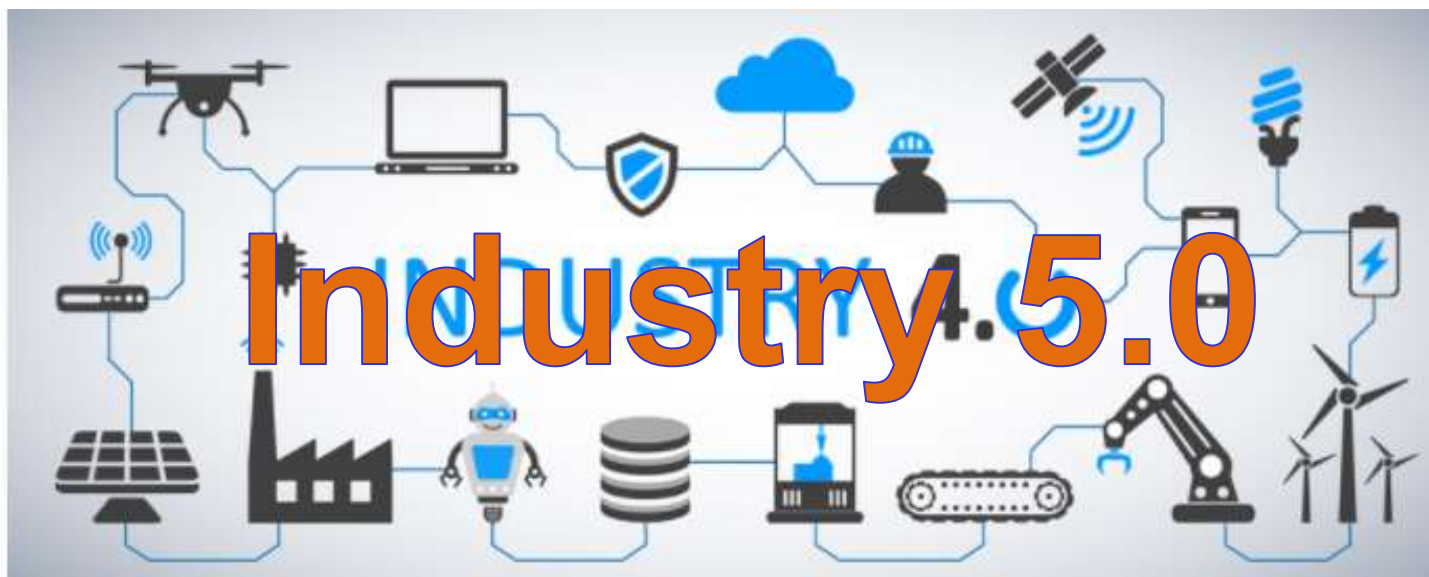


Holistic Correlation of Events for increased Security and Safety of Factories of the Future

Isabel Praça
icp@isep.ipp.pt

- *Industry 4.0*



- IoT & IIoT
- Artificial Intelligence & Machine Learning
- Augmented Reality, Virtual Reality, and Mixed Reality
- Big Data Analytics
- 5G

- *Towards Industry 5.0*

- places the wellbeing of the worker at the centre of the production process and uses new technologies to provide prosperity beyond jobs and growth while respecting the production limits of the planet
- complements the existing "Industry 4.0" approach by specifically putting research and innovation at the service of the transition to a **sustainable**, **human-centric** and **resilient** European industry

