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SRIPTOP

# Bridging the Physical and Digital Worlds: Control Technologies for Factories of the Future and Green Energy Solutions

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Kompetenčni center za sodobne tehnologije vodenja

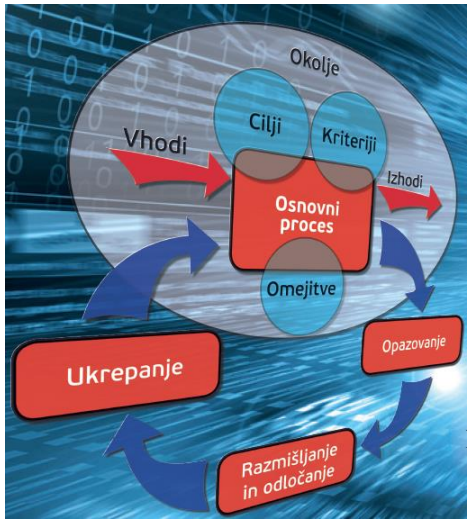
TECOS

Gospodarska zbornica Slovenije

IJS

# The field of Control Technology

Control technology (**automation, cybernetics, informatics**) is distinctive infrastructural **enabling technology** that is included in practically all modern devices, machines, processes and systems with the task of ensuring their **functionality, reliability, safety and operational efficiency**.



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Vertical value chain on Intelligent control systems in factories of the future

Horizontal network on Control technology

INDUSTRY

ENERGY

Prioritized technological areas

Key research development areas

# Key research development directions

## New building blocks for Integration physical and digital world in factories of the future

- New generation of **sensors** & **communication interfaces**
- Development of autonomous software **agents with self-learning abilities**
- Production **data spaces** and **secure data sharing**

## Development of new procedures for real-time monitoring and management of production processes

- New approaches **to extract hidden information** from measured data, identification of mathematical models
- Focus on: (i) **production models** for a specific product segment, (ii) agents for **insight into unmeasurable** (hidden) process states, and (iii) **predictive control** and **optimization**

## Control technologies in green energy solutions

- **Electrification** of technological processes
- Use of **hydrogen technologies** for storage, conversion, distribution and energy supply
- Development of **energy management** procedures including RES, energy conversion & distribution

# Prioritized Technological Areas

## Artificial intelligence for control and optimization of systems

- Production **automatization**
- **Quality** and process control
- Optimization of **energy efficiency**
- **Adaptive** manufacturing
- **Workforce** management

## Digital twins in technical processes

- **Reorganization** and **optimization** of production processes
- **Internal logistics** and **scheduling**
- **Connectivity** with the live data/process

## Energetics in complex systems

- **Techno-economic optimization** of energy building blocks
- Industrial participation in **grid balancing**
- **Hydrogen prosumer** and renewables

## Predictive maintenance

- **Detecting changes** in equipment function
- Monitoring the **condition** of equipment/machinery
- Estimation of **indicators** of **equipment** wear and tear
- Supporting **maintenance planning**

## Industrial IoT

- New **IIoT solutions** for data collection, analysis and distribution
- Data collection, **AI integration**, remote management and **improved control** of processes

## Integrated MES

- Flexible **data integration** and data management
- Improved **functional integration** with other production IT systems
- Development of **new MES/MOM functionalities** (quality, scheduling, maintenance, …)

## Autonomous mobile systems*

*joint topic with robotics

- **autonomous logistics** in spatially limited areas
- **internal logistics** and
- autonomous **adaptation of production lines**
- environmental monitoring

