PREDIS

WEBINAR WP7 – 19th of January 2021

What PREDIS WP7 will do

This project has received funding from the Euratom research and training programme 2014-2018 under grant agreement No 945098.

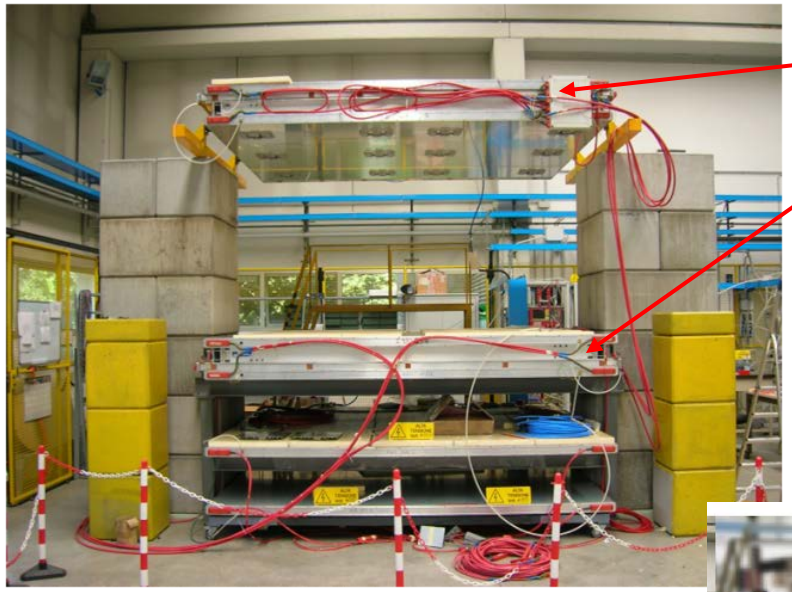
PREDIS

MUON IMAGING

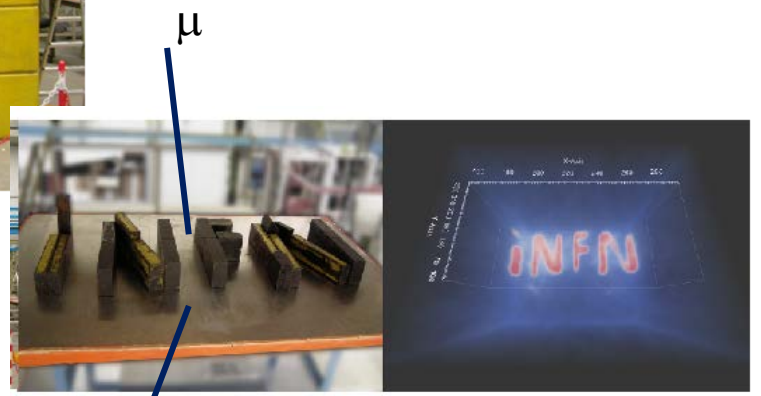
This project has received funding from the Euratom research and training programme 2014-2018 under grant agreement No 945098.

An experimental setup for Cosmic muon tomography

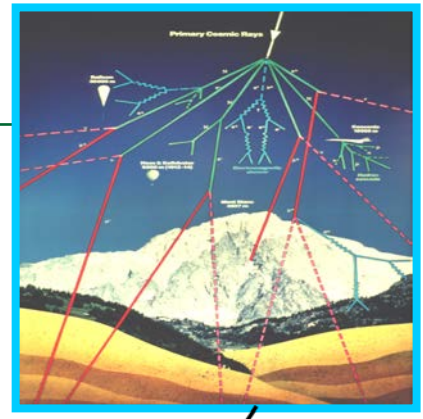
The INFN Padova group has assembled a demonstrator for the study of muon tomography using two spare Muon Chambers out of the set produced for CMS and installed in the barrel