Publications



REPORT | JANUARY 2021 | RESEARCH AND INNOVATION

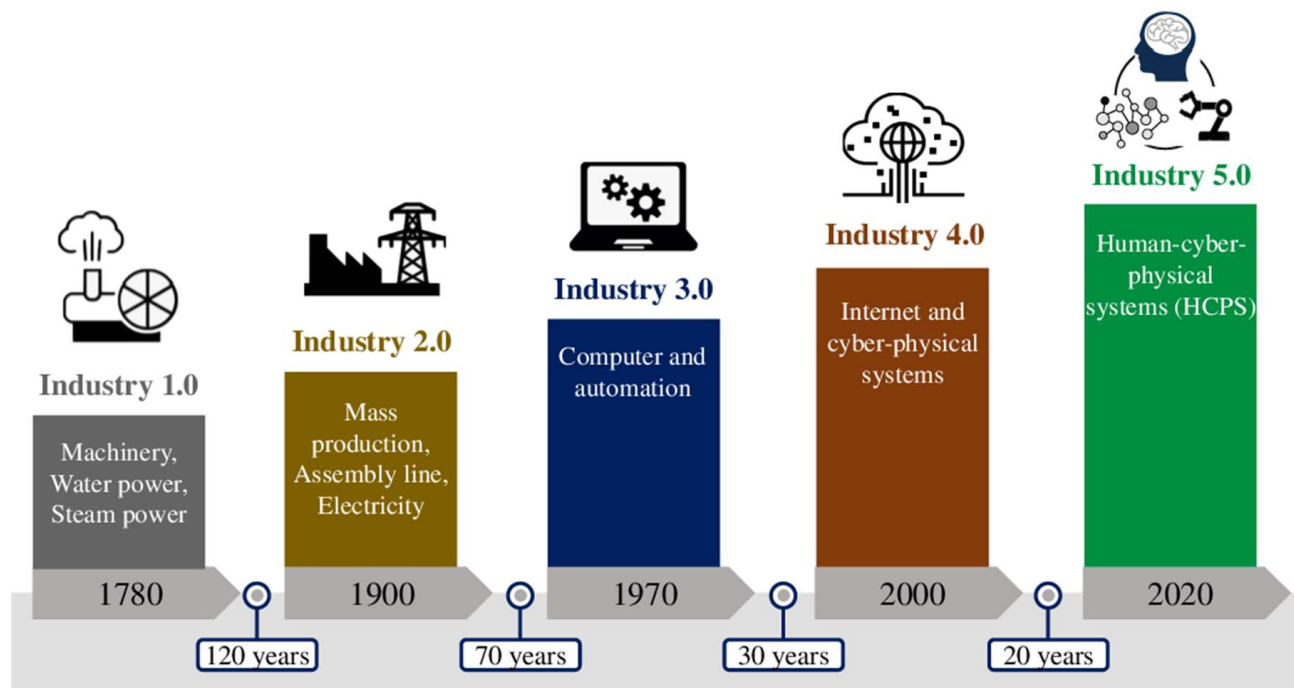
Industry 5.0

Towards a sustainable, human-centric and resilient European industry

Holistic Correlation of Events from increased Security and Safety of FoF



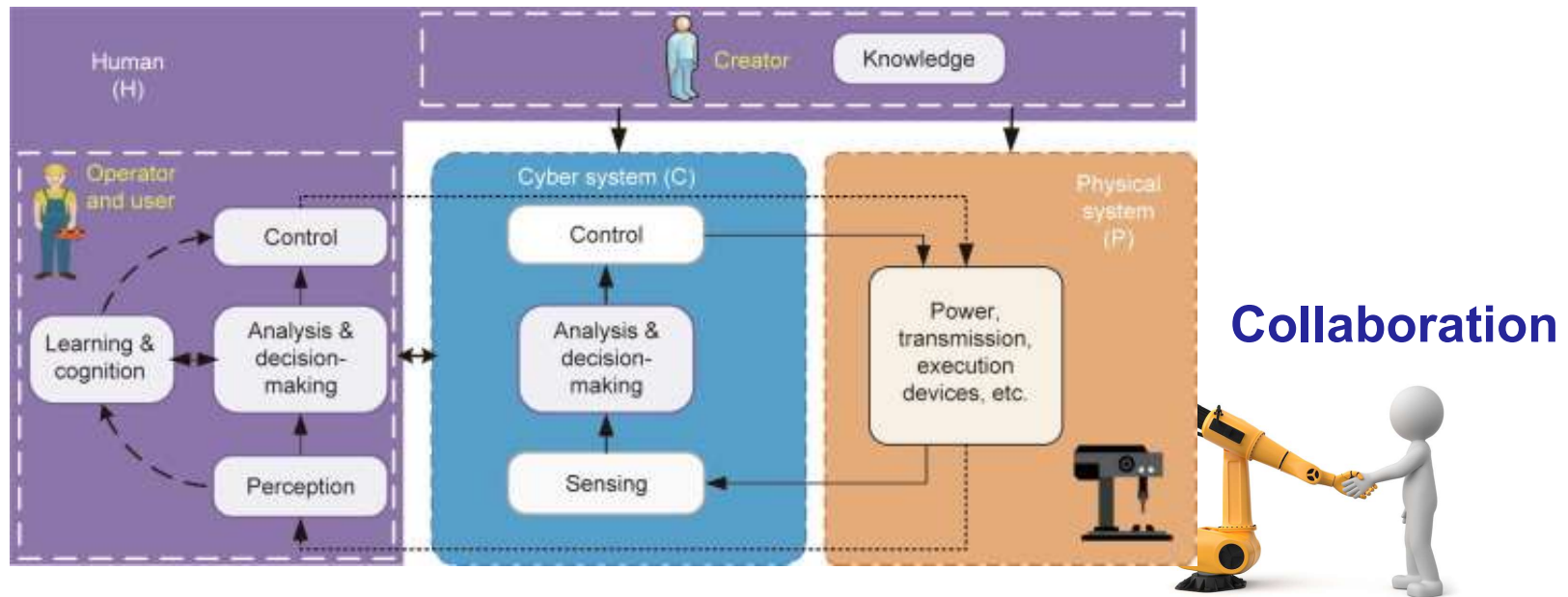
- Towards Industry 5.0*



Chen, X., Eder, M.A., & Shihavuddin, A.S. (2020). A concept for human-cyber-physical systems of future wind turbines towards Industry 5.0.



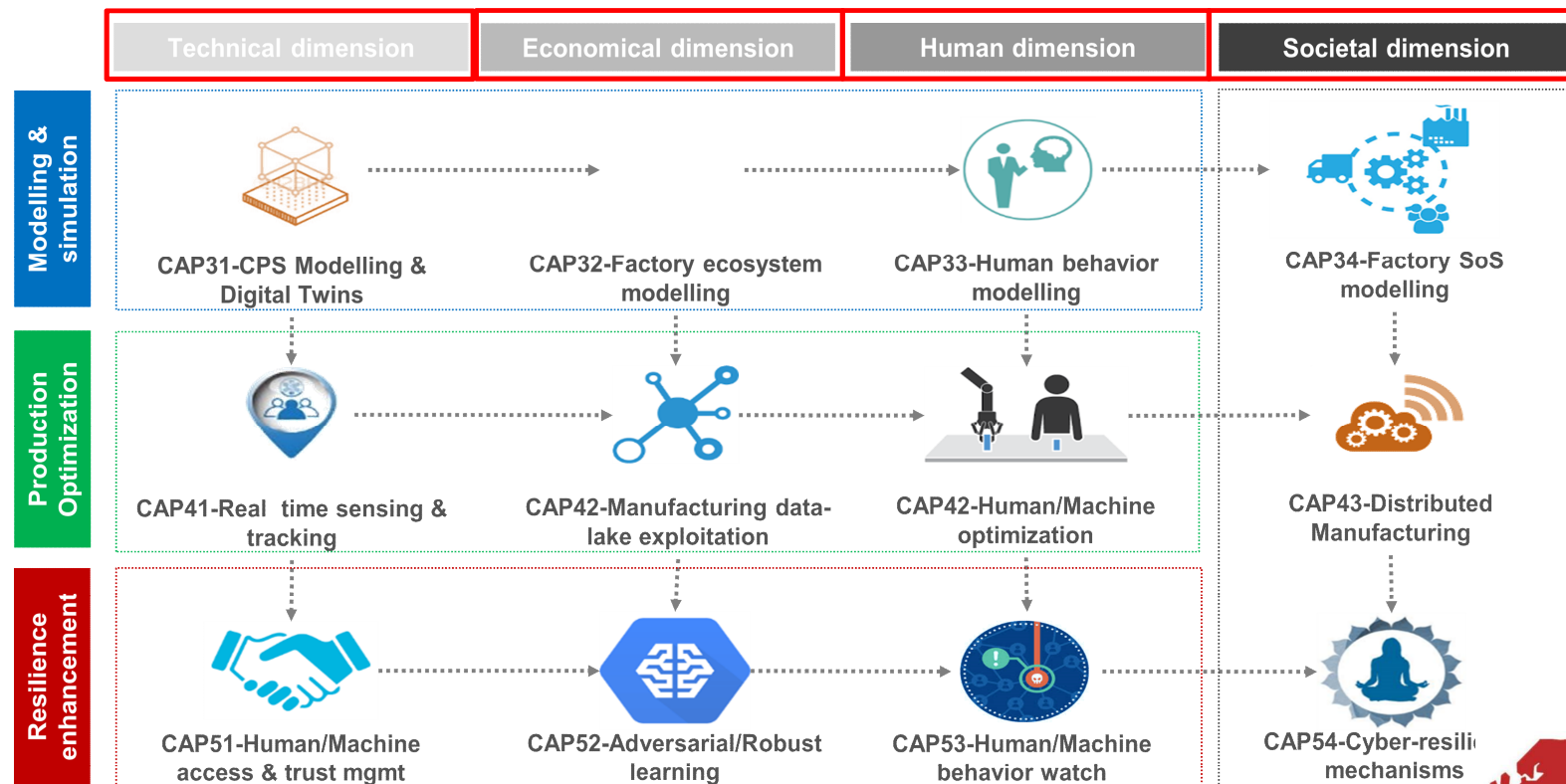
- Human Cyber-Physical Systems*



Holistic Correlation of Events from increased Security and Safety of FoF



- *CyberFactory#1 Vision* (<https://www.cyberfactory-1.org/>)

