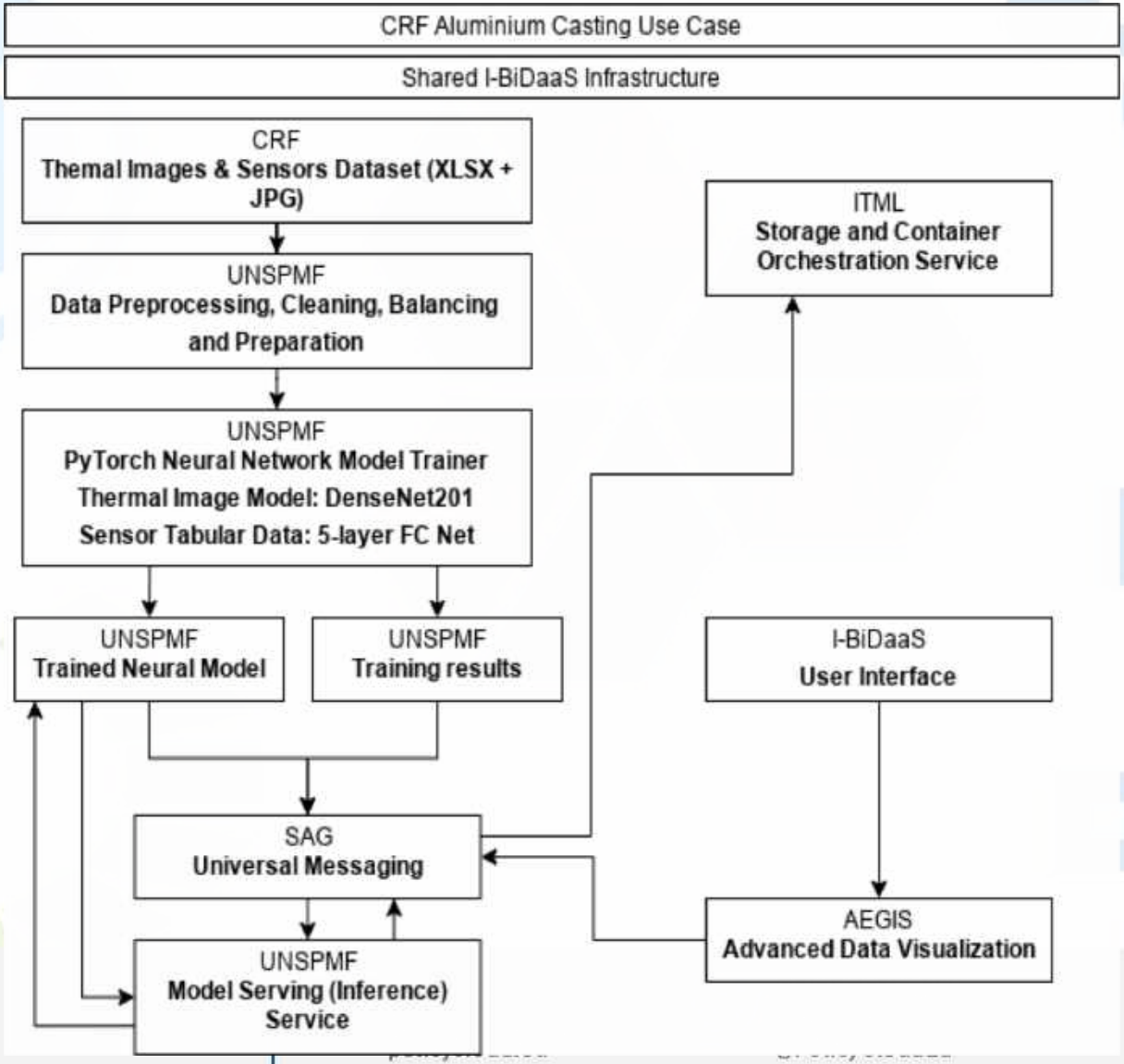
- Architecture of the joint neural network



- Good accuracy for different classes:
  - Orange line: model trained on full dataset - **73.54%** accuracy
  - Pink line: model trained on balanced dataset - **54.06%** accuracy (**better model on relevant classes**)



Production process of aluminium die casting



I-BiDaaS applied to CRF use cases

- **Maintenance and monitoring of production assets**
  - Different sensors are installed on the production line
  - Can we prevent faults before they happen?
  - Can we see the trend of a sensor's behavior across different days?
  - Can we see the similarity between sensors ?

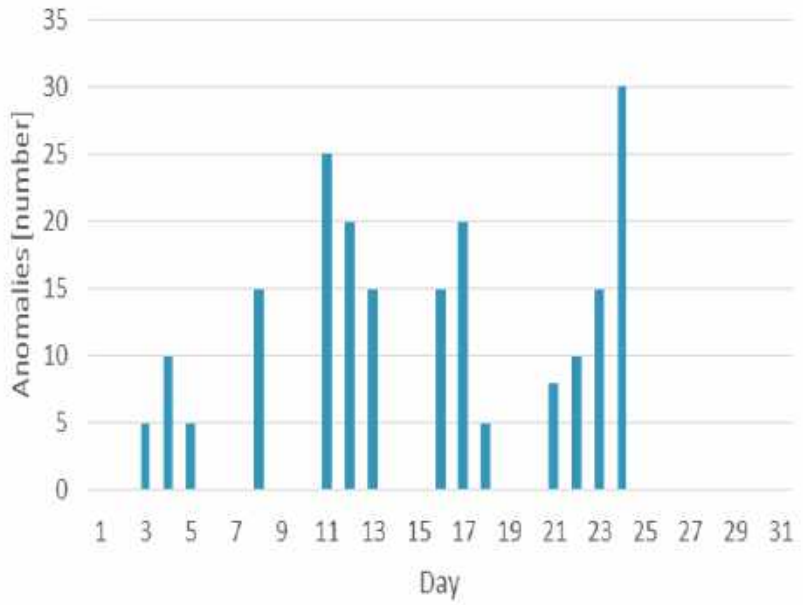
Maintenance and monitoring of production assets

- **Challenges**
  - High volume dataset (over 100 sensors, 26 months of measurements)
  - How to model the similar behavior?
  - Unlabeled data

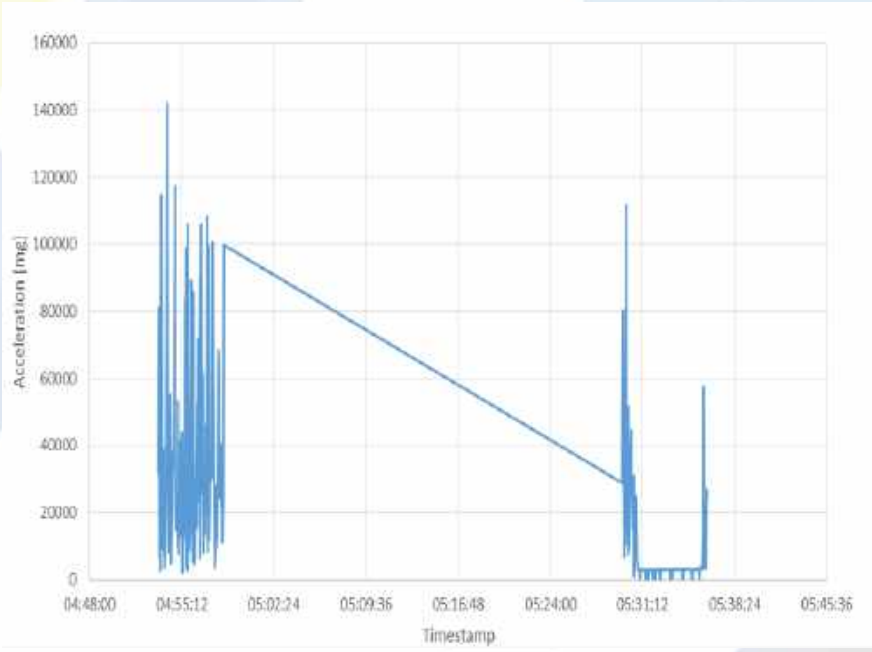
- **I-BiDaas approach**
  - Pandas library for data preprocessing
  - Time series per sensor with number of outliers per day
    - Visualization
    - Further analysis
  - Rescaled time series pairwise distance
  - Obtain the **most similar** sensors