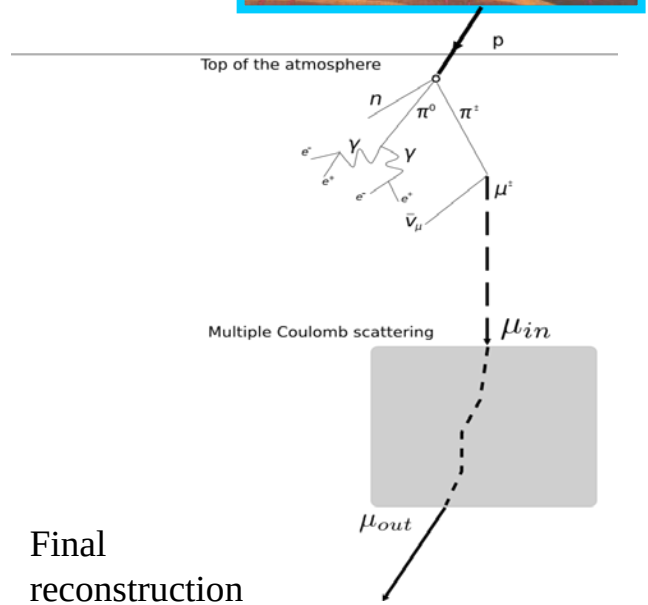


- **Two Drift Chambers 2.5x3.0 m^2**
- **Gap between chambers: 160 cm**
  vol. ≈ 11.5 m^3



Example of material to detect (lead)





Final reconstruction

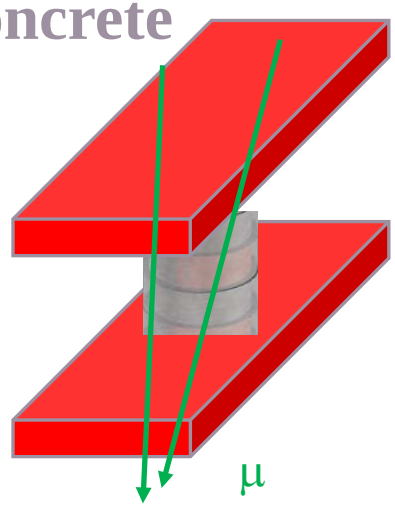
This project has received funding from the Euratom research and training programme 2014-2018 under grant agreement No 945098.

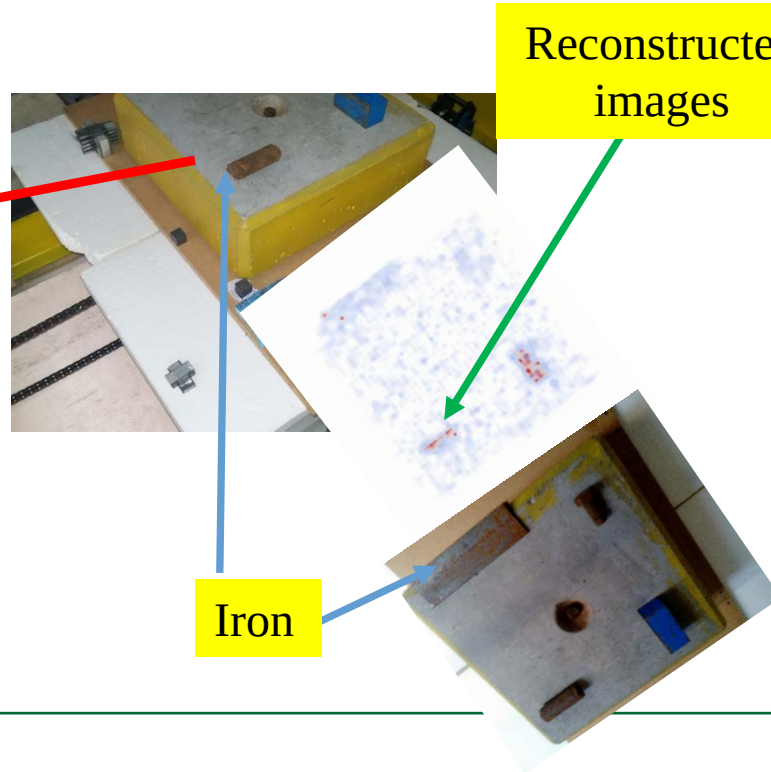
INFN muon tomography for PREDIS

Detect Nuclear waste in concrete blocks

Is it possible to scan them with muons to see the content? E.g. Iron in concrete

Our preliminary activity: a concrete block (50x50x17 cm^3) with some Iron objects of different dimensions on the mu-tomography system. **We can clearly distinguish Iron!**