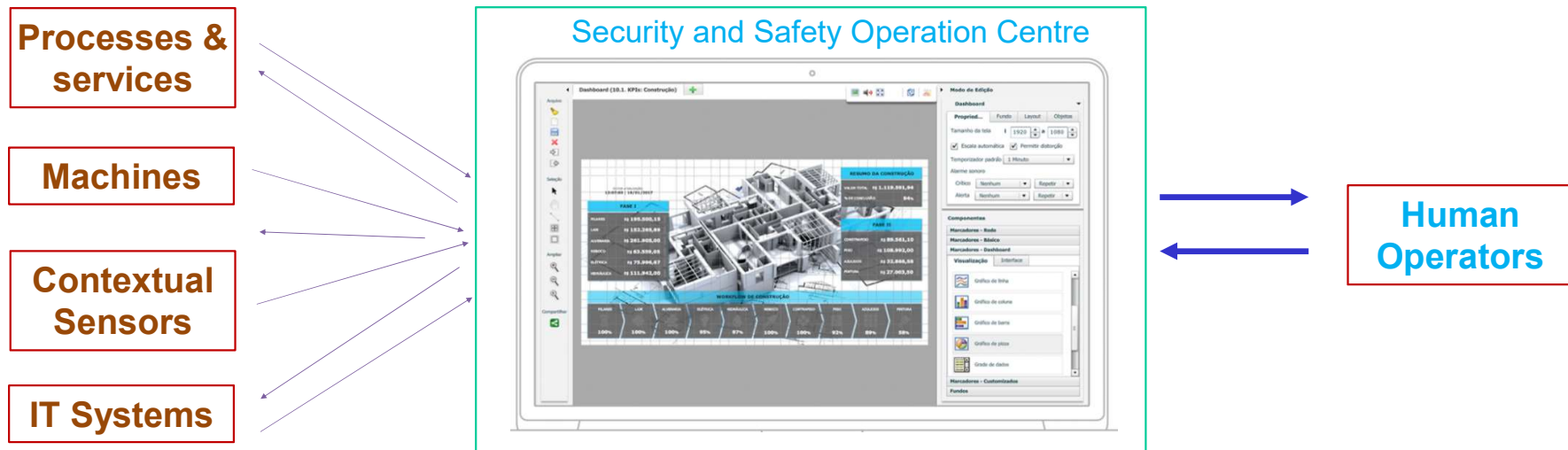


Holistic Correlation of Events from increased Security and Safety of FoF



• *Cyber Factory#1 - Digital Twin Concept and Definition*

“a DT is a formal digital representation of some asset, process or system that captures attributes and behaviors of that entity suitable for communication, storage, interpretation or processing within a certain context”