Maintenance and monitoring of production assets

- Time series of outliers for a sensor

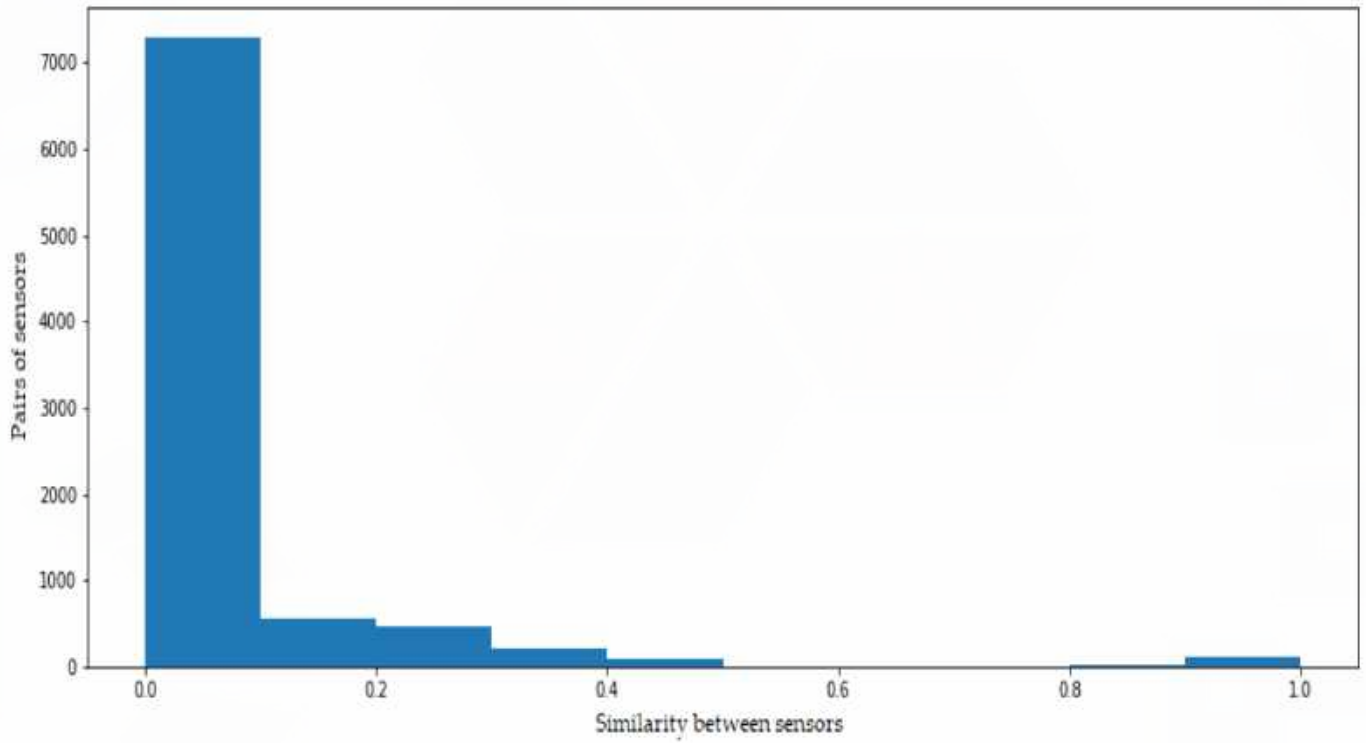


- Time series of measurements for a sensor

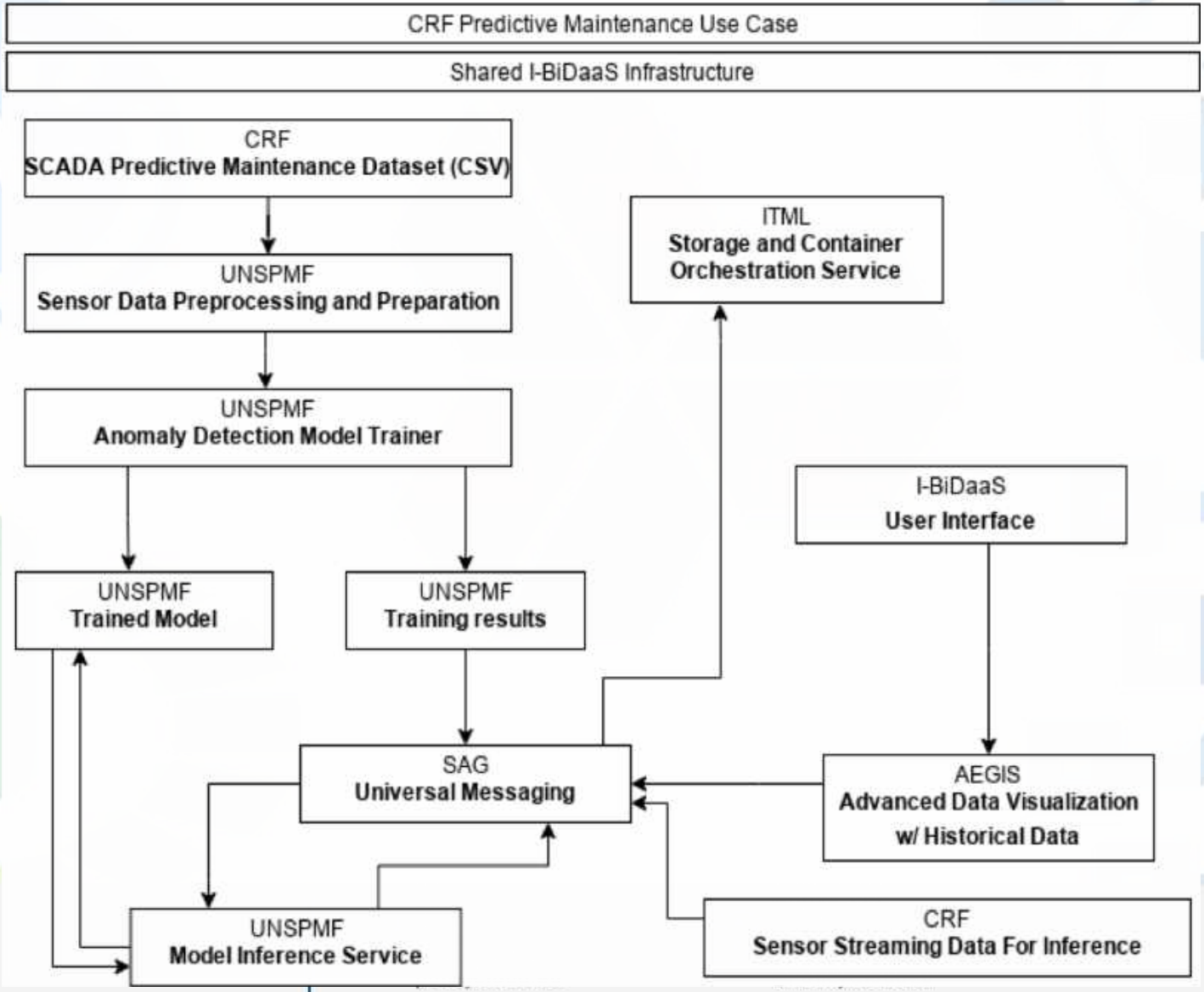


Maintenance and monitoring of production assets

- Histogram of similarity between sensors



Maintenance and monitoring of production assets



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Policy Cloud Cloud for Data-Driven Policy Management

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Manufacturing Pilot: step by step

Giuseppe Danilo Spennacchio

Flexible and Adaptive Systems Specialist at Factory Innovation Department, CRF, Italy

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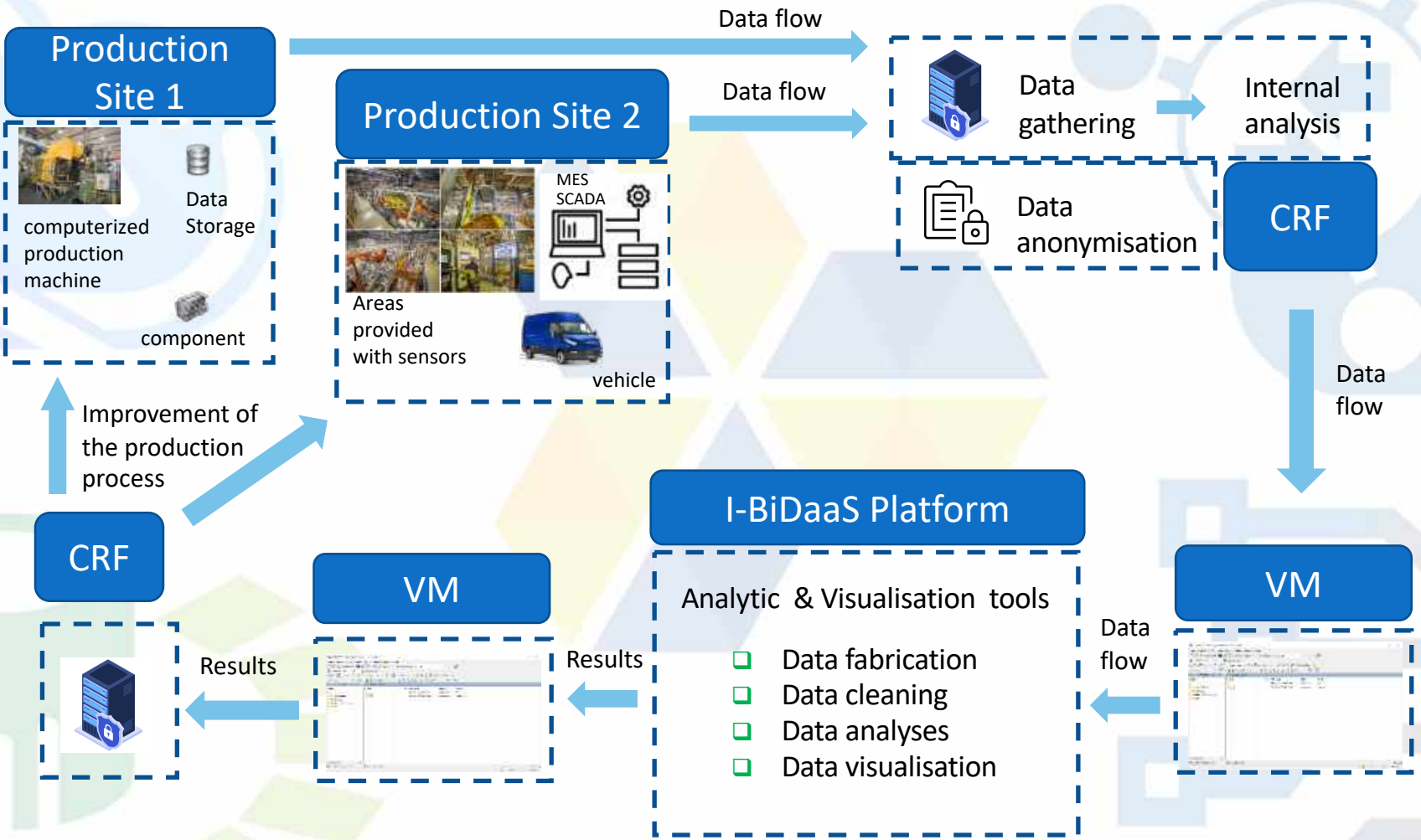
Current situation

- **Data Analytics in CRF**
  - Data analyses are executed in Factory Innovation Department (CRF)
- **Analytics lifecycle**:
  - *Security: original data provided by plants are retrieved in the CRF server*
  - *Quality analysis: data and defects manually detected are elaborated*
  - *Anonymisation: result of elaboration is gathered in new anonymised files with all information useful for analytics*
  - *Results: periodically discussion with manufacturers*

I-BiDaaS solution



CFR Data Roadmap

M9
Definition of dataset characteristics, format and first structured dataset

M3
Preliminary Definition of Use Case

START

M6
Use Case Consolidation and definition of dataset

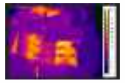
M12
Definition of Rules for the IBM's Data Fabrication Tool