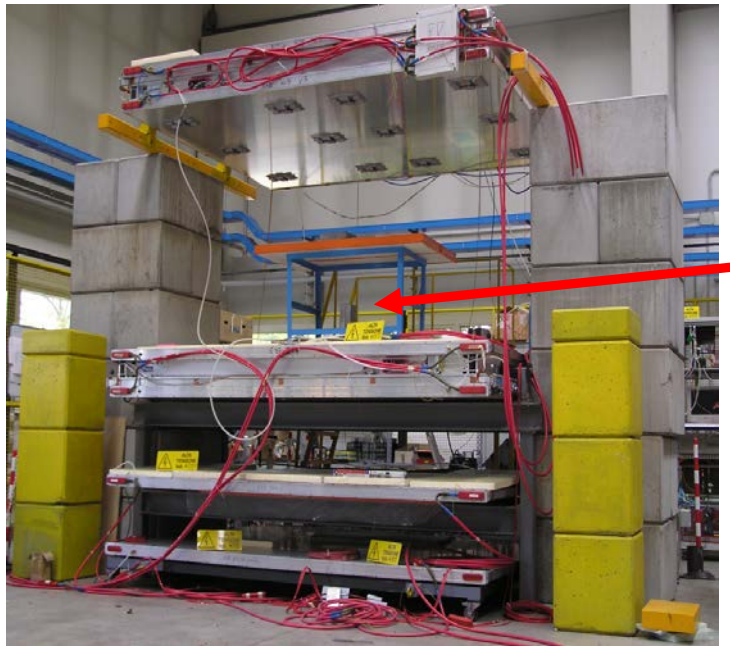


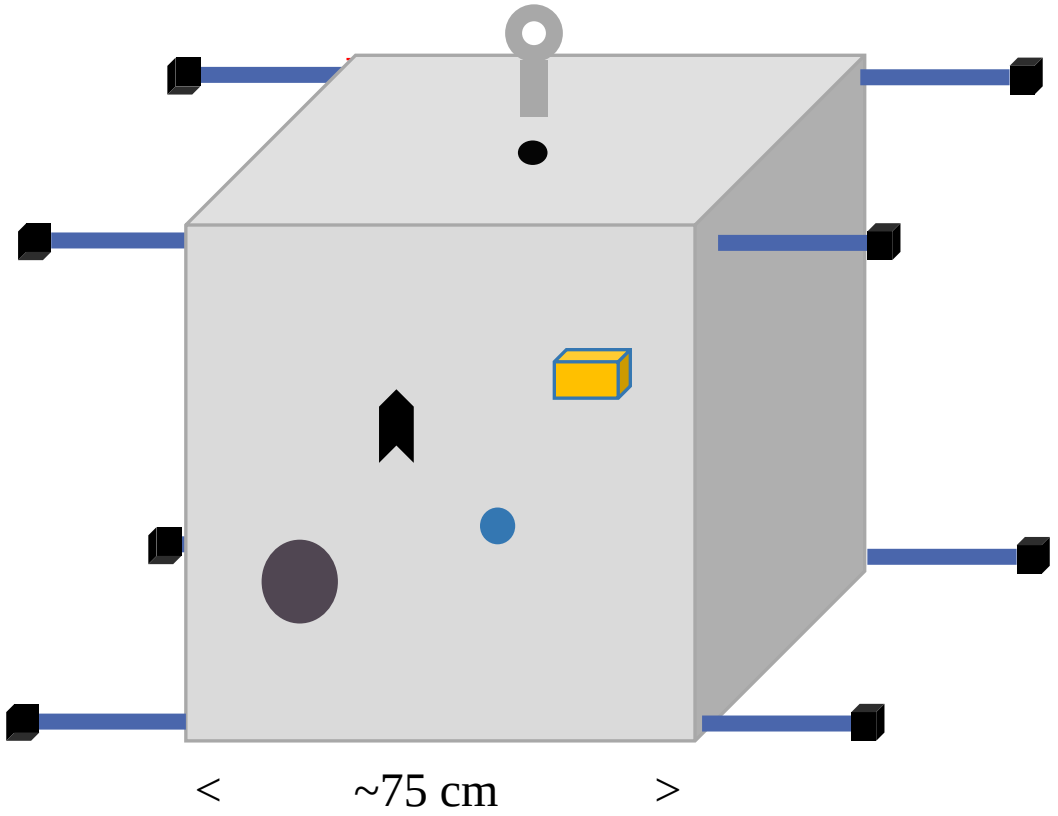
This project has received funding from the Euratom research and training programme 2014-2018 under grant agreement No 945098.