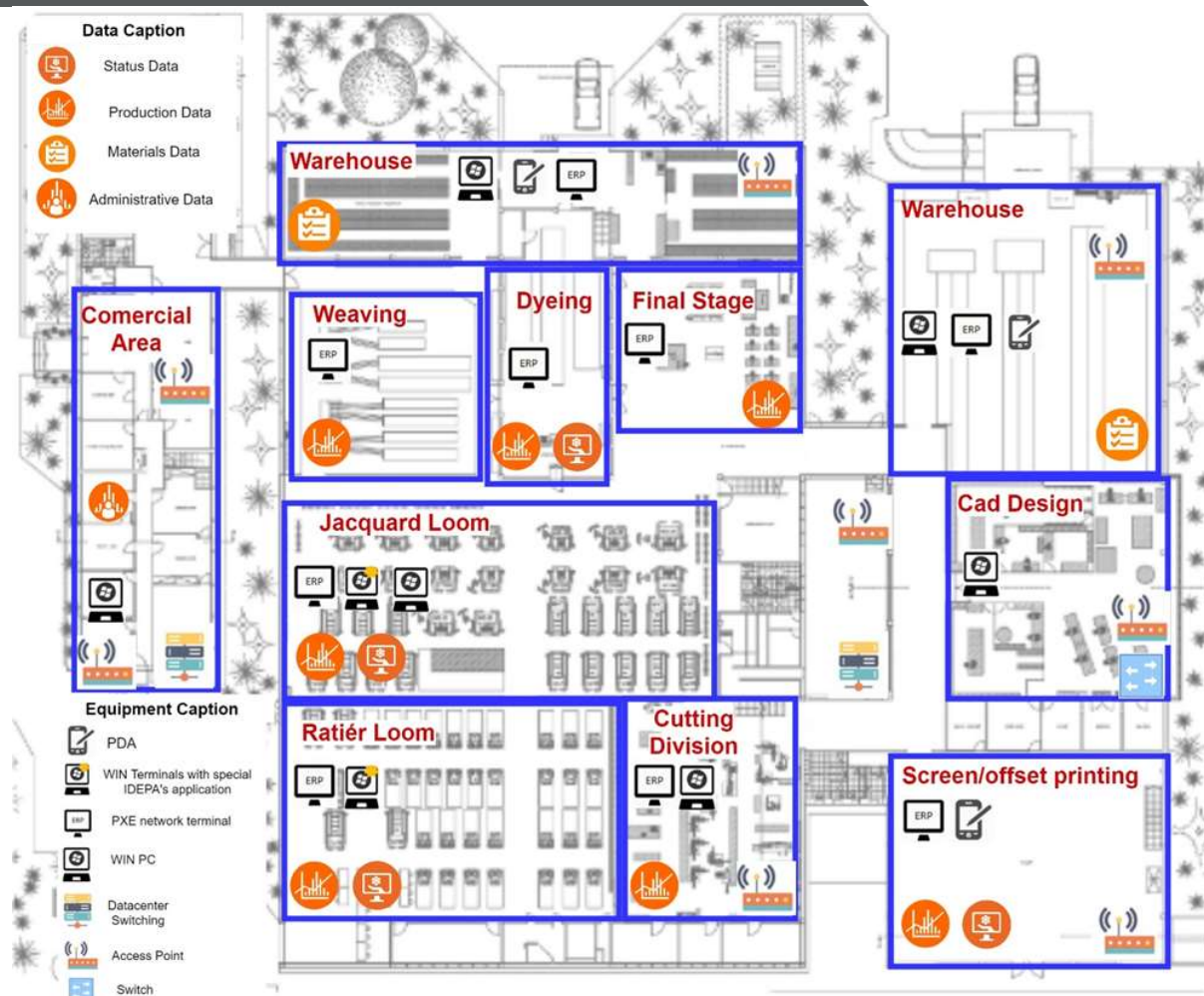


Holistic Correlation of Events from increased Security and Safety of FoF

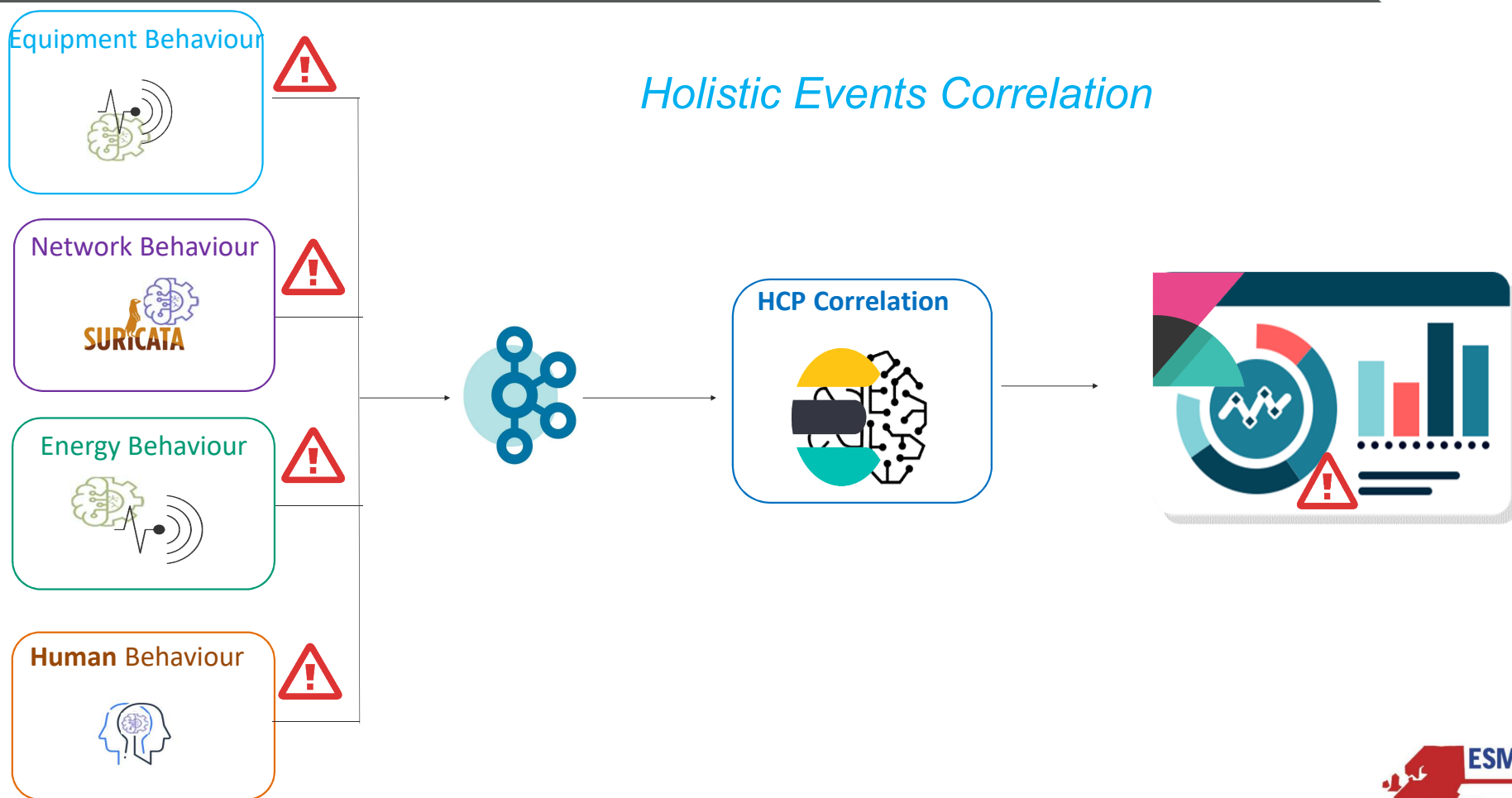
• IDEPA – Case Study



- Data-driven services born from the different cross domains: Technical, Human, Economical and Societal.
- Several different types of information will be included on the Data Lake:
 - Energy behavior
 - Human Emotional & Physical Behavior Detection
 - Network Intrusion Detection
 - IoT Sensing



