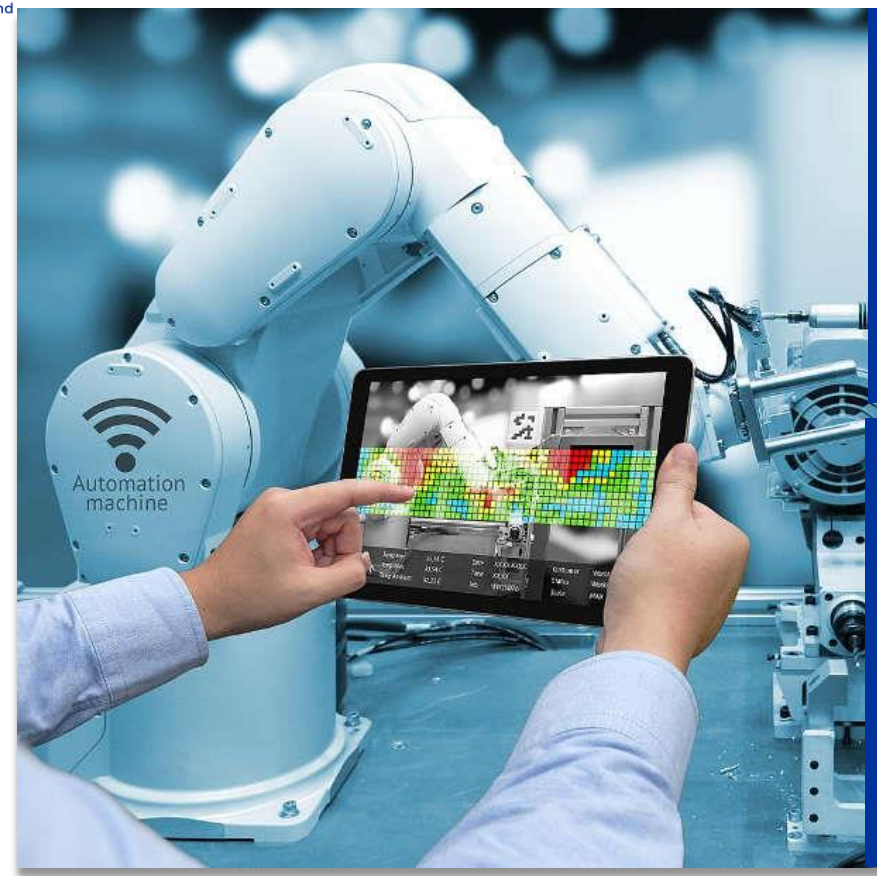
Interreg
Austria-Czech Republic
European Regional Development Fund

PredMAIn



PredMAIn – Project Presentation

01.06.2022

EDM - Industrie 4.0 in Vysočina

Dr. Mario Pichler
Software Competence Center Hagenberg GmbH
www.scch.at

Image source: https://www.produktion.de/digital-manufacturing/studie-predictive-maintenance-spart-geld-303.html

https://www.at-cz.eu/at/ibox/pa-1-starkung-von-forschung-technologischer-entwicklung-und-innovation/atcz279_predmain

EUROPÄISCHE UNION

scch { software competence center hagenberg }

intemac

ACT research

PROFACTOR

Jihočeská univerzita v Českých Budějovicích
University of South Bohemia in České Budějovice

COMPAS AUTOMATIZACE

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Agenda

- Short intro: Software Competence Center Hagenberg GmbH (SCCH)
- PredMAIn Background
- Project Factsheet
- What is the topic?
- Why is the topic relevant in the program region?
- Problems & Challenges
- Objective(s)
- Approach
- Important Result: Cost Model
- Consortium