INFN muon tomography for PREDIS

Next step

Realize as a benchmark a concrete mockup with hidden material inside (dimensions and type to be possibly discussed with end users)





This project has received funding from the Euratom research and training programme 2014-2018 under grant agreement No 945098.

PREDIS

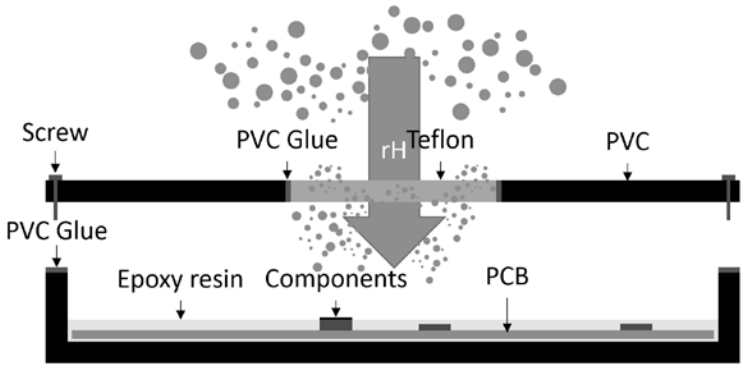
RFID SENSORS

This project has received funding from the Euratom research and training programme 2014-2018 under grant agreement No 945098.

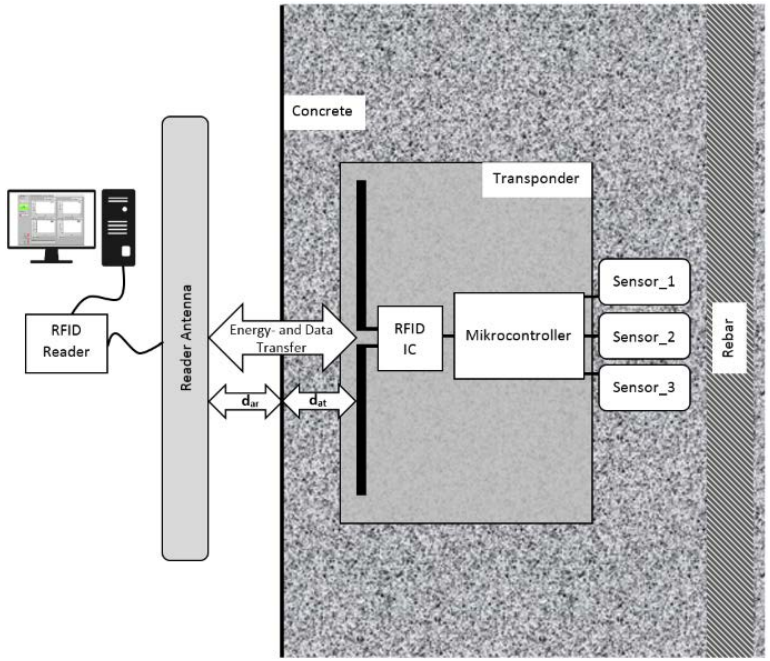
RFID: Embedded monitoring of waste canisters
Technology concept