# Optimization and performance improving in metal industry by digital technologies

INEVITABLE
inevitable-project.eu

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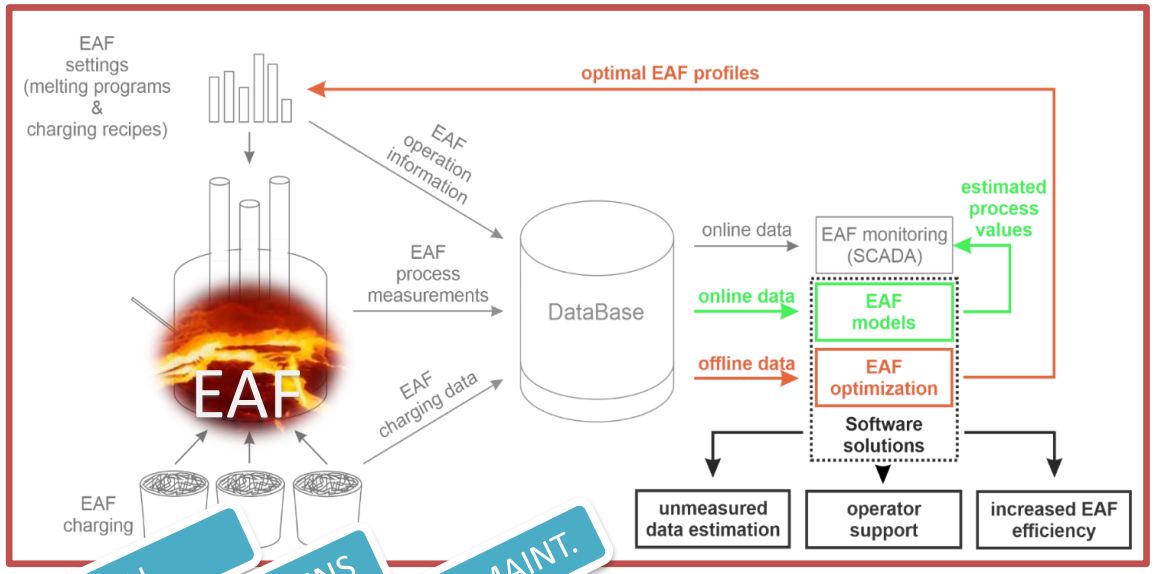
**H2020 Call:** DT-SPIRE-06-2019
**Start date:** 2019-01-10
**Duration:** 42 Months
**Coordinator:** Jožef Stefan Institute




AI
DIGITAL TWINS
PREDICTIVE MAINT.

**Recipe adaptation and optimization**
- Initial rolling force
- Tension, velocity

**Equipment monitoring**
- X-ray

AI
Int. MES

...rms / equipment condition

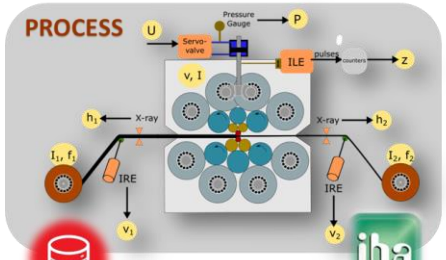
**Started in September 2024**
SEAMLESS DIGITAL INTEGRATION IN STEEL VALUE CHAIN FOR HIGH QUALITY FINAL PRODUCTS

**HORIZON-CL4-2024-TWIN-TRANSITION-01**
Project number: 101178919
Project acronym: SMARTChain
Project duration: 36 months
Partners: 14, Countries:7

SMARTChain
www.smartchain-project.eu

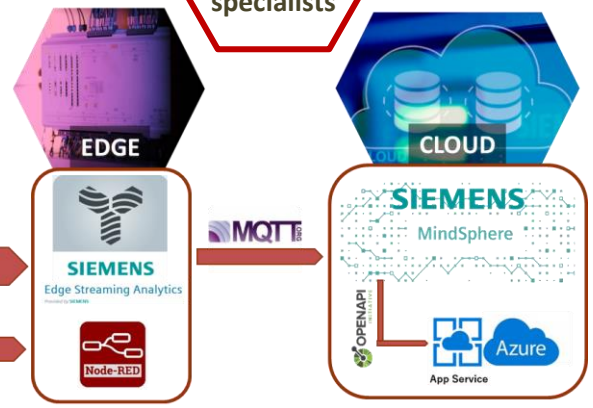
sij acroni
Jožef Stefan Institute Ljubljana, Slovenia
SIEMENS
University of Ljubljana Faculty of Electrical Engineering

4 Industrial end users
4 Process Control and automation specialists
4 Meta-llurgical institutions

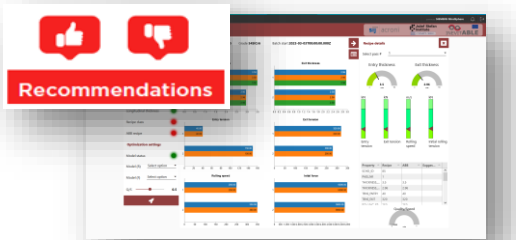



MES
Fast data acquisition system
ODBC
OPC UA
MQTT

Capability to monitor more than 700 process variables, producing daily more than 4 GB of data




https://youtu.be/tKkxCOSgCb4




Funded by the European Union

# Regions and (E)DIHs alliance for AI-at-the-Edge adoption by EU Industry 5.0 Manufacturing SMEs

AI REDGIO 5.0
www.airedgio5-0.eu

SRIQTOP

**Call: HORIZON-CL4-2022-TWIN-TRANSITION-01**
**Project reference: 101092069**
**Start/end: January 2023 – December 2025**
**Coordinator: POLITECNICO DI MILANO (POLIMI)**