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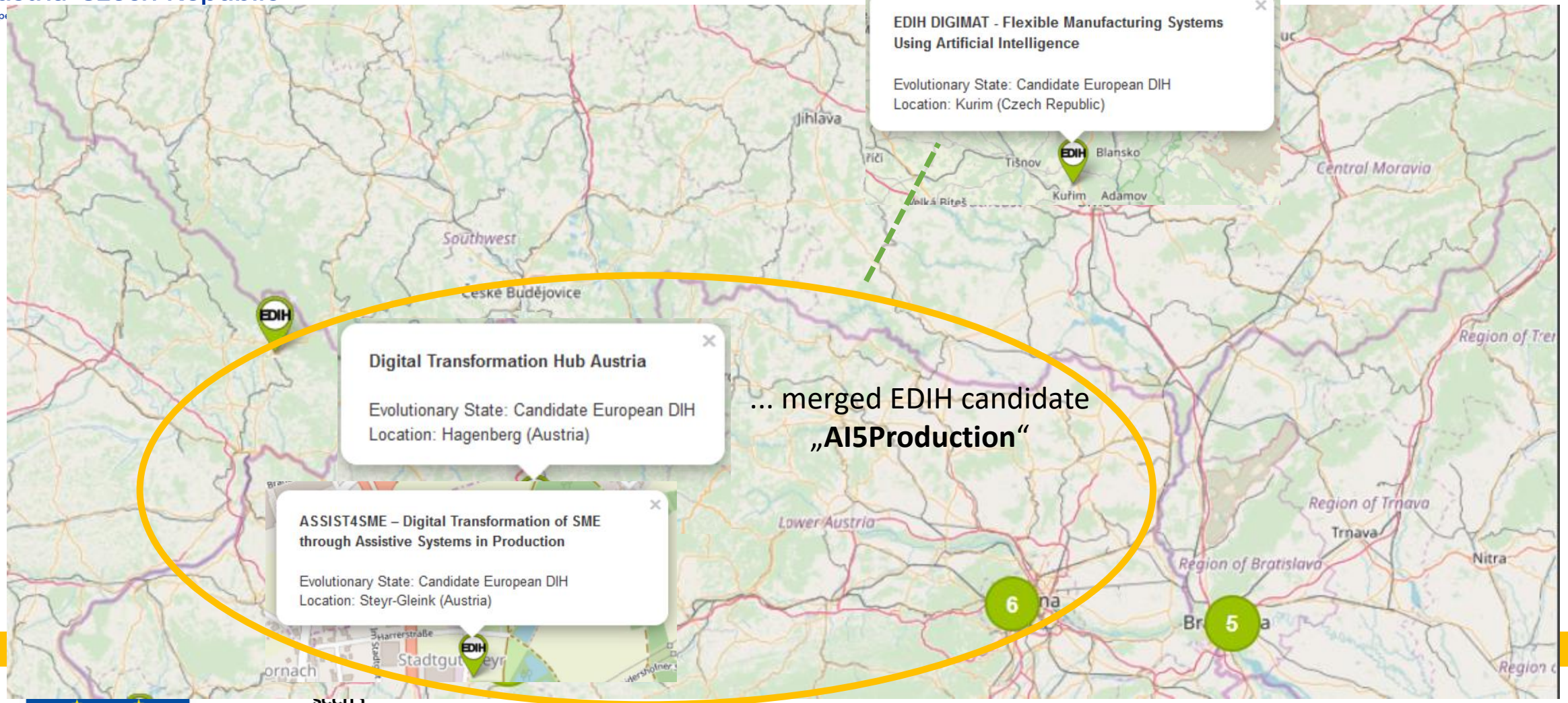
Software Competence Center Hagenberg

scch { }

- Non-Profit GmbH for Data Science & Software Science
- Founded by the Johannes Kepler University Linz in 1999
- ~115 employees (over 145 with partners)
- € 8.5 million in sales
- COMET competence center

PredMAIn Background



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Project Factsheet

Project title - acronym	**AI-based Predictive Maintenance - PredMAIn**
Funding agency / program	INTERREG Austria – Czech Republic 2014-2020