Holistic Correlation of Events from increased Security and Safety of FoF

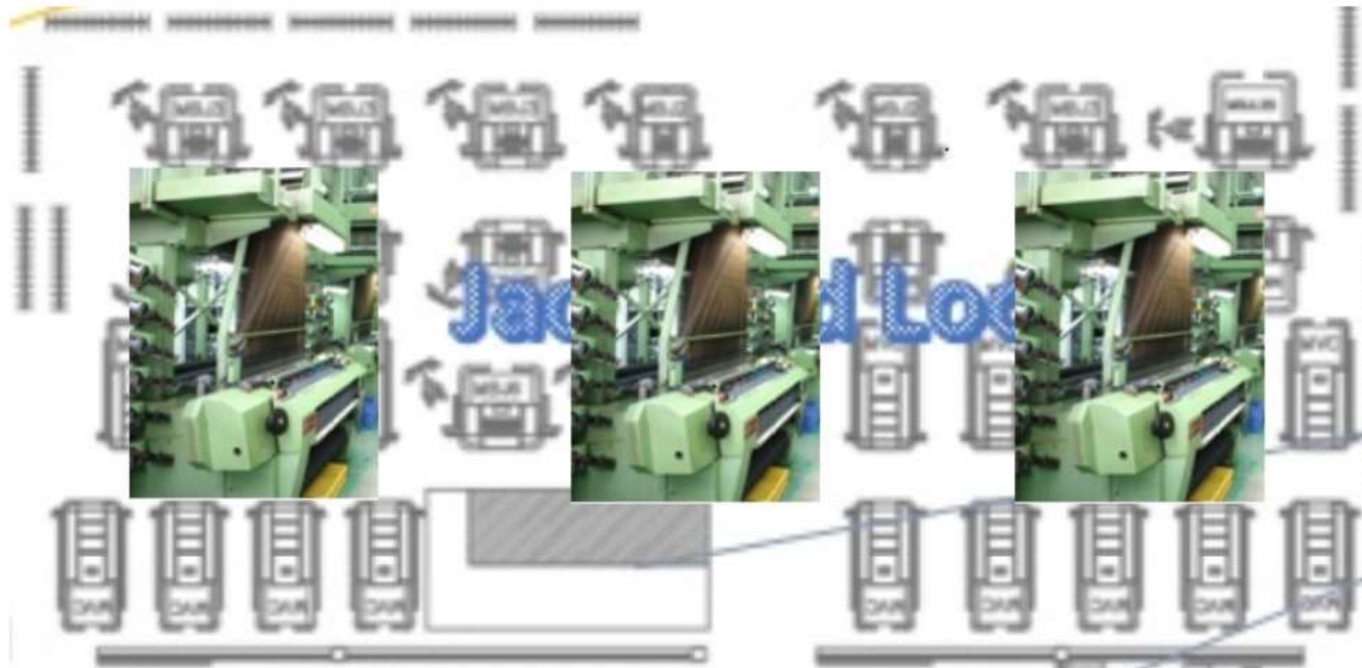


Holistic Correlation of Events from increased Security and Safety of FoF



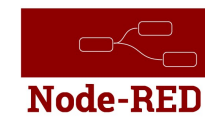
Login/Users Map view Eq. Panel Go-NoGo test

Equipment Behaviour



Equipment info:

Name: eq01
Temperature 01: 35.426 °C
Temperature 02: 40.891 °C
Temperature 03: 38.187 °C
Temperature 04: 30.375 °C
Vibration: 0.531 mm/s