- contactless powering and communication in concrete

Encapsulation



Embedding

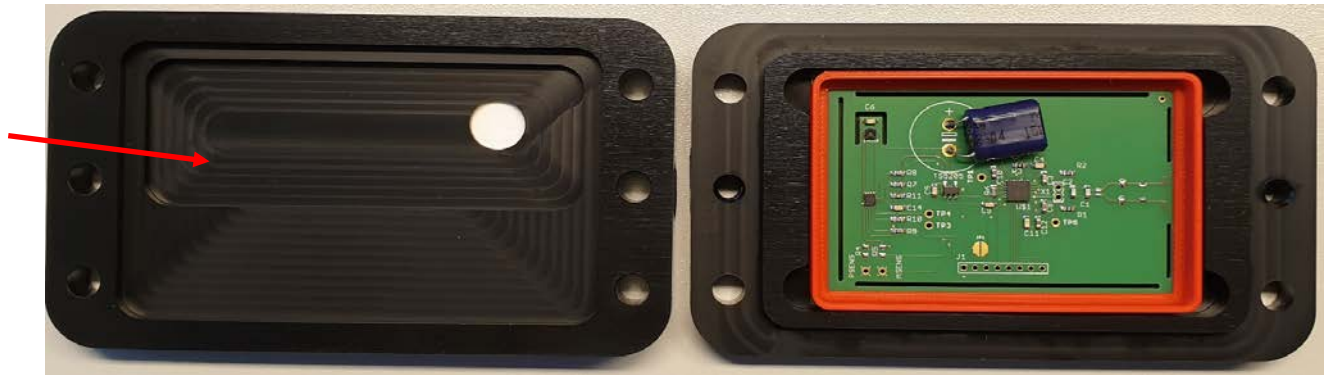


This project has received funding from the Euratom research and training programme 2014-2018 under grant agreement No 945098.

RFID: Embedded monitoring of waste canisters
Technology concept

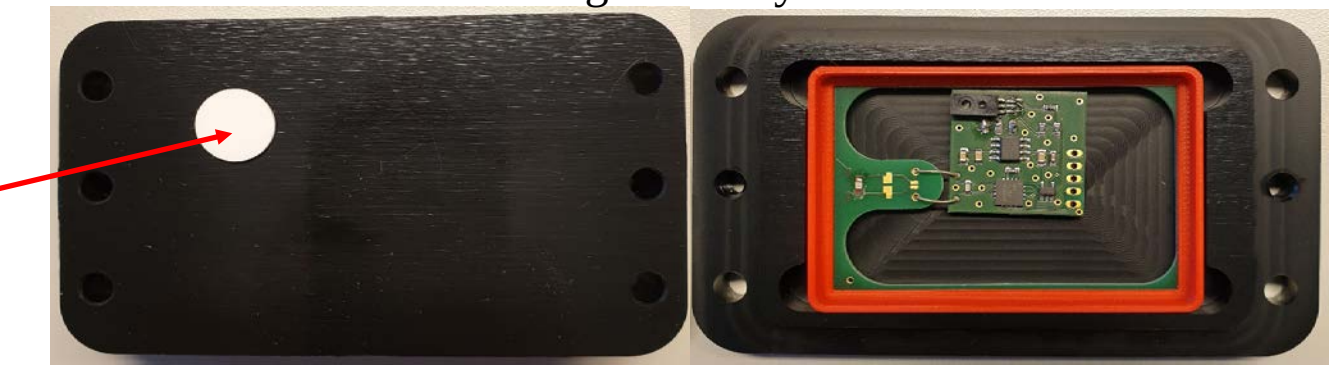
Digital sensor system (under development)

Encapsulation (PVC)