I4MS ICT Innovation for Manufacturing SMEs

- 43 partners from 18 Countries
- 22 EU leading edge Regional Representatives
- 13 EU leading edge Technology Providers (10 SMEs)
- 7 Industrial Cases SMEs or MIDCAPs
- 2 open calls

kcstv Kompetenčni center za sodobne tehnologije vodenja

**Participating as regional representative**

## (E)DIH Ecosystem and Collaboration Corridors

DIH-DiTMaPS

SRC-EDIH Smart, Resilient and Sustainable Communities · European Digital Innovation Hub

IH4INDUSTRY The EU Network of DIHs in the Manufacturing domain

dih4industry.eu

DIGI-SI

DIH JSI

## Didactic factories network

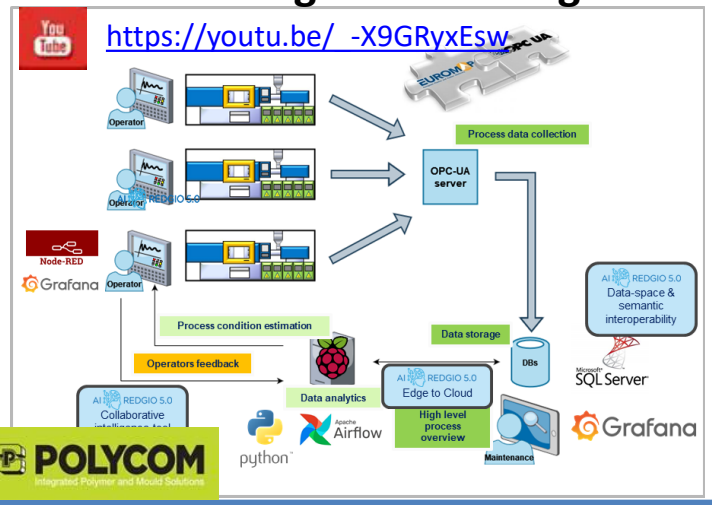
Jožef Stefan Institute Ljubljana, Slovenia

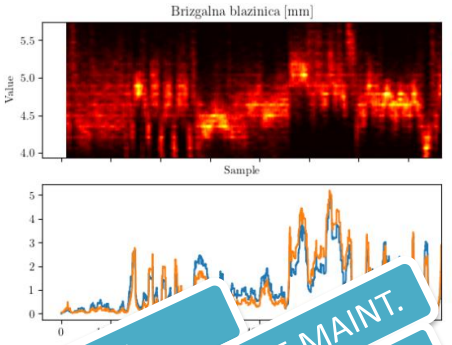
University of Ljubljana Faculty of Mechanical Engineering

RUDOLFOVO Science and Technology Centre Novo mesto

## Continuous monitoring of moulding machines using AI at the edge

https://youtu.be/_-X9GRyxEsw

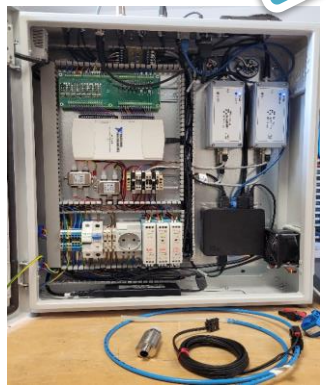


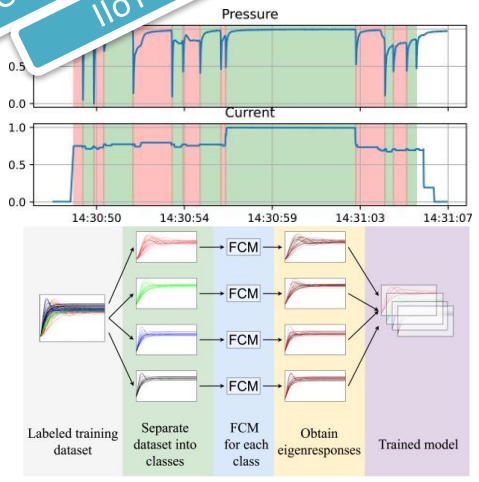


AI PREDICTIVE MAINT. IIoT

## Self-evolving monitoring systems for assembly production lines

https://youtu.be/xE8uOQ-UHUQ






Jožef Stefan Institute Ljubljana, Slovenia

University of Ljubljana Faculty of Electrical Engineering

Funded by the European Union

https://digitop.info/

# DIGITOP: Digital transformation of robot-supported factories of the future*

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**4th research and development area of the DIGITOP programme**