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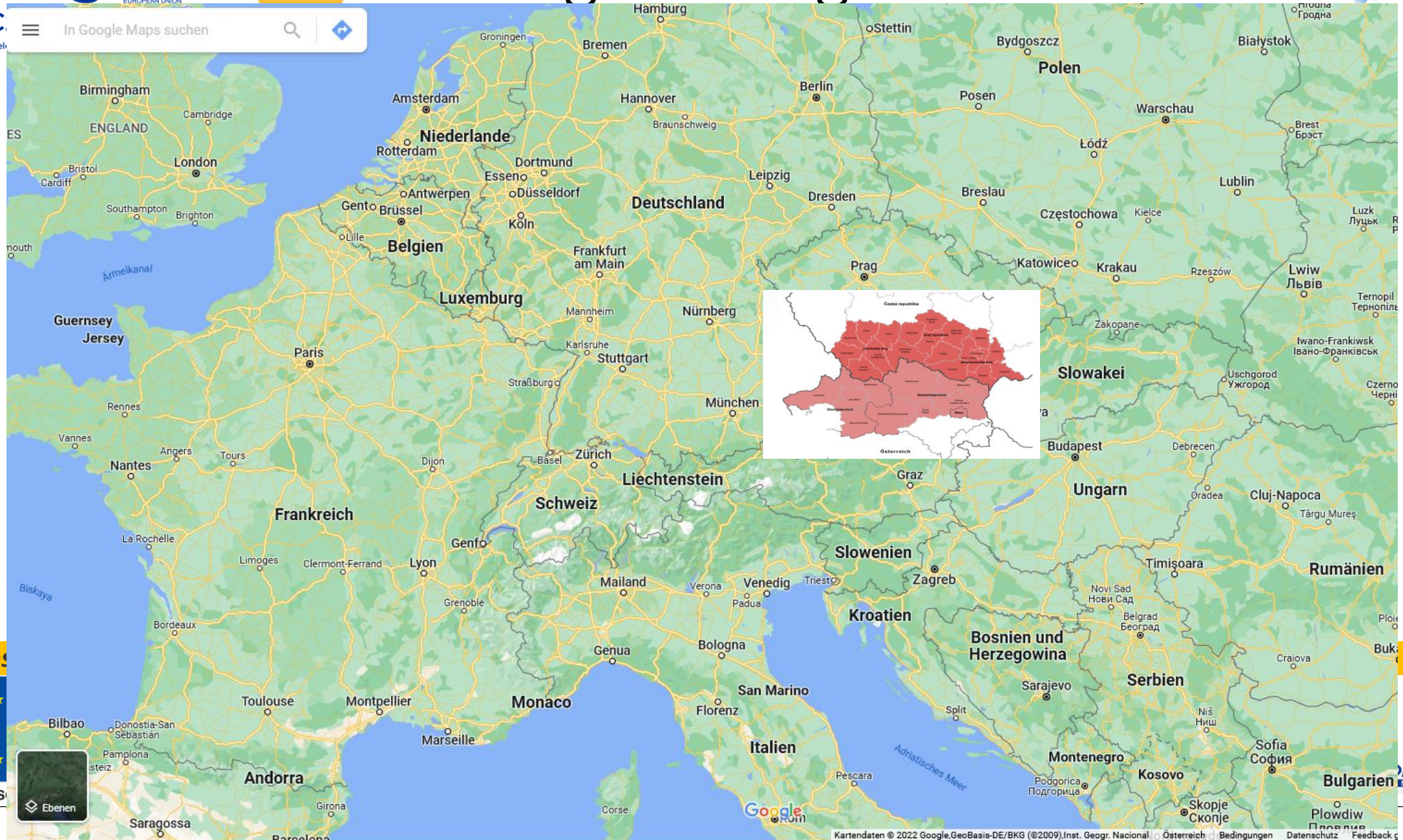
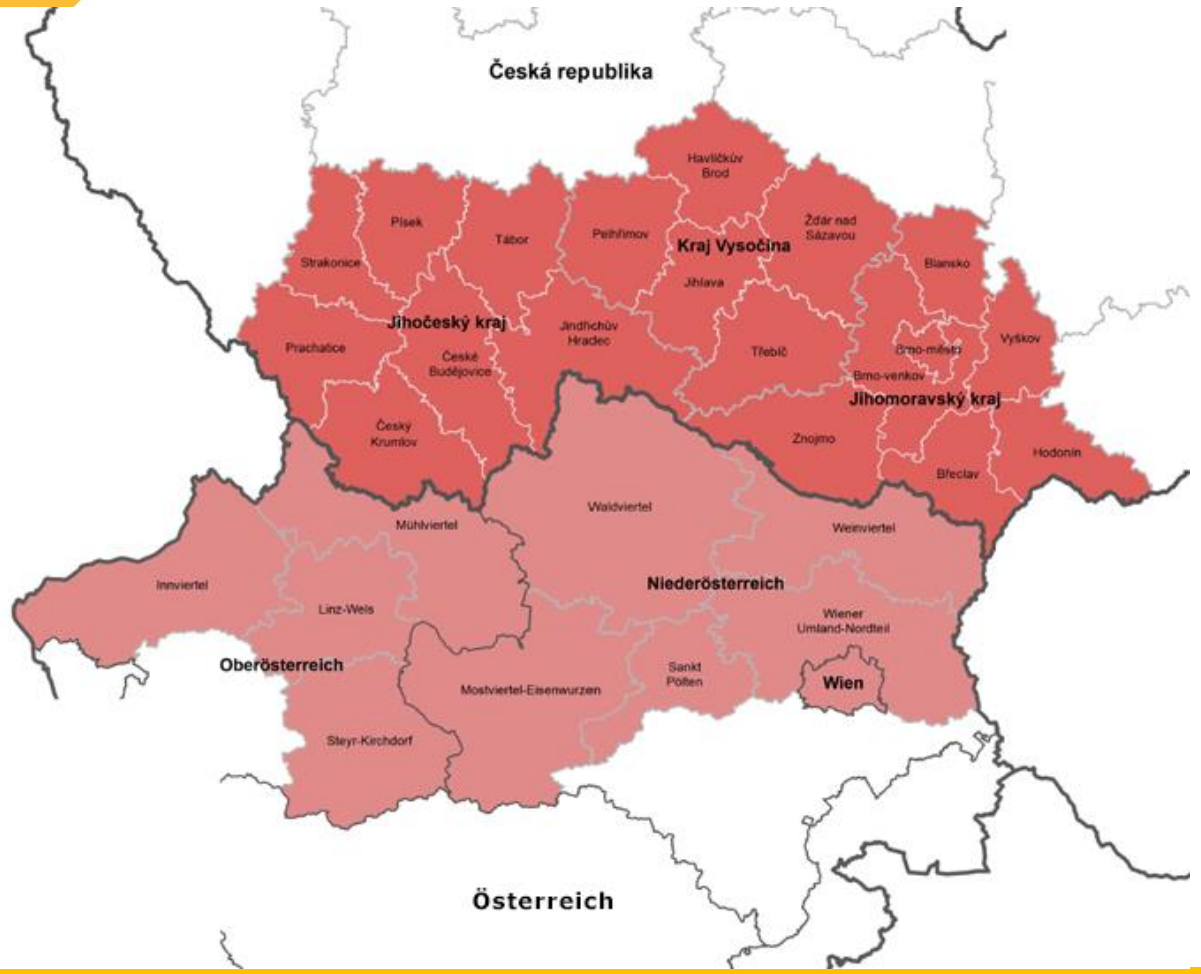
Program Region