Analog sensor system

Teflon filter

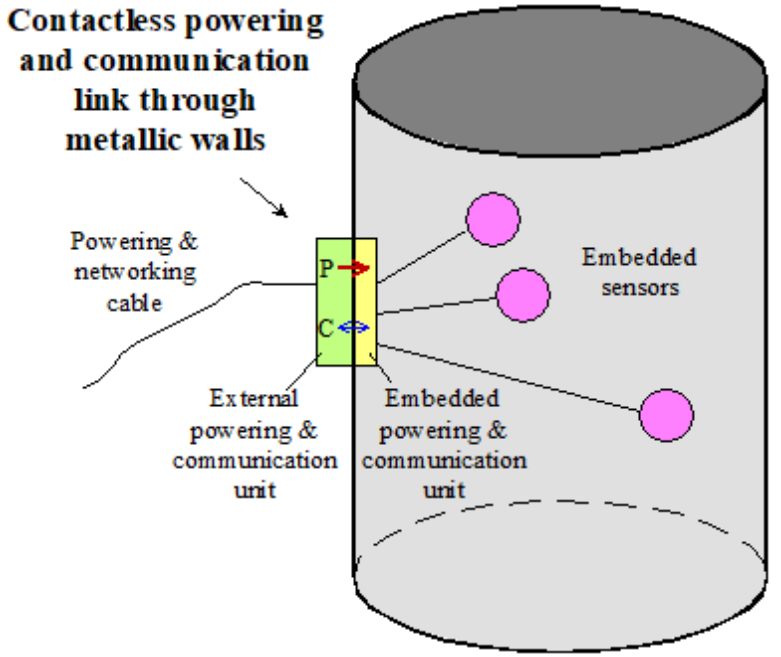


Temperature and humidity sensor

This project has received funding from the Euratom research and training programme 2014-2018 under grant agreement No 945098.

RFID: Embedded monitoring inside metallic waste canisters
Technology concept for communication and energy supply

- Option 1: Inductive RFID
  - Based on loop antennas at the opposite sides of the wall.
  - Standard inductive RFID technologies cannot penetrate through metals => Customized solution with remarkably lower operation frequency necessary
  - Performance depends on the wall thickness and material electromagnetic properties => work will start with feasibility study (experiments, simulations)
- Option 2: Acoustic (ultrasonic) link
  - Piezoelectric elements bonded at the opposite sides of the wall.
  - Critical issue: bonding technology
  - No commercial technologies available.



This project has received funding from the Euratom research and training programme 2014-2018 under grant agreement No 945098.