M15
Validation of synthesized data

M21
CRF Demo

M18
Hackathon event in Melfi

M24
Provided a new type of data (Thermal data) for the 1°use case



M27
Progress on analytics

M30
Progress on visualisation

M33
Experimental implementation

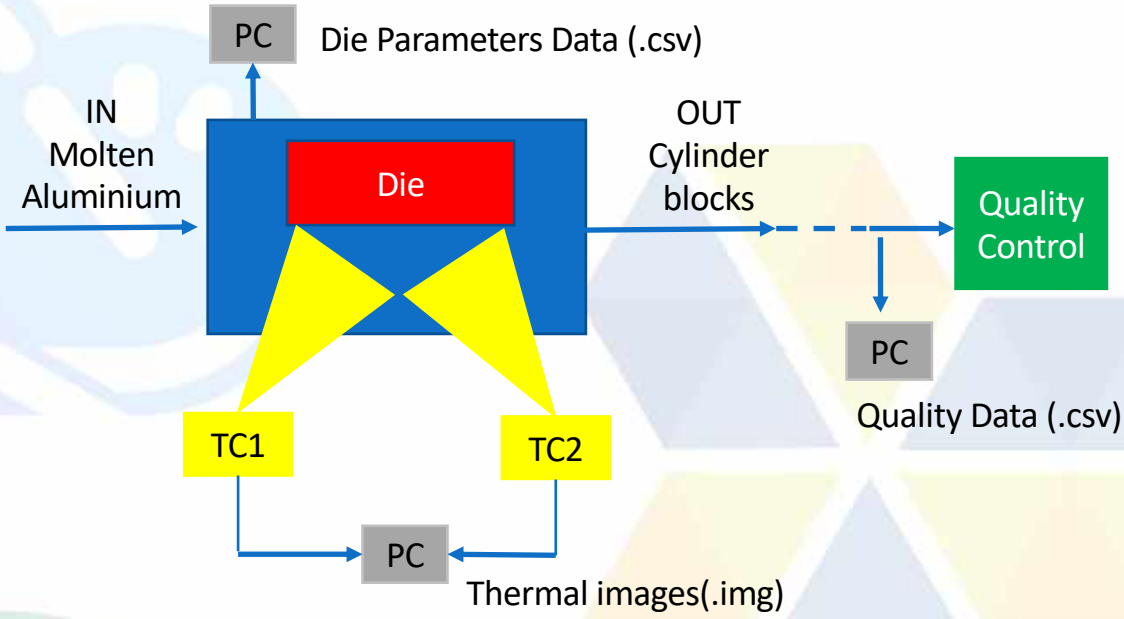
FINISH

M36

Q1 Q2 Q3 Q4 | Q1 Q2 Q3 Q4 | Q1 Q2 Q3 Q4

2018 2019 2020

Production Process of Aluminium Die Casting



Complex process:
an **enormous amount** of heterogeneous **data** such as piston speed in the first and second phase, intensification pressures; Temperatures, etc

Business Goal

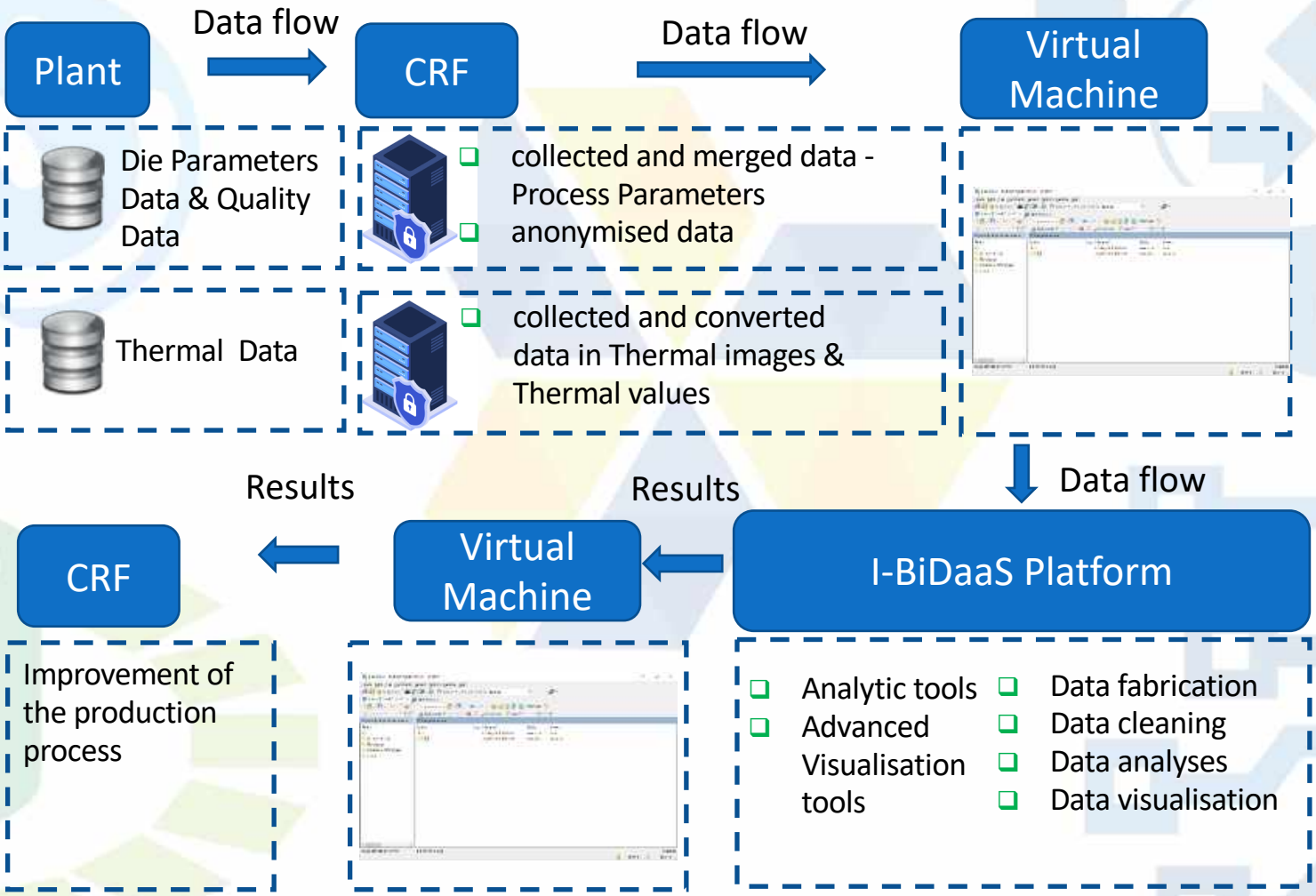
Quality Process Improvement:

- avoid decrease of quality level
- prevent repairs and reworks
- reduce scrap and waste

Use Case Goals

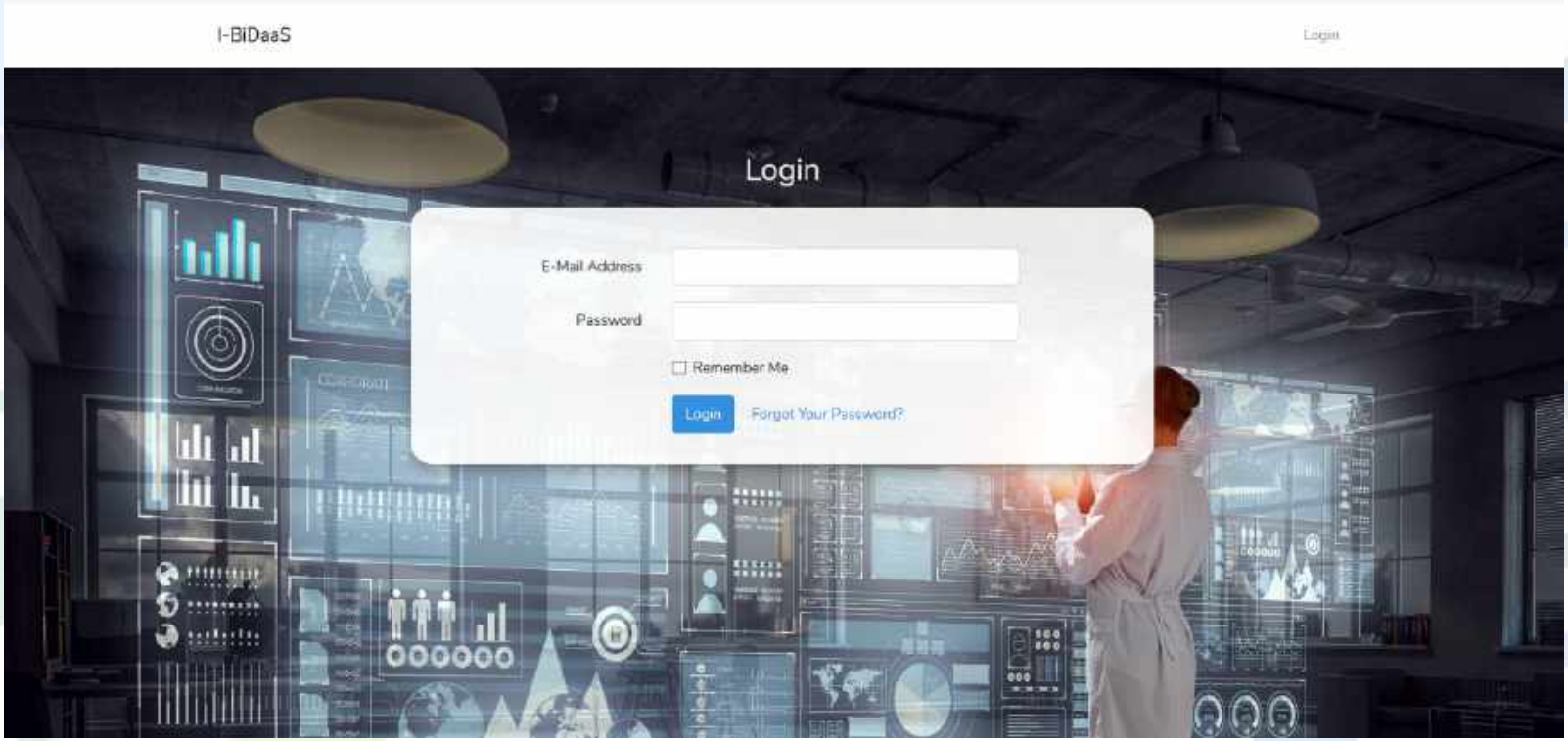
- Develop high level algorithms
- Identify and select critical parameters
- Provide a mode to quickly visualize analyses results