Program Region



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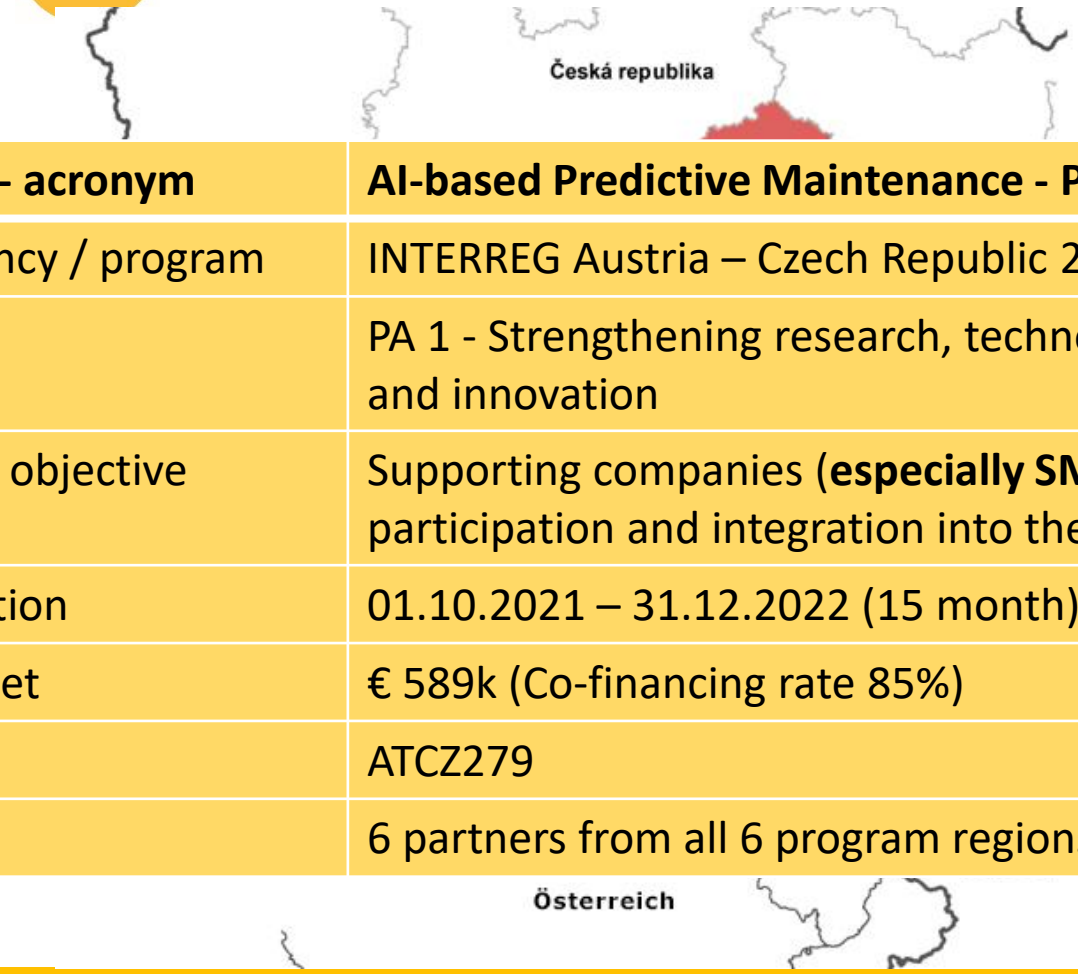
Project Factsheet



Project title - acronym	**AI-based Predictive Maintenance - PredMAIn**
Funding agency / program	INTERREG Austria – Czech Republic 2014-2020
Priority	PA 1 - Strengthening research, technological development and innovation
Specific objective	Supporting companies (**especially SMEs**) in their participation and integration into the innovation system
Project duration	01.10.2021 – 31.12.2022 (15 month)
Project budget	€ 589k (Co-financing rate 85%)
Project no.	ATCZ279
Consortium	6 partners from all 6 program regions