Holistic Correlation of Events from increased Security and Safety of FoF



Login/Users Map view Eq. Panel Go-NoGo test

Equipment Info



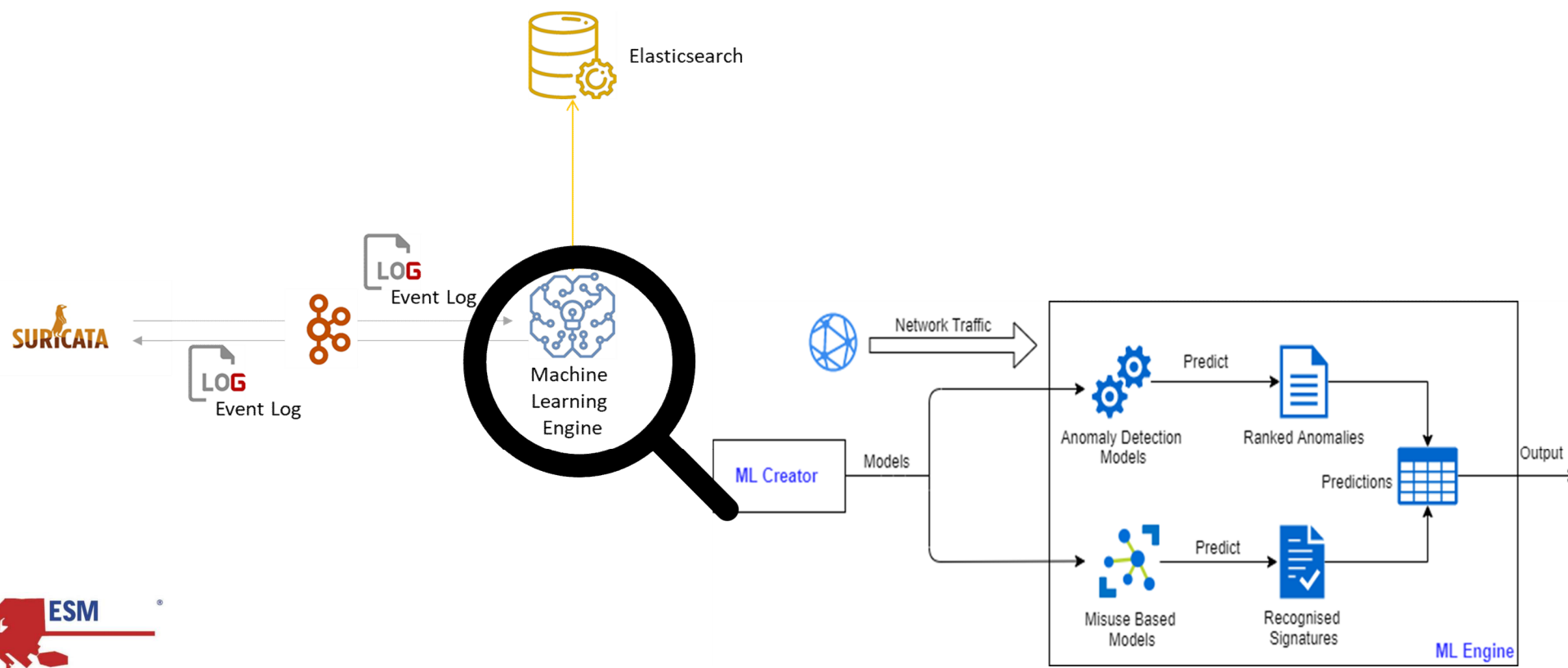
Alarm 01 ON
Alarm 02 OFF

Raise Alarms

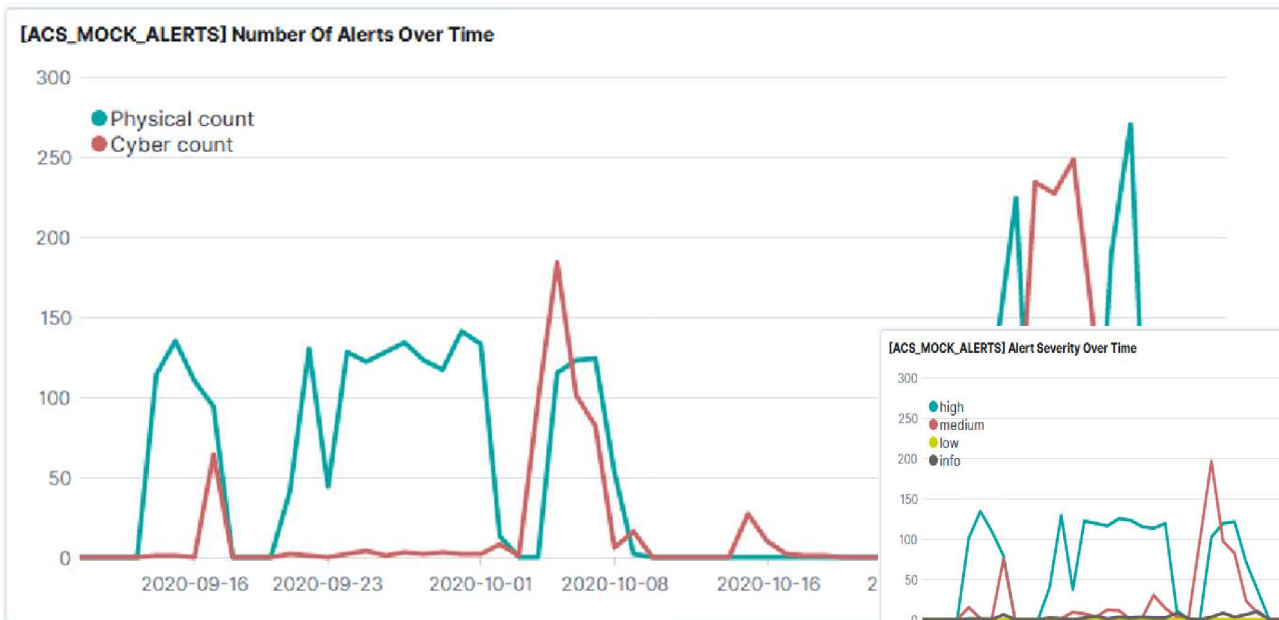
Holistic Correlation of Events from increased Security and Safety of FoF



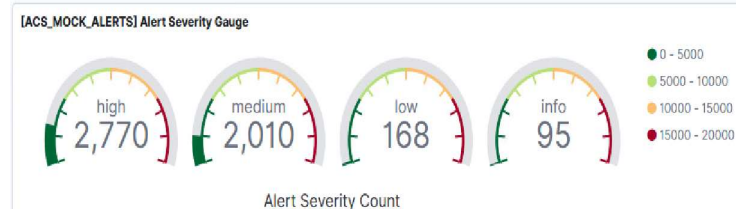
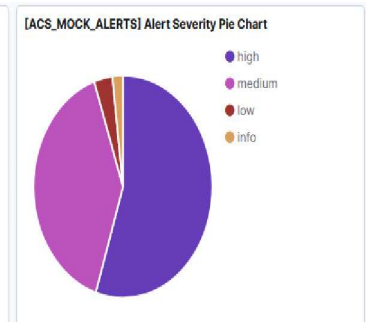
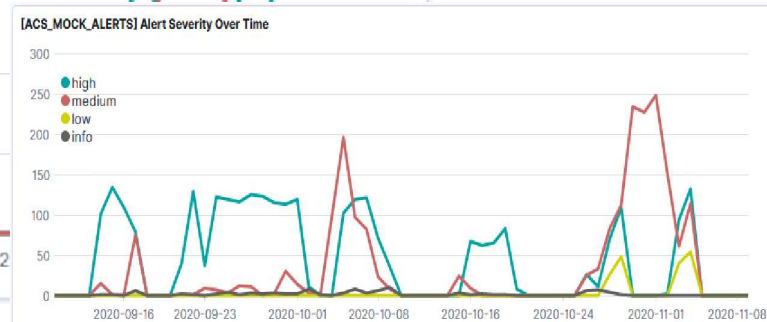
- Network Behavior Modeling*



Holistic Correlation of Events from increased Security and Safety of FoF



- *Network Behavior*



Holistic Correlation of Events from increased Security and Safety of FoF



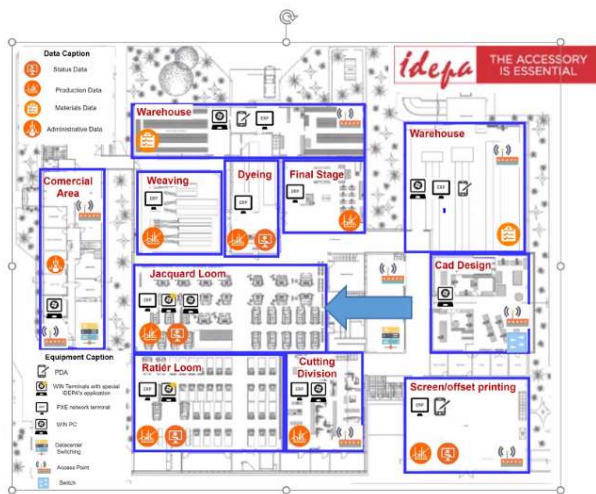
CyberFactory#1 Forecasting Tool | Homepage | Training | Predicting | Tuning | Direct Prediction | Profile Prediction | Consumption Profiles

Welcome to CyberFactory#1 Energy Forecasting Tool!

This tool was developed within ISEP - GECAD under the CyberFactory#1 project (Addressing opportunities and threats for the Factory of the Future (FoF)). It aims at providing a multifunctional tool to perform forecasting for power generation/consumption using different algorithms.

GECAD is a Research Unit having as mission the development of scientific research and innovation for the incorporation of Engineering and Computing Complex Systems, Intelligent Energy Systems is the International and National reference, namely in areas like Smart Grids, Electricity Markets, Distributed Resources, Demand Response, Energy Efficiency and

[Learn more about CyberFactory#1](#)



```
new 1 - Notepad++
File Edit Search View Encoding Language Settings Tools Macro
Run Plugins Window ?
new 1 - Notepad++
1, "QSBT Geral"
2, "Compressor"
3, "Jacquard"
4, "Debuxo"
5, "Grafica"printing
6, "Ratiere"
7, "Corte e Dobra"Cutting d...
8, "Sublimação"
9, "Calandra 2"
10, "Ringir 1"Dyeing
11
```

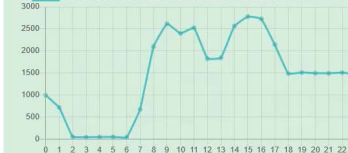
• Energy Behavior Modeling

Results:

- Mean Absolute Error (MAE): 254.8628
- Accuracy (R2): 82.78%
- Predicted Values:

Profile Chart:

CONSUMPTION PROFILE (average of 24 hours from 2021-02-01 to 2021-02-04)



Prediction Chart:

PREDICTED CONSUMPTION (predictions of records from the input data file)