* coordinated by robotics

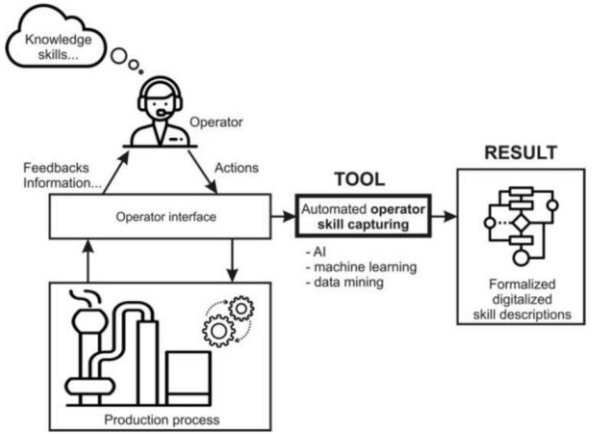
## Operator skill capturing and formalization

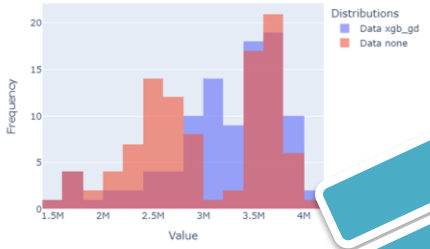
METRONIK

Jožef Stefan Institute
Ljubljana, Slovenia

University of Ljubljana
Faculty of Electrical Engineering

- Fluctuation of workforce pose a risk due to lost knowledge and skills
- To capture, formalize and digitize the specialized skills and knowledge of process operators detected from from historical process data






AI

Int. MES

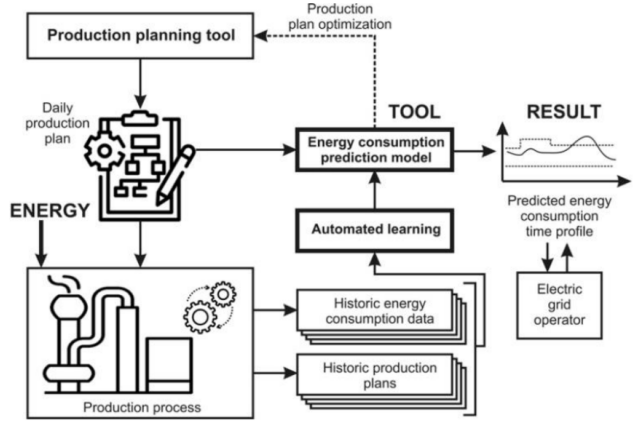
## Improved prediction of production energy needs

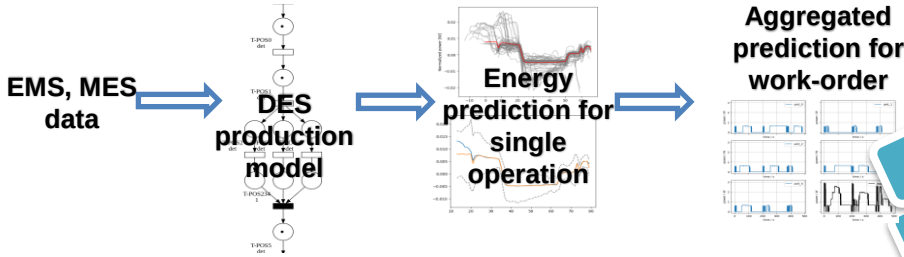
KOLEKTOR
KOLEKTOR SISTEH d.o.o.

Jožef Stefan Institute
Ljubljana, Slovenia

University of Ljubljana
Faculty of Electrical Engineering

- More accurate prediction of energy needs provides means for more efficient energy management
- Identify predictive models from historical process data (MES, EMS)




AI

Energetics

Int. MES

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NextGenerationEU

THE RECOVERY AND RESILIENCE PLAN

# Internationalization activities

## EFFRA & MiE

Involved as EFFRA member, represented in MiE members board and WGs

## A.SPIRE & Processes4Planet

Involved in transversal Digital working group, Energy working group and Process optimization working group.

## Hydrogen EUROPE & CLEAN Hydrogen Partnership

Involved in the area of green hydrogen.

## Vanguard Initiative

Member of AI Pilot and in the process of joining to a new hydrogen pilot.

## United Nations Industry Development Organization

**Smart Manufacturing Innovation center**

**UNIDO AIIM Global Aliance**

## The international academy for production engineering

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