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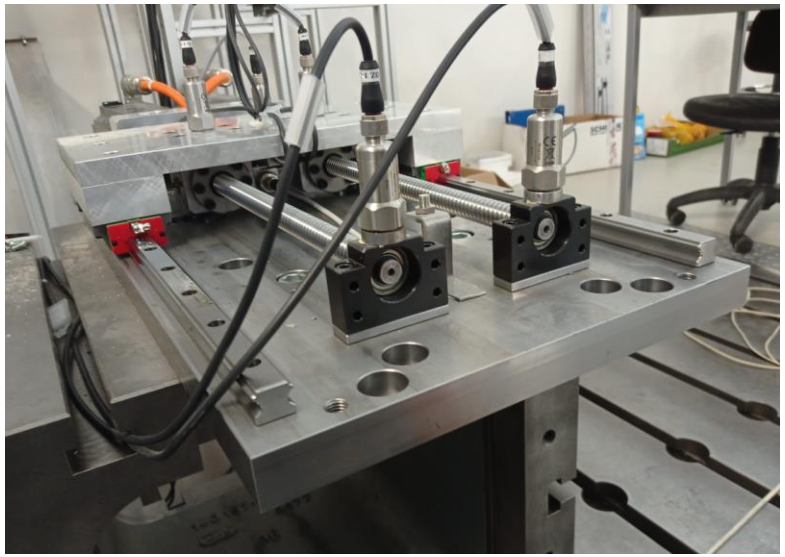
What is the topic?

- Machines and products show **signs of wear due to** their **use**
  - these lead to increased power consumption (i.e. less energy efficiency), shorter service life, decrease in product quality etc.

e.g., ball screw as a component of many machines -> conversion from rotating to linear motion



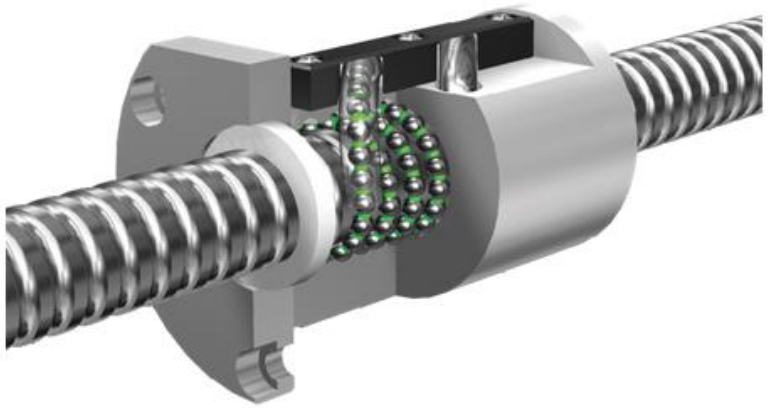


Image source: https://www.medicaldesignandoutsourcing.com/what-are-ball-screws/

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What is the topic?

- Remedy through **predictive maintenance (PdM)**
  - Detect emerging signs of wear etc. as early as possible
  - Advancements in sensor technologies have significantly contributed to improvements
    - because it allows data to be recorded over the entire machine runtime
  - But large amounts of data also require new methods of data analysis
    - **Artificial intelligence (AI)** is increasingly supporting humans and improving their capabilities

→ **AI-based predictive maintenance as project topic - PredMAIn**

(Main use case of AI in production and manufacturing)

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Why is the topic relevant in the program region?

- **Production and manufacturing** are a fields of **strength in the program region**
  - both large companies and many SMEs active in this area
- **PdM** programs typically have a **very high return on investment (ROI) for manufacturers**
  - thanks to reduced maintenance costs/losses and increased production capacity

- Study: Potential to ...
  - reduce **maintenance costs by 25% to 35%**, eliminate **breakdowns by 70% to 75%**, reduce **break-down time by 35% to 45%** and consequently increase **production from to 25% to 35%**[1]

[1] J. J. Montero Jimenez, S. Schwartz, R. Vingerhoeds, B. Grabot, and M. Salaün, "Towards multi-model approaches to predictive maintenance: A systematic literature survey on diagnostics and prognostics," Journal of Manufacturing Systems, vol. 56, pp. 539-557, 2020.