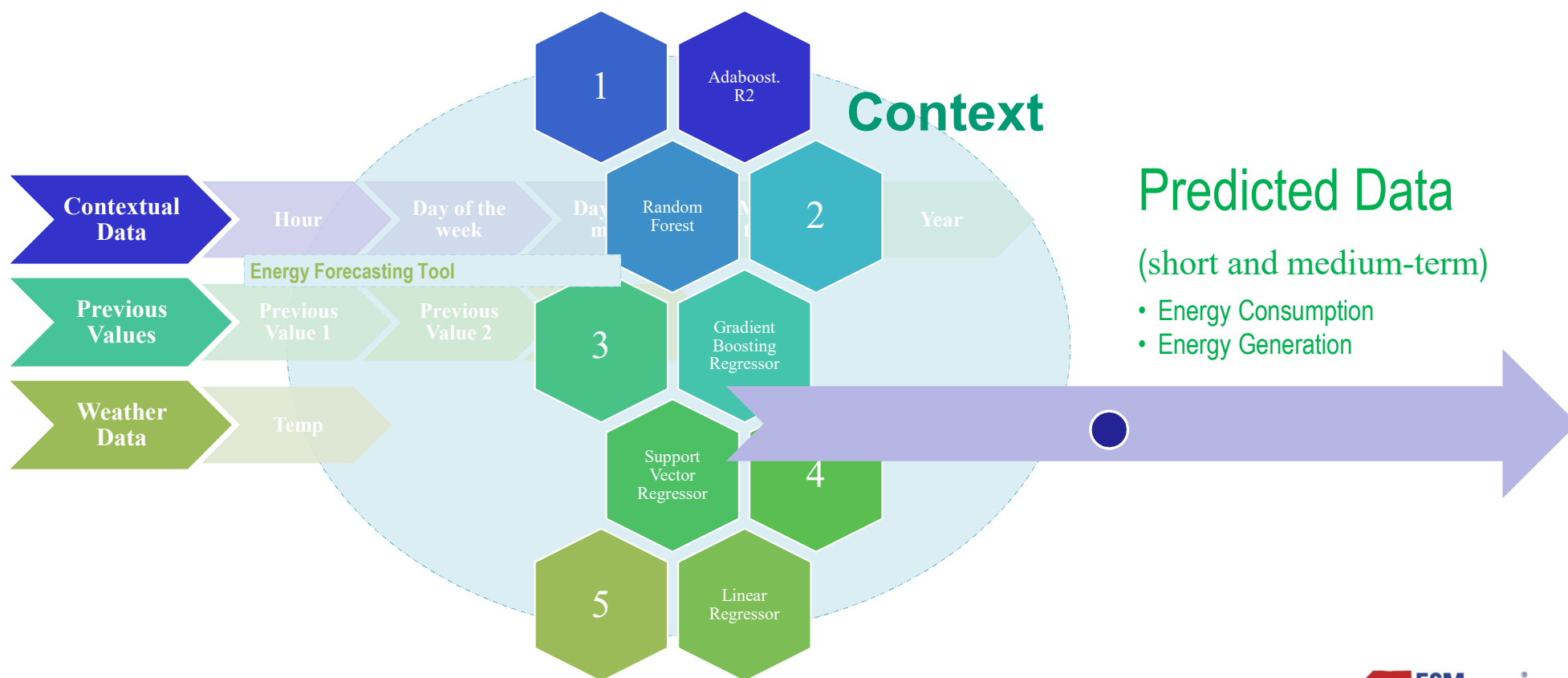


Prediction Details:

	day_m	month	hour	year	day_w	PREDICTED VALUE
0	19	2	1	2021	6	1120.303114
1	19	2	2	2021	6	206.087912
2	19	2	3	2021	6	180.053375
3	19	2	4	2021	6	142.146978
4	19	2	5	2021	6	142.146978
5	19	2	6	2021	6	206.087912
6	19	2	7	2021	6	481.571429
7	19	2	8	2021	6	2306.100962
8	19	2	9	2021	6	2430.691209
9	19	2	10	2021	6	2430.691209
10	19	2	11	2021	6	2430.691209
11	19	2	12	2021	6	2237.842033
12	19	2	13	2021	6	2237.842033



Holistic Correlation of Events from increased Security and Safety of FoF

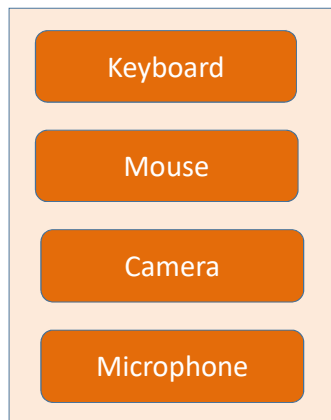


Wannous S., Praça I., Andrade R. (2021) Intelligence as a Service: A Tool for Energy Forecasting and Security Awareness. In: De La Prieta F., El Bolock A., Durães D., Carneiro J., Lopes F., Julian V. (eds) Highlights in Practical Applications of Agents, Multi-Agent Systems, and Social Good. The PAAMS Collection. PAAMS Workshops 2021. Communications in Computer and Information Science, vol 1472. Springer, Cham. https://doi.org/10.1007/978-3-030-85710-3_15