Production Process of Aluminium Die Casting – data flow



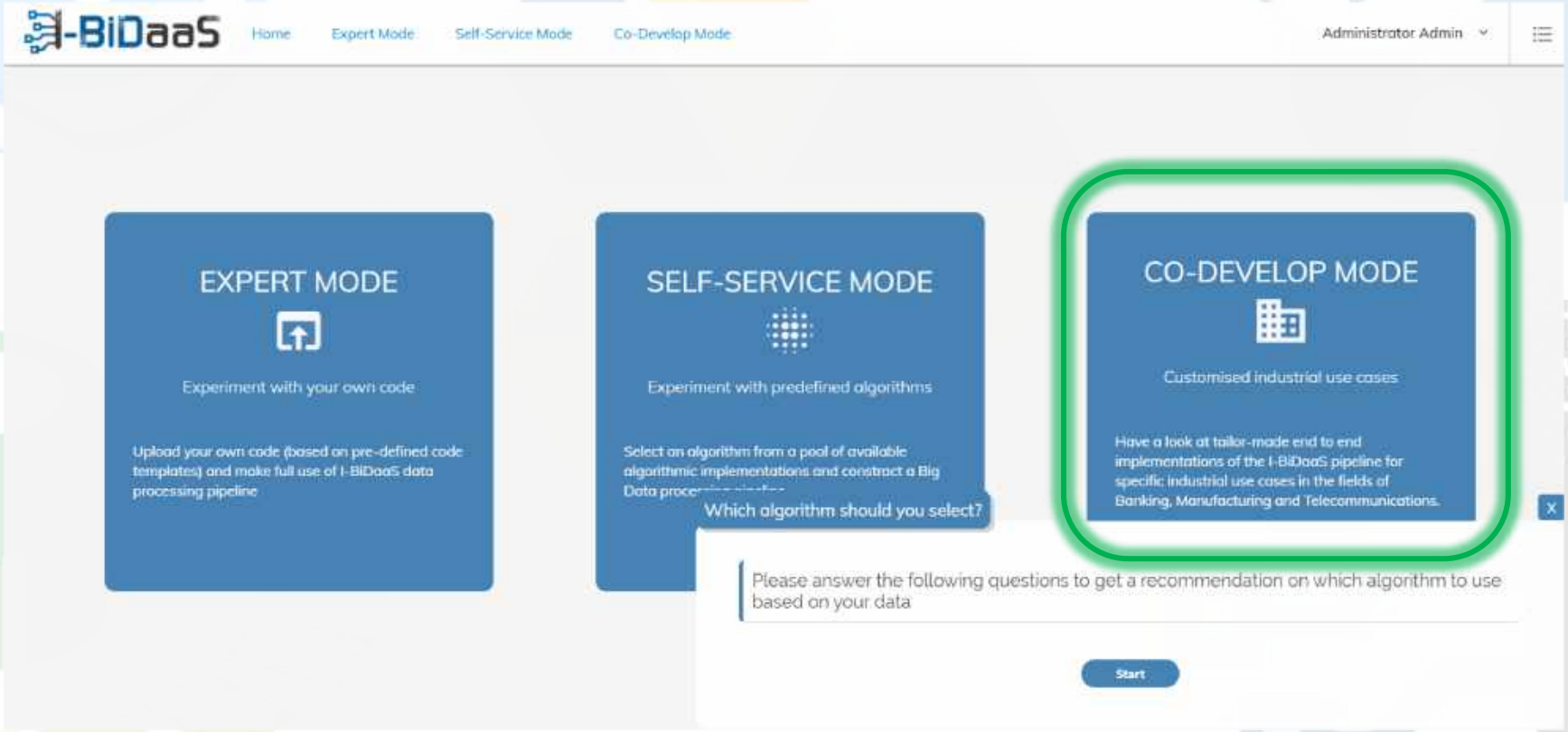
Production Process of Aluminium Die Casting - demo

I-BiDaaS platform to easy utilise I-BiDaaS solutions developed by data analysts and technologists.



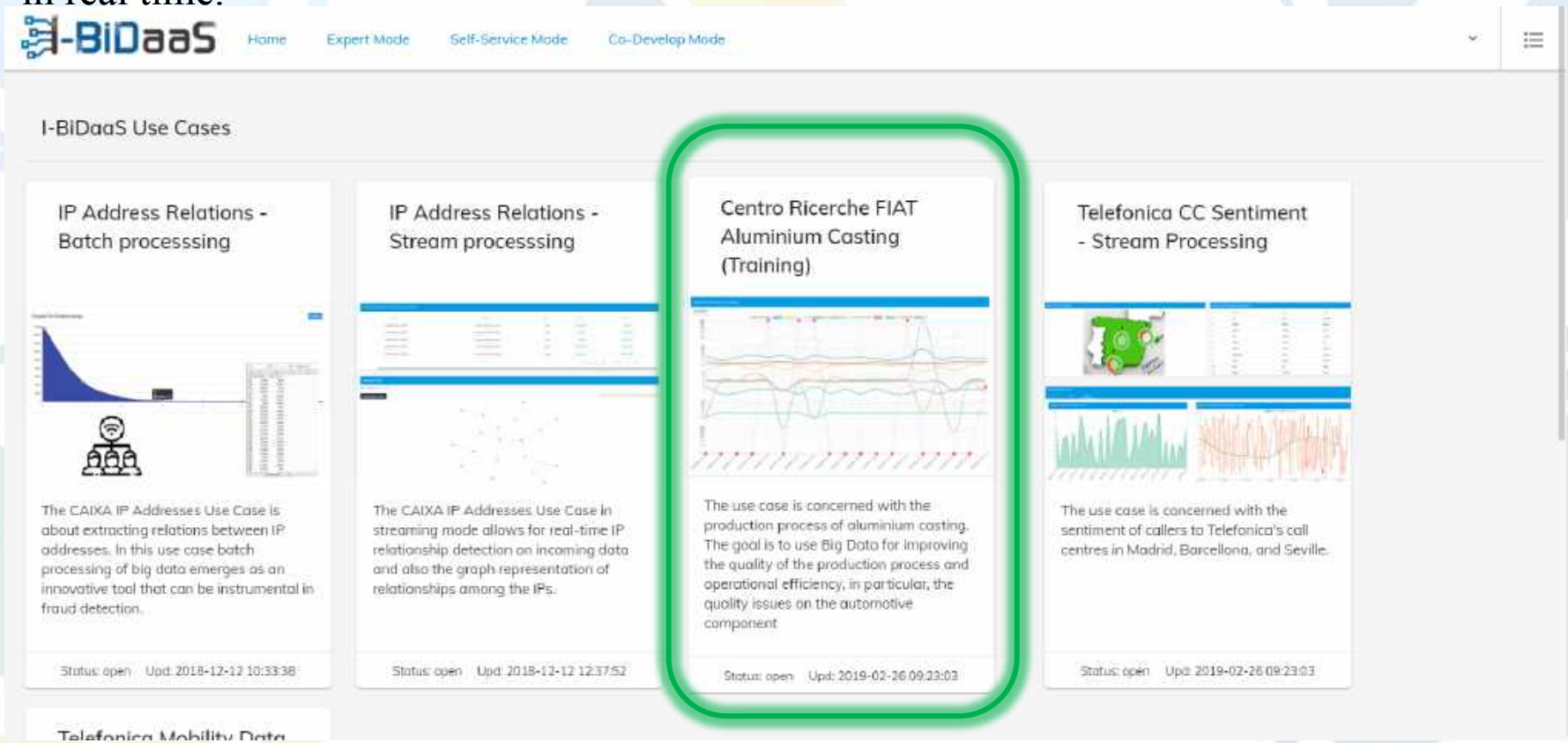
Production Process of Aluminium Die Casting - demo

After login, we selects co-develop mode, in which the data source and analysis algorithm are predefined.



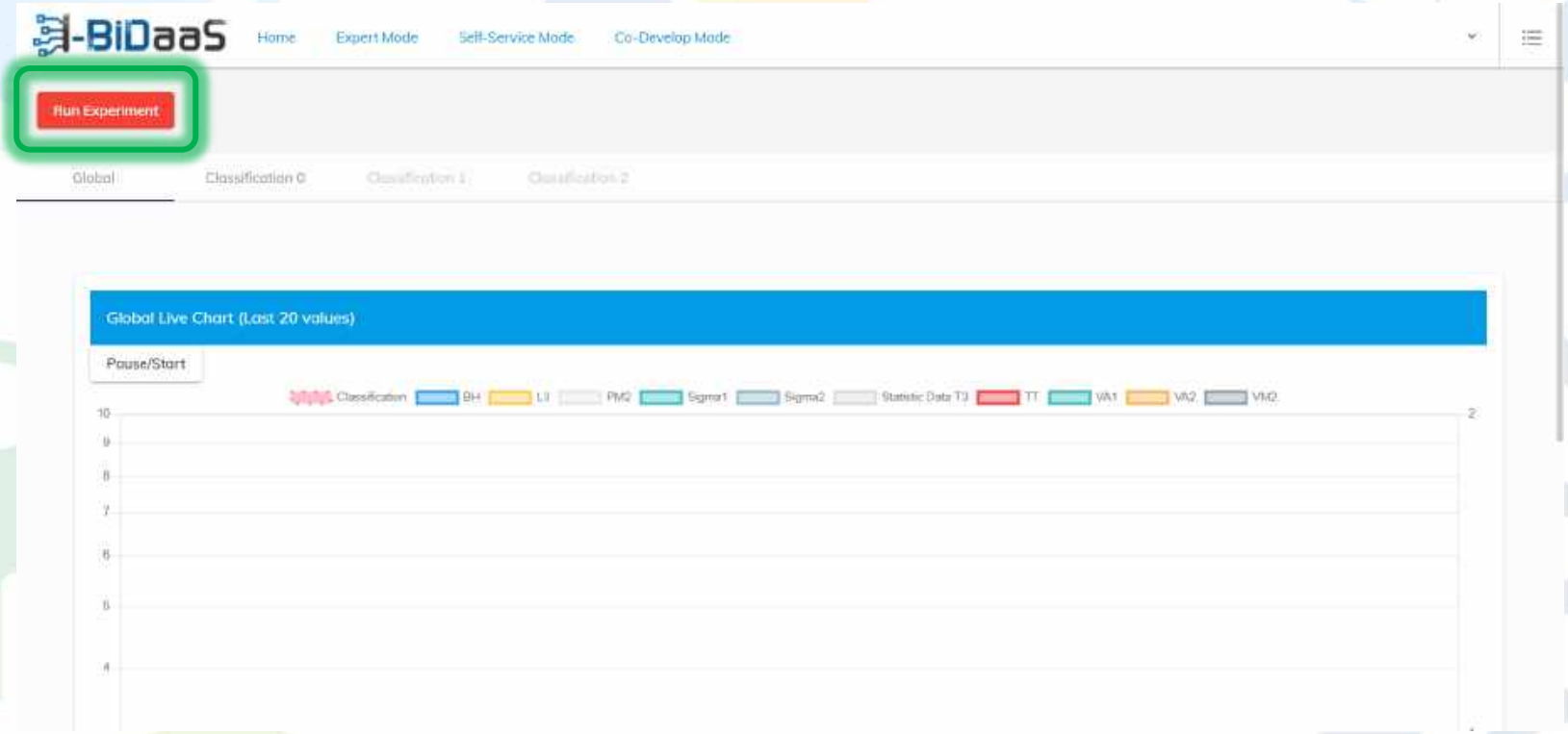
Production Process of Aluminium Die Casting - demo

The Aluminium Die Casting use case is a complex industrial process with many heterogeneous parameters. The co-develop mode allows to us to check data processing in real time.