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Problems & Challenges

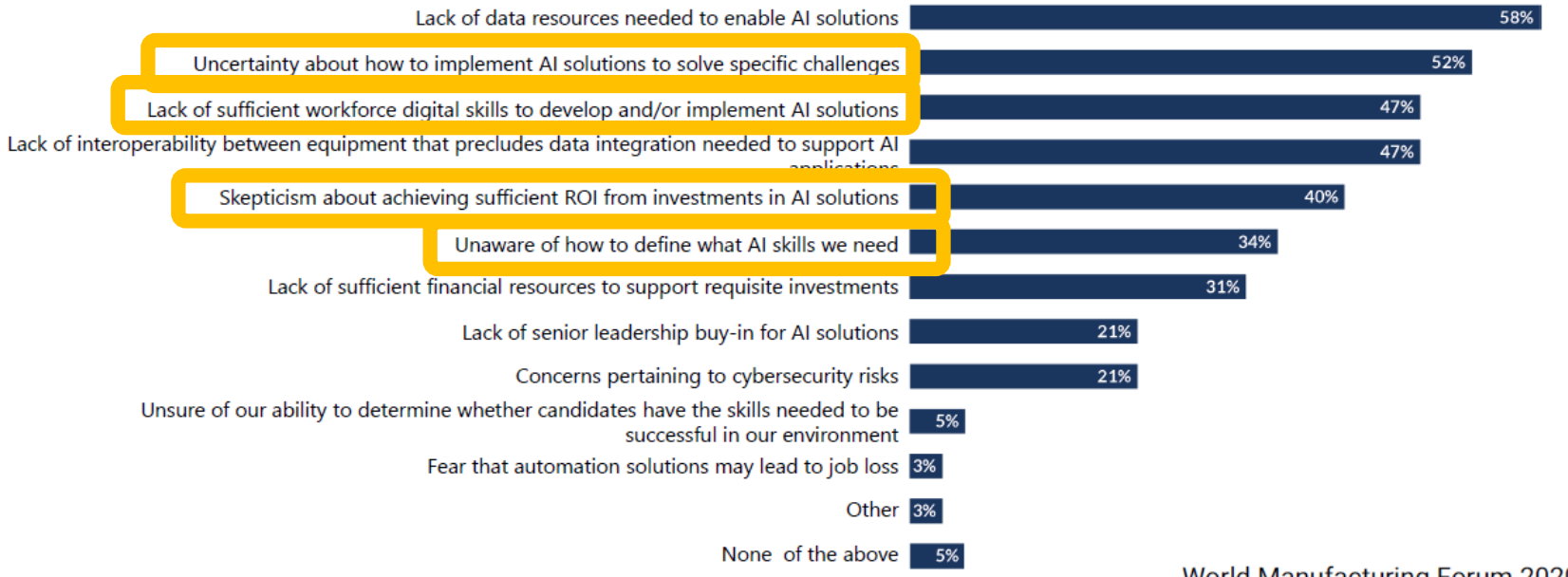
- Assumption/hypothesis:

  PredMAIn potential of manufacturing SMEs in the program region is insufficiently exploited

Barriers remain and are holding back companies from adopting AI

Barriers to AI adoption

(Source: MAPI Foundation)



World Manufacturing Forum 2020

https://www.at-cz.eu/at/ibox/pa-1-starkung-von-forschung-technologischer-entwicklung-und-innovation/atcz279_predmain

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Project Objective(s)

- Overall project goals
  - raise **awareness about PredMAIn potential for SME** in the program region (AT&CZ)
  - creation of **general and transferable PredMAIn knowledge for manufacturing SME**

- Program-specific goals
  - **Increasing competency** on AI-based predictive maintenance **in the program area**
  - Establishment of **long-term R&D cooperation** in the program region

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Project Approach

1. **Research and demonstration (→ knowledge package for SME)**
   a) Investigation of the state of the art on this topic
   b) Joint development of a demonstrator by the project partners
   c) Findings from completed and currently ongoing projects at the partners on this topic

2. **Cross-border networking** of relevant (research) partners in this field to establish long-term (research) cooperations
   - Joint further development of knowledge in follow-up projects (additional participants welcome)
     - Industry 5.0 (resilience, sustainability, human-centricity), ...

also **through EDIHs**!

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Important Result

‘A cost model for the comparison of maintenance strategies’

… for demonstrating and convincing SMEs about the advantages of AI-based predictive maintenance

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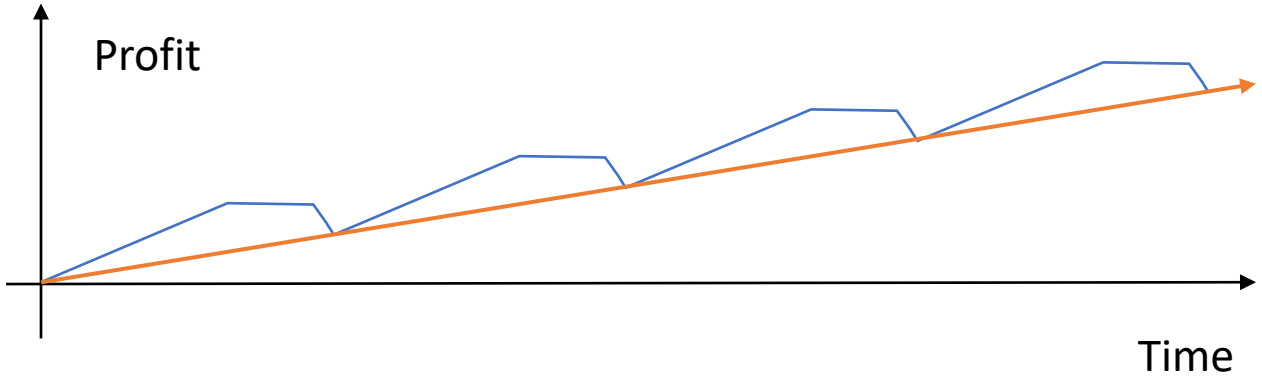
Cost Model