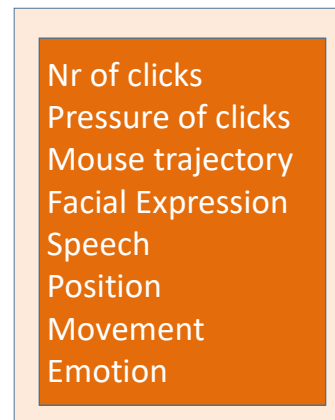


• Human Behavior Modeling

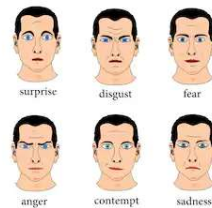
Non-intrusive sensors



Features



Emotion recognition



fatigue

stress

suspicious
behavior



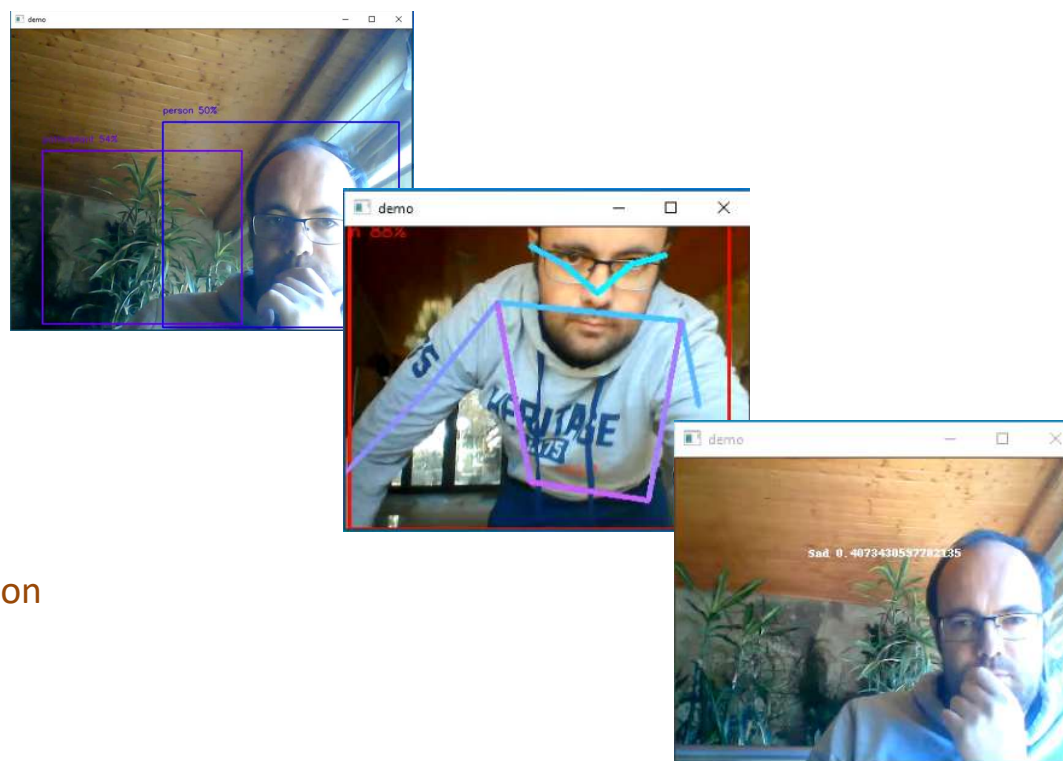
Safety

Security

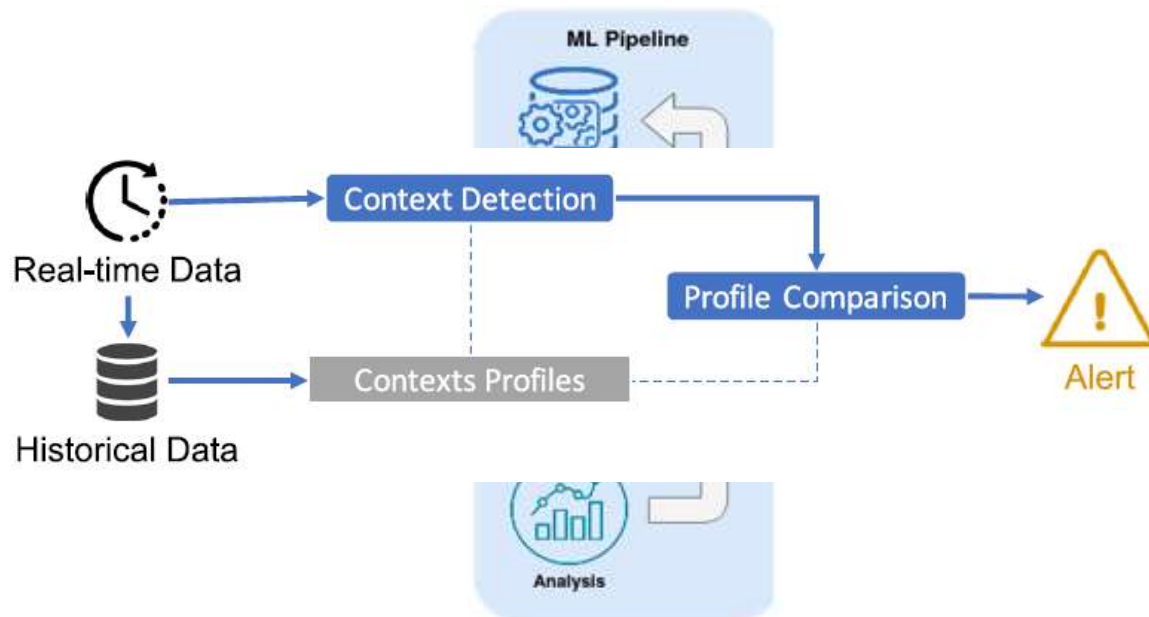
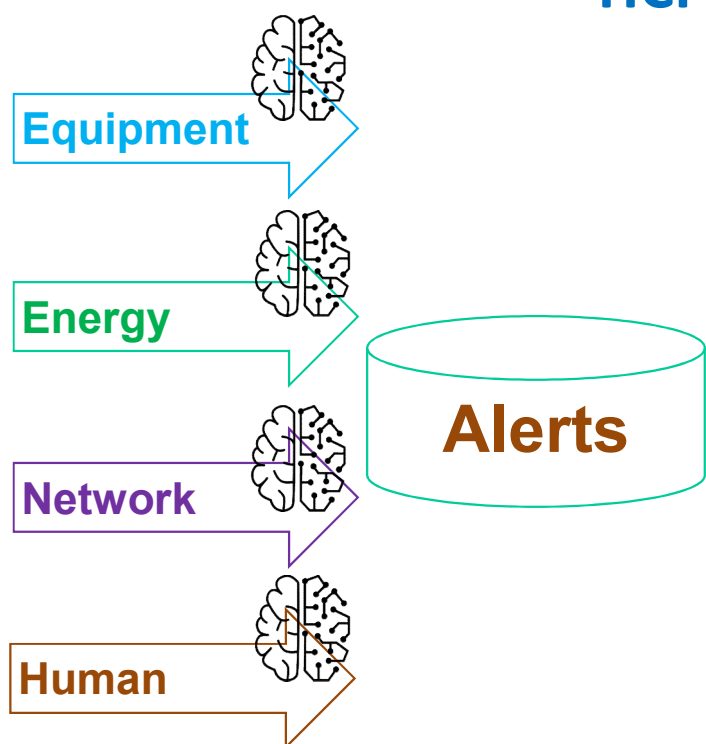
User Behaviour analytics

• *Human Behavior – Emotional state recognition*

- Object Detection
- Human Pose Detection
- Human Recognition
- Facial Emotion Recognition



HCP Correlation



Stay Tuned!

<https://www.cyberfactory-1.org/en/home/>
icp@isep.ipp.pt