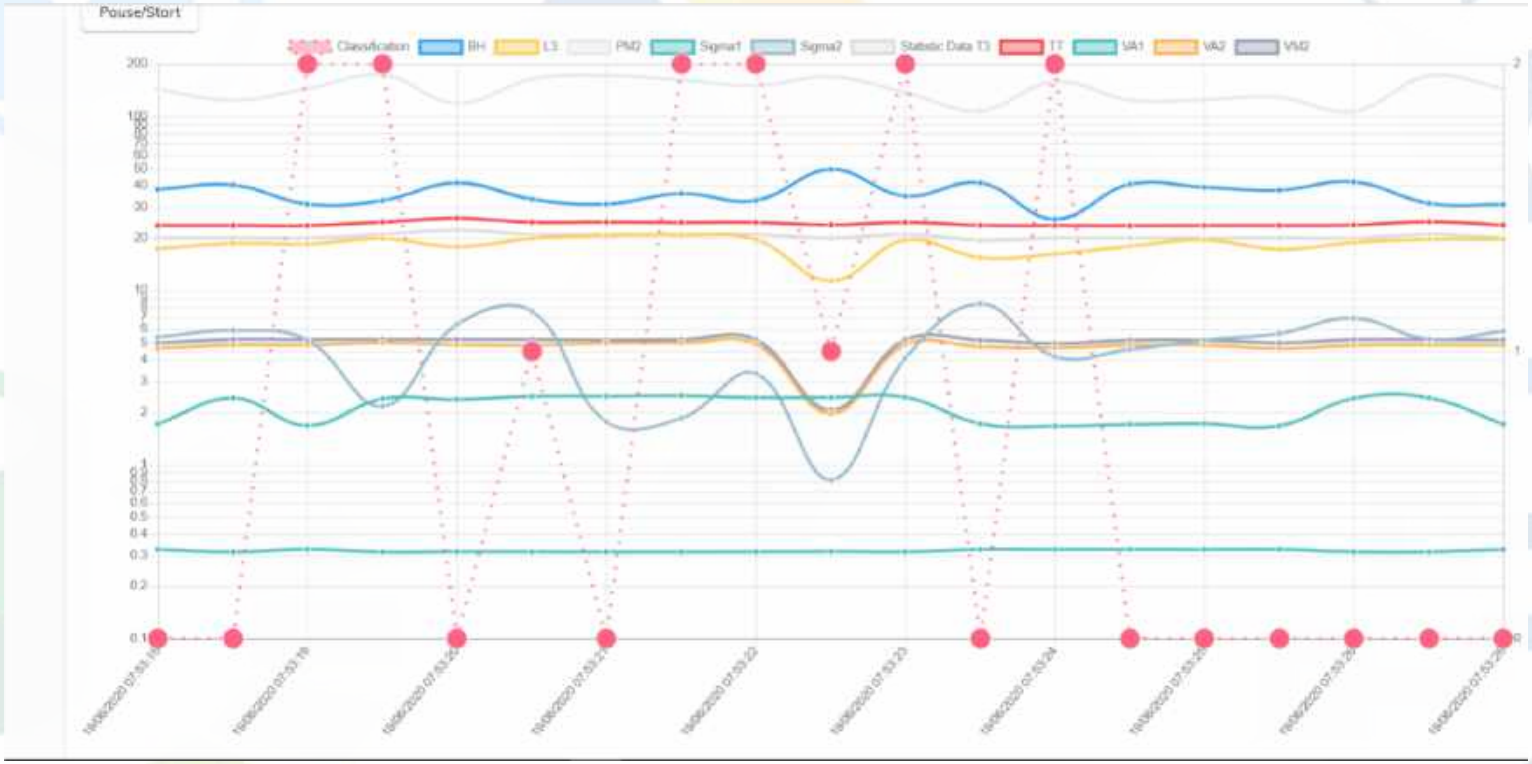
Production Process of Aluminium Die Casting - demo

A dynamic diagram will show the incoming streaming data in real-time, as well as aggregations of them that are constantly updated, after pressing the top-left button ‘Run Experiment’.



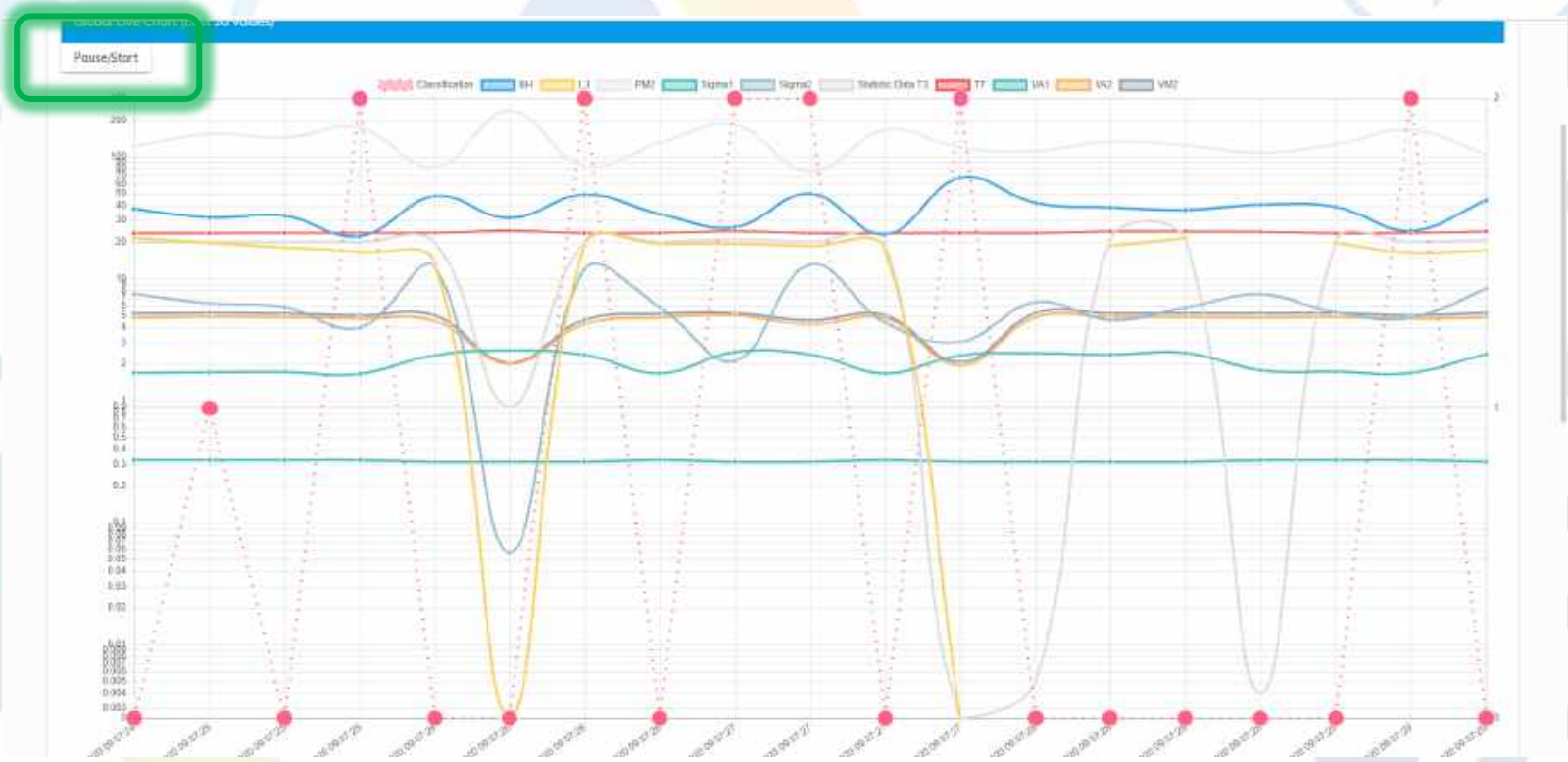
Production Process of Aluminium Die Casting - demo

We can visualise the trend of parameters and quickly check if there is something of anomalous compared to the set values of parameters



Production Process of Aluminium Die Casting - demo

If we see something of anomalous, we can press on the button ‘Pause/Start’ and quickly visualise data trends