1. The natural principle in which predictive maintenance (PredMain) with AI increases the profit of its users (SMEs)

- Let's consider a simple, microscopic view of how production in a SME induces **profit**.

Note: This profit doesn‘t need to be measured in monetary units – it may be more efficient to use the number of produced items gained or lost for production gain or maintenance loss, respectively.



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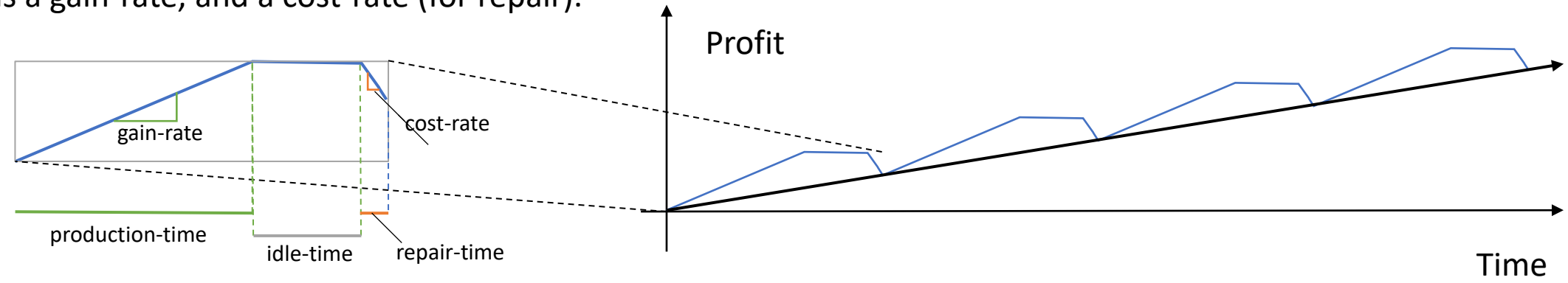
Cost Model

1. The natural principle in which predictive maintenance (PredMain) with AI increases the profit of its users (SMEs)

- There is production time, idle time, repair time.
- The downtime is the sum of idle- and repair time.
- There is a gain-rate, and a cost-rate (for repair).



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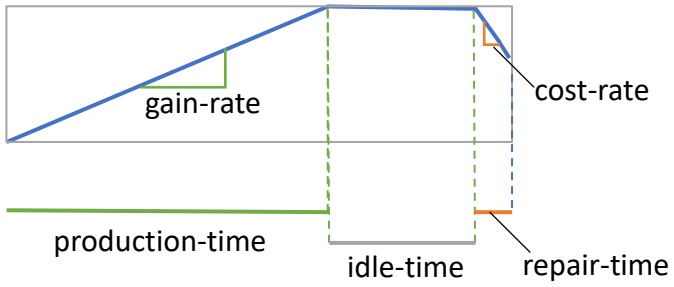
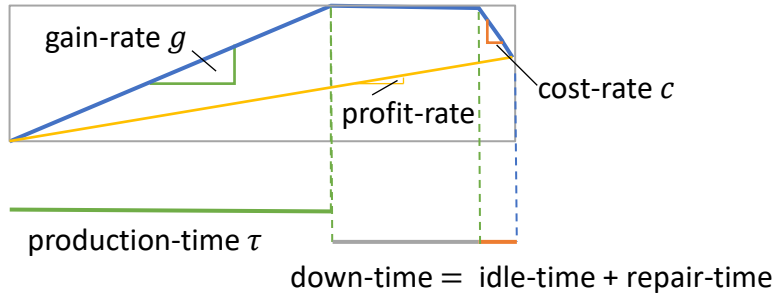
$$p = \frac{Profit}{Unit\ Time} = \frac{g \cdot \tau - c \cdot \rho}{\tau + \delta}$$





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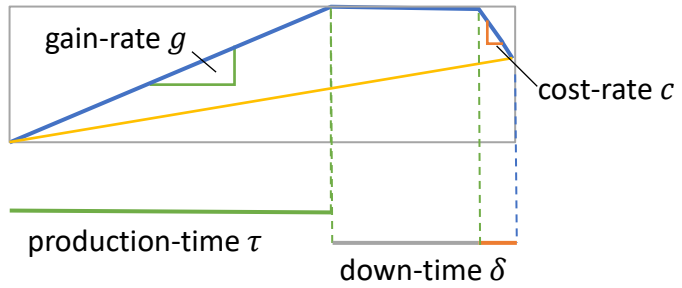
$$p = \frac{Profit}{Unit\ Time} = \frac{g \cdot \tau - c \cdot \rho}{\tau + \delta}$$

To maximize profit:

- Minimize downtime δ (idle-time or repair time ρ).
- Minimize cost rate c (for repair, but also idle period).
- Maximize production time τ. **USE Pred. Maintenance:**
  Get τ as close as possible to time of breakdown!