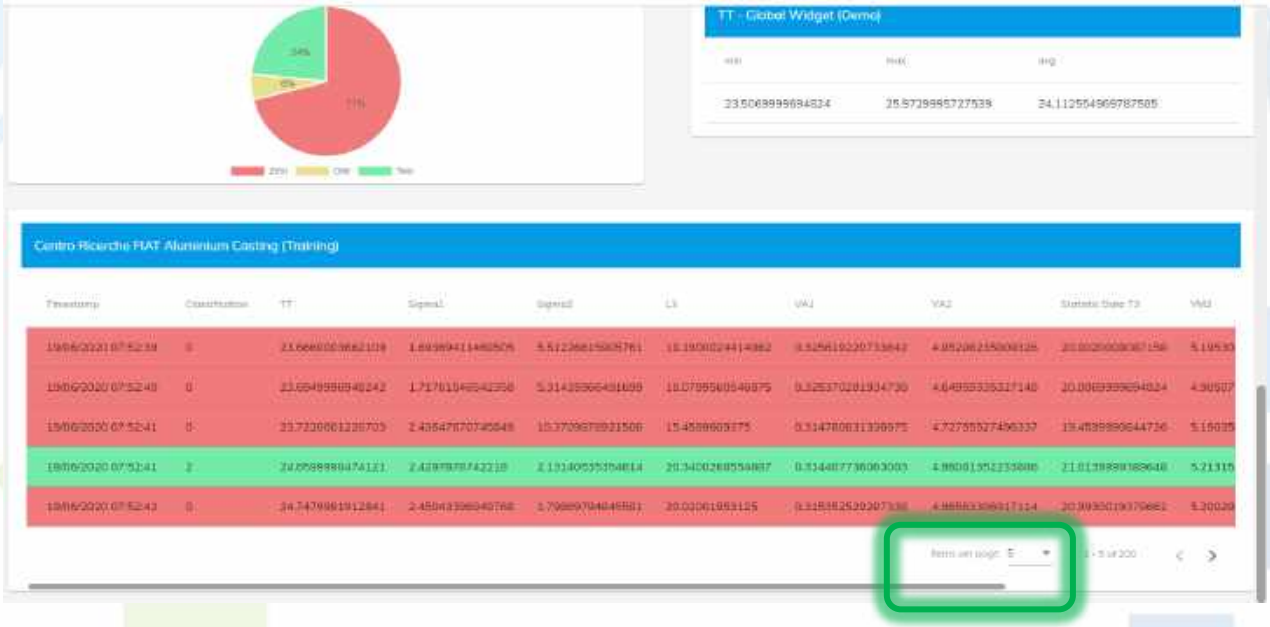


Production Process of Aluminium Die Casting - demo

we can visualise the parameter values for each classification level (0,1,2) press on the corresponding button

Production Process of Aluminium Die Casting - demo

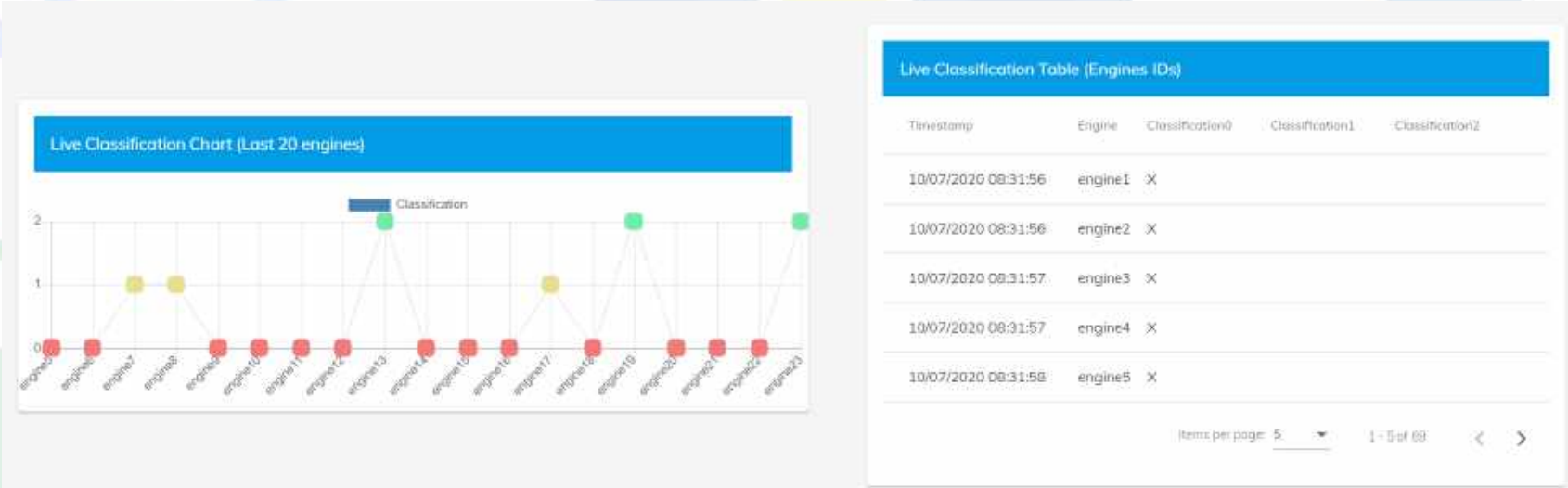
we can visualise the data table, that shows a colour- coded presentation of the results according to a given dimension of data (classification level)



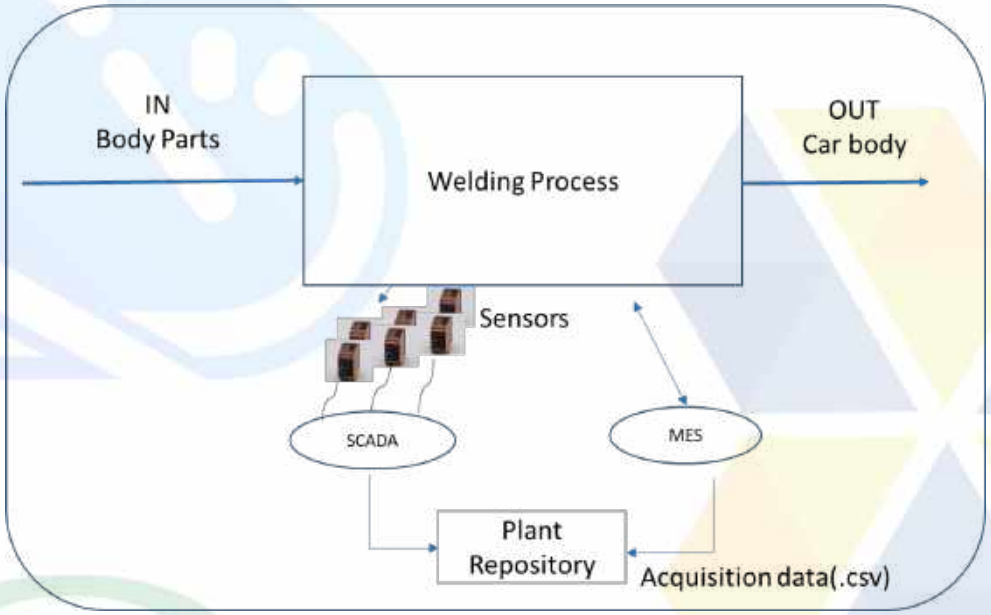
We can choose how many items per page to visualise

Production Process of Aluminium Die Casting - demo

We can visualise in real time and quickly the sequence of engine block with their level of classification



Maintenance and Monitoring of production assets



Business Goal

Predictive Maintenance:

- predict faults before they happen
- predict unnecessary actions (preventive or planned maintenance)
- avoid micro or macro stoppages
- predict retooling and refurbishing

Use Case Goals

- collect, structure and analyse sensor data with high level algorithms
- obtain thresholds for anomalous measurements
- create a structured foundational database to be easily utilised to check outlier detections for a continuous and periodic control of the service conditions (PM)

Maintenance and Monitoring of production assets

Number of sensors	Physical Quantity Measured	Unit of Measurement
87	Acceleration	mg
30	Velocity	mm/s
9	Temperature	°C
8	Pressure	bar
8	Flow	l/min
1	Displacement	mm
2	Energy Vector(water)	l
1	Energy Vector(air)	m^3
1	Energy Vector(air)	m^3/h

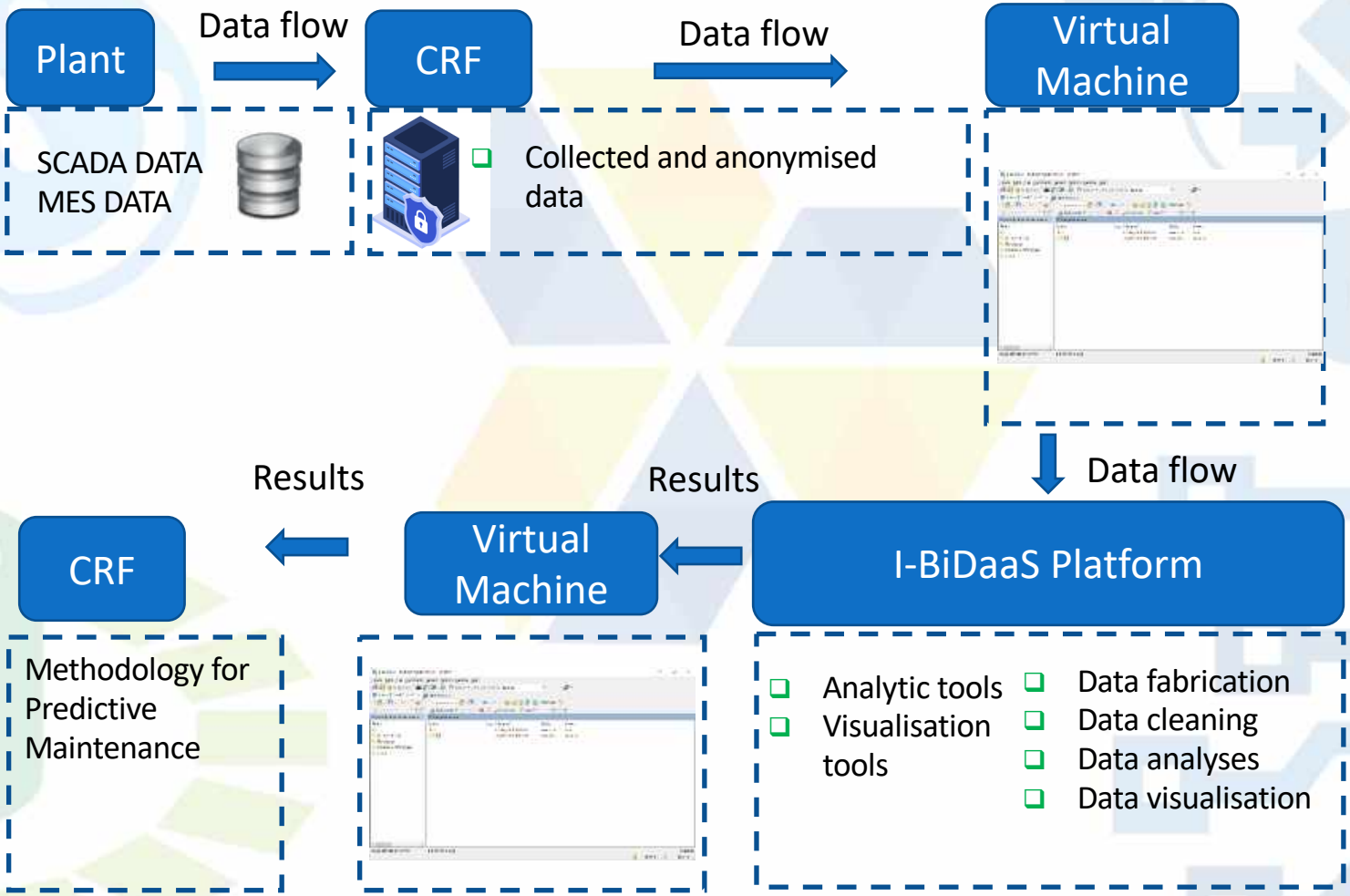
Sensors:

- detect the change in the environment and transfers these information to other systems
- convert a physical phenomenon into a measurable analog value (or sometimes a digital signal) which is human-readable and suitable for a display or transmission for reading or further processing

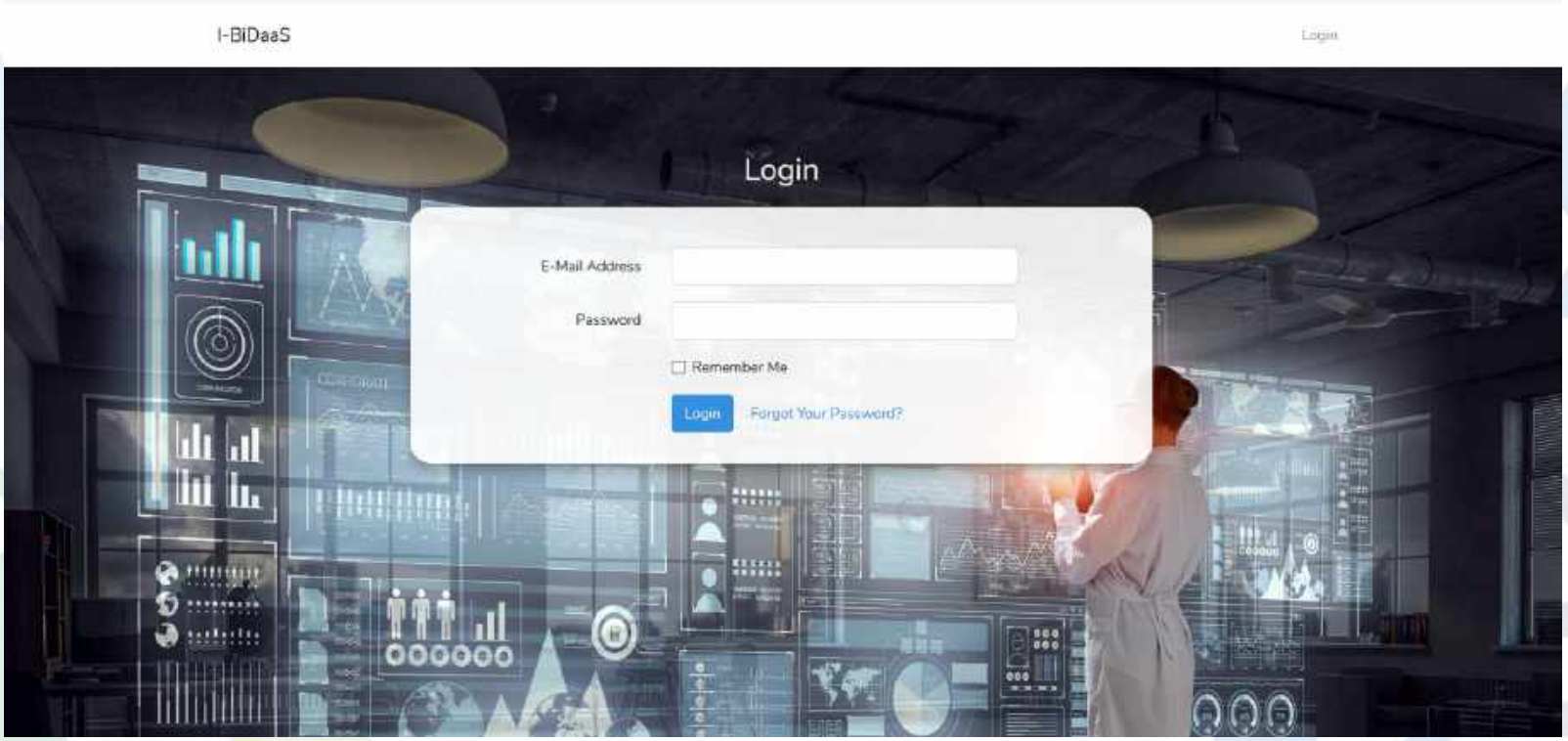
- The **monitoring** of vibrations is important to **check the status of a machine**
- The **analysis of the trend of vibrations** over time allows to **predict** the onset of **deterioration** and to intervene in time before the failure
- **Accelerometers** are used for measuring vibration and shock on machines and basically anything that moves

The continuous and periodic control of the service conditions of a machine is known as Predictive Maintenance

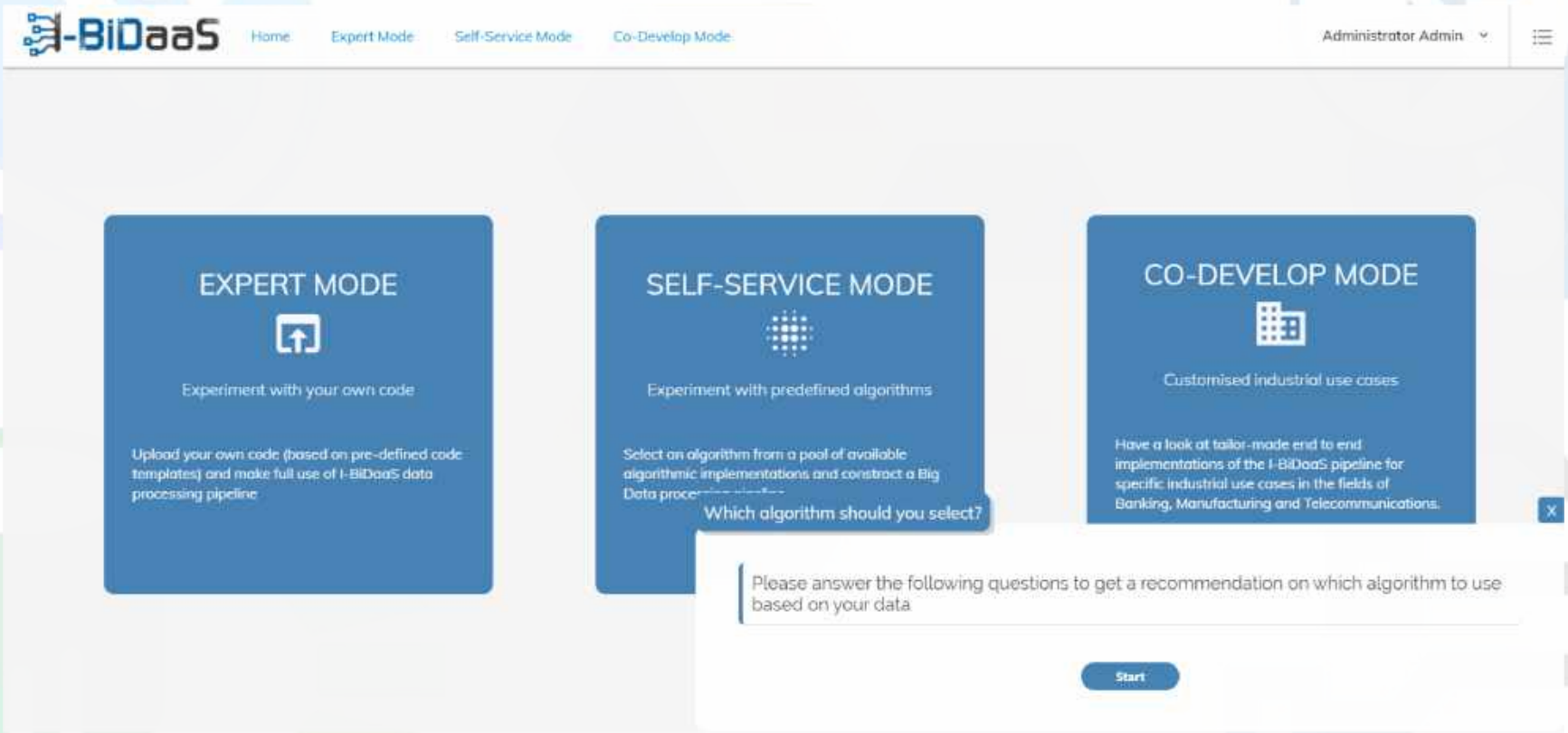
Maintenance and Monitoring of the production assets – data flow