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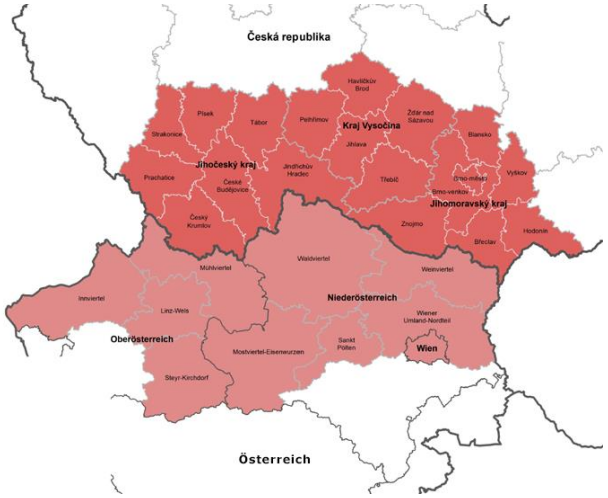
Project Consortium

- Carefully selected to
  - be able to **create** and present a transferable **knowledge package in only 15 months**
  - conduct joint research on the demonstrator **through existing know-how**

- Consortium composition
  - from all six program regions
  - **four research centers**
  - **one university partner**
  - and **one SME** partner



... plus additional **LOI partners** from the whole program region

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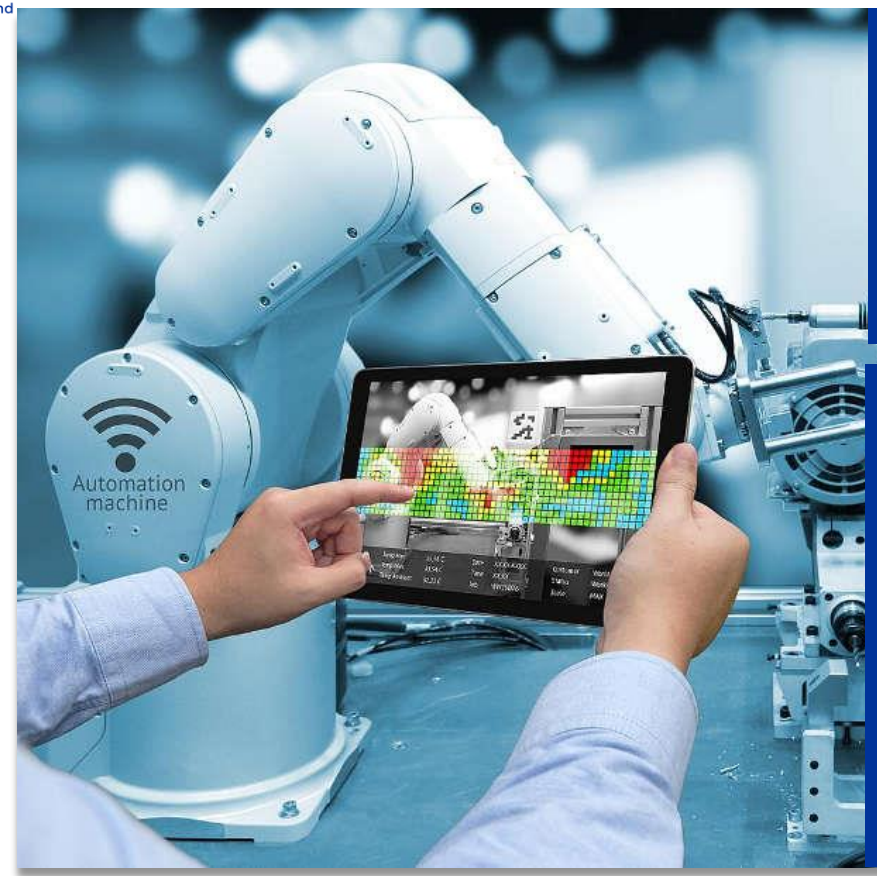
PredMAIn



Thanks for your attention!

PredMAIn – Project Presentation

Dr. Mario Pichler, SCCH
mario.pichler@scch.at

Image source: https://www.produktion.de/digital-manufacturing/studie-predictive-maintenance-spart-geld-303.html

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ACT research

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