Maintenance and Monitoring of production assets - demo

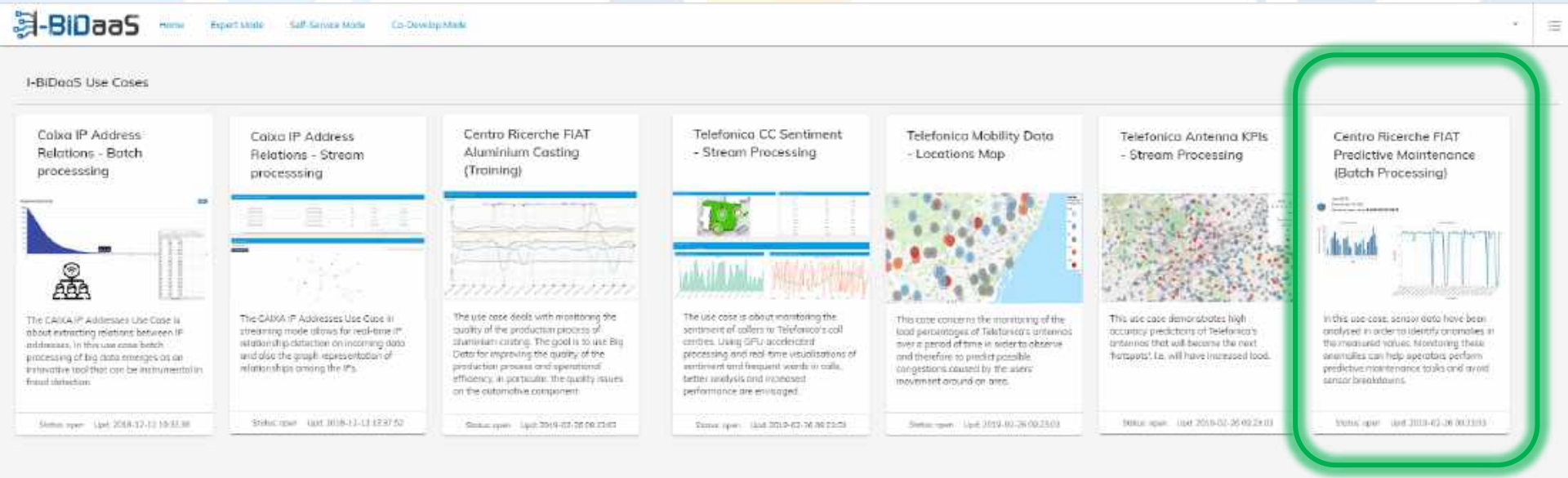


Maintenance and Monitoring of production assets - demo



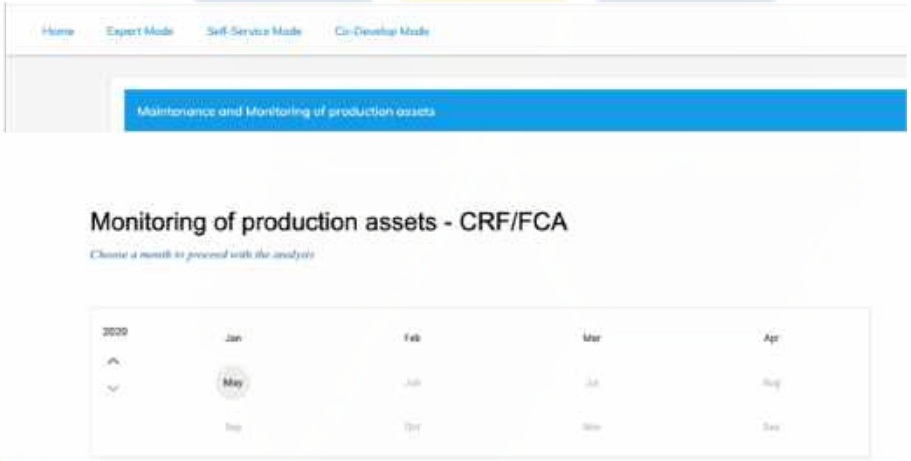
Maintenance and Monitoring of production assets - demo

Maintenance and Monitoring of production assets. The co-develop mode allows us to monitor the outlier time series for each sensor any day



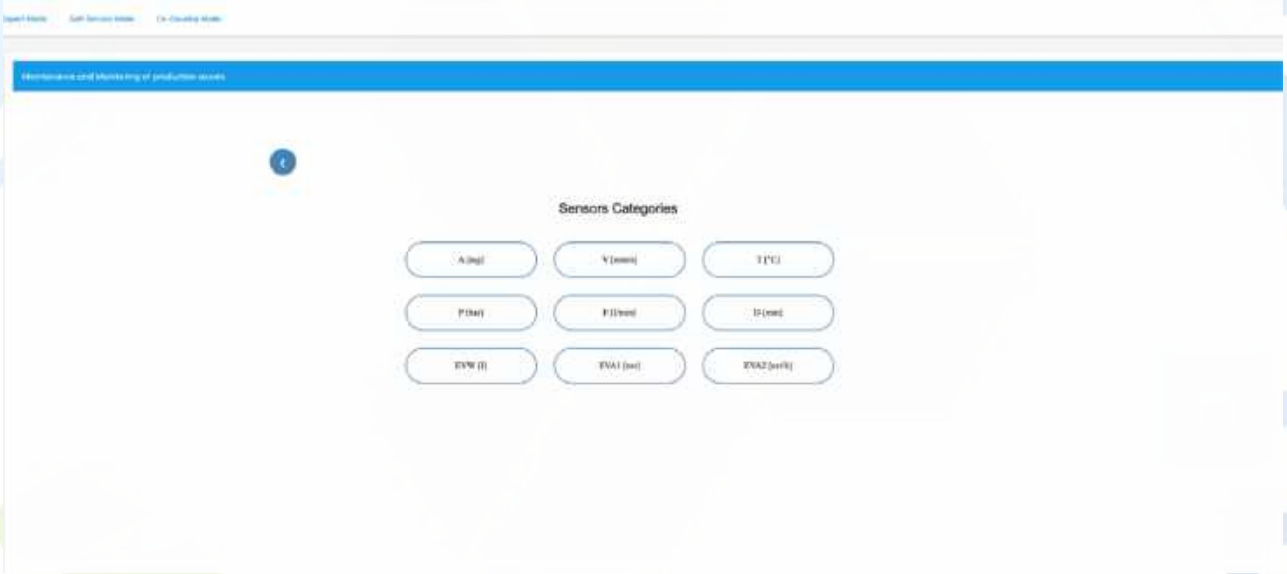
Maintenance and Monitoring of production assets - demo

Structured foundational database to be easily utilised to check outliers for a continuous and periodic control of the service conditions (Predictive Maintenance)



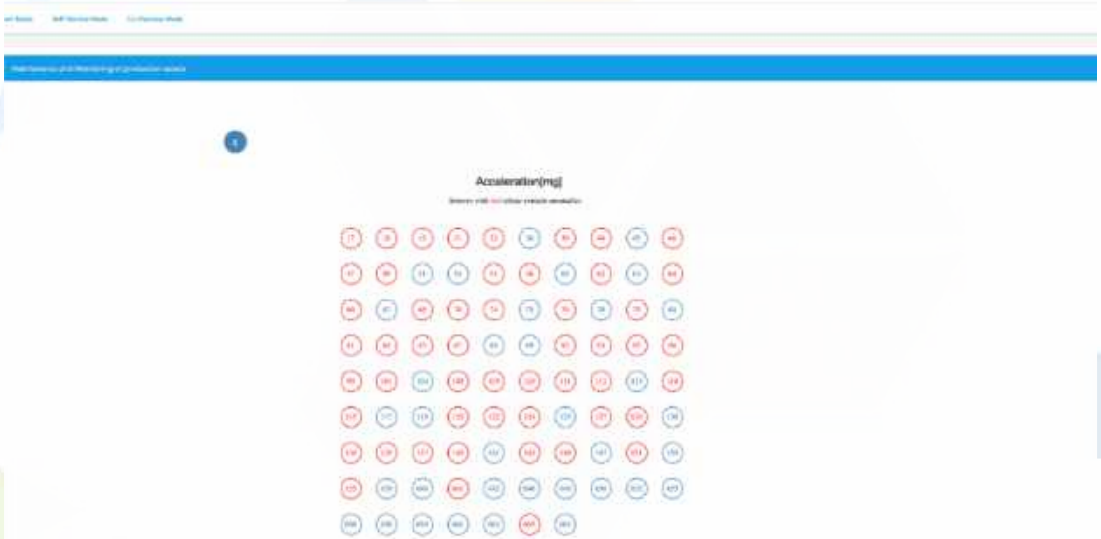
Maintenance and Monitoring of production assets - demo

Sensors - Categories



Maintenance and Monitoring of production assets - demo

Accelerometer [mg] / Id sensor



65

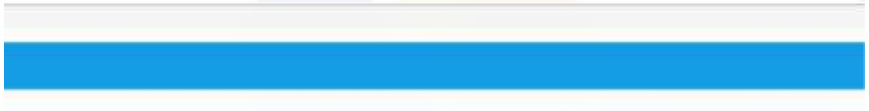
Maintenance and Monitoring of production assets - demo

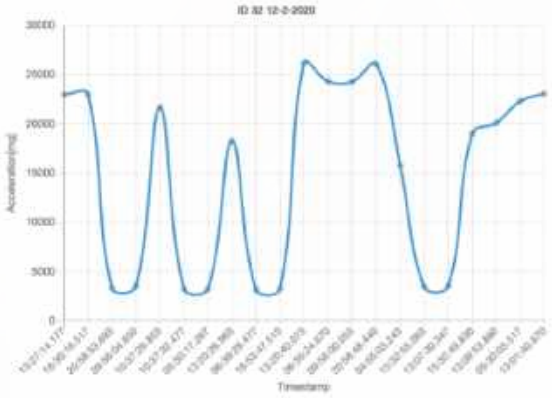
Anomalies number per day

66

Maintenance and Monitoring of production assets - demo

- Data has been transformed into separate time series - one per sensor
- anomalous measurements





CRF benefits from I-BiDaaS

Benefits	KPIs
To enhance production times, to reduce costs and, consequently, to obtain results that satisfy manufacturers' requests in terms of product quality, machine performance and timing	Increase of 3-7 % of quality control level related to good products and decrease of 1-4% and 0-2 % of two quality control levels related to defective products
To improve the efficiency of manufacturing plants, by getting the best performance from the machinery to reduce production losses and achieve greater competitiveness of the company	Increase of 1 - 1.5 % in current Overall Equipment Effectiveness (OEE) and decrease of 50 % in maintenance costs
To reduce time to produce decisions	From one month to real time
To break data silos and achieve accuracy of new models with respect to internal CRF models in use	Increase of 6 % for the first use case and 20% for the second one

BIG DATA VALUE PPP

BigDataStack
Holistic stack for big data applications and operations

I-BiDaaS
Industrial-Driven Big Data as a Self-Service Solution

Policy Cloud
Cloud for Data-Driven Policy Management

Track & Know

bdva.eu
bigdatastack.eu
ibidaas.eu
trackandknowproject.eu
policycloud.eu

@BDVA_PPP
@BigDataStackEU
@Ibidaas
@Track&Know
@PolicyCloudEU

Questions?

Thank you!

Your feedback is valuable for us!

https://bit.ly/2O8YV8D

The below-mentioned projects have been funded by the European Commission Horizon 2020
BigDataStack: grant agreement No 779747
I-BiDaaS: grant agreement No 780787
Track and Know: grant agreement No 780754
Policy Cloud: grant agreement No 870675