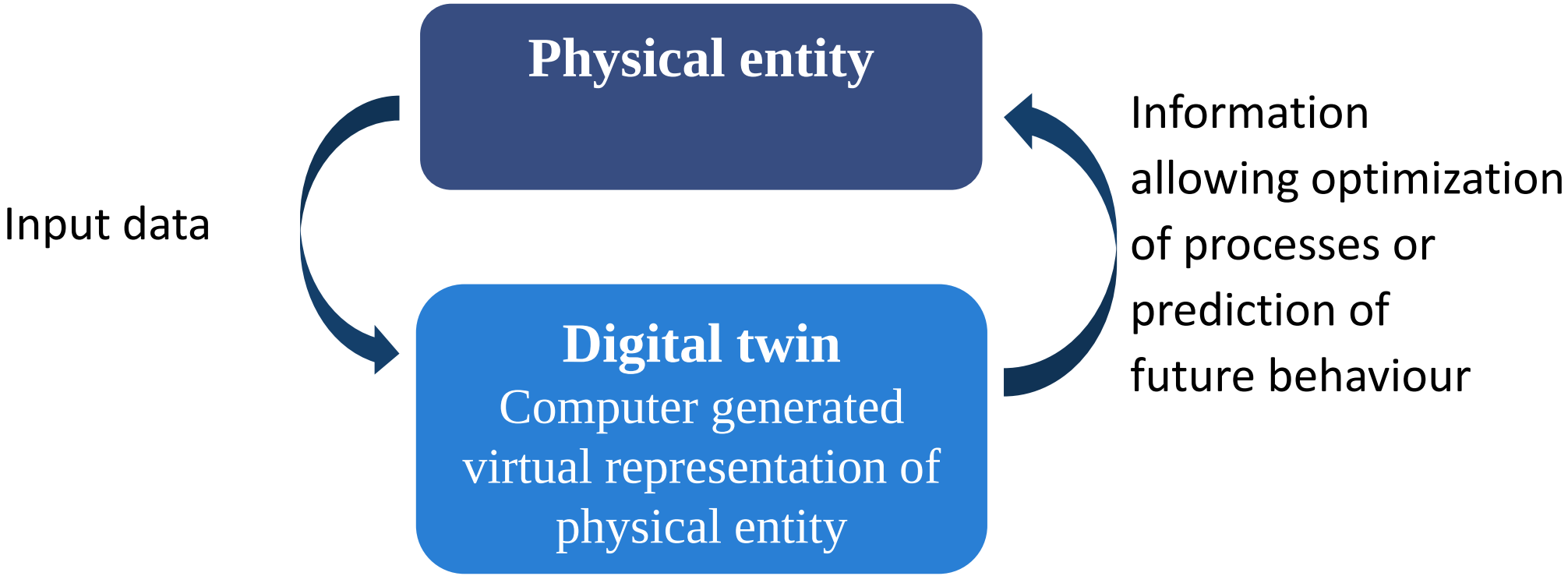
PREDIS

DIGITAL TWIN

This project has received funding from the Euratom research and training programme 2014-2018 under grant agreement No 945098.

Digital twin

What? A virtual representation of a physical entity



D. Jones et al. / CIRP Journal of Manufacturing Science and Technology 29 (2020) 36–52

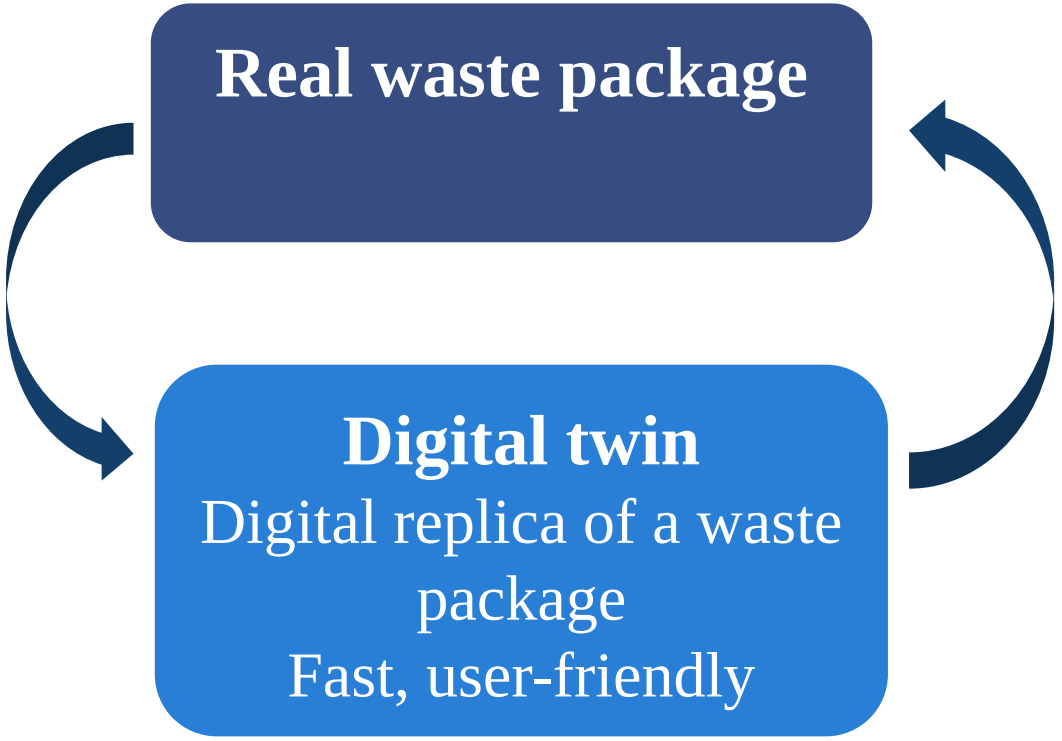
This project has received funding from the Euratom research and training programme 2014-2018 under grant agreement No 945098.

Digital twin of a cemented waste package

Our vision:

Input data:

- Design, geometry
- Composition (cement, aggregates, waste,…)
- Storage conditions
- Monitoring data



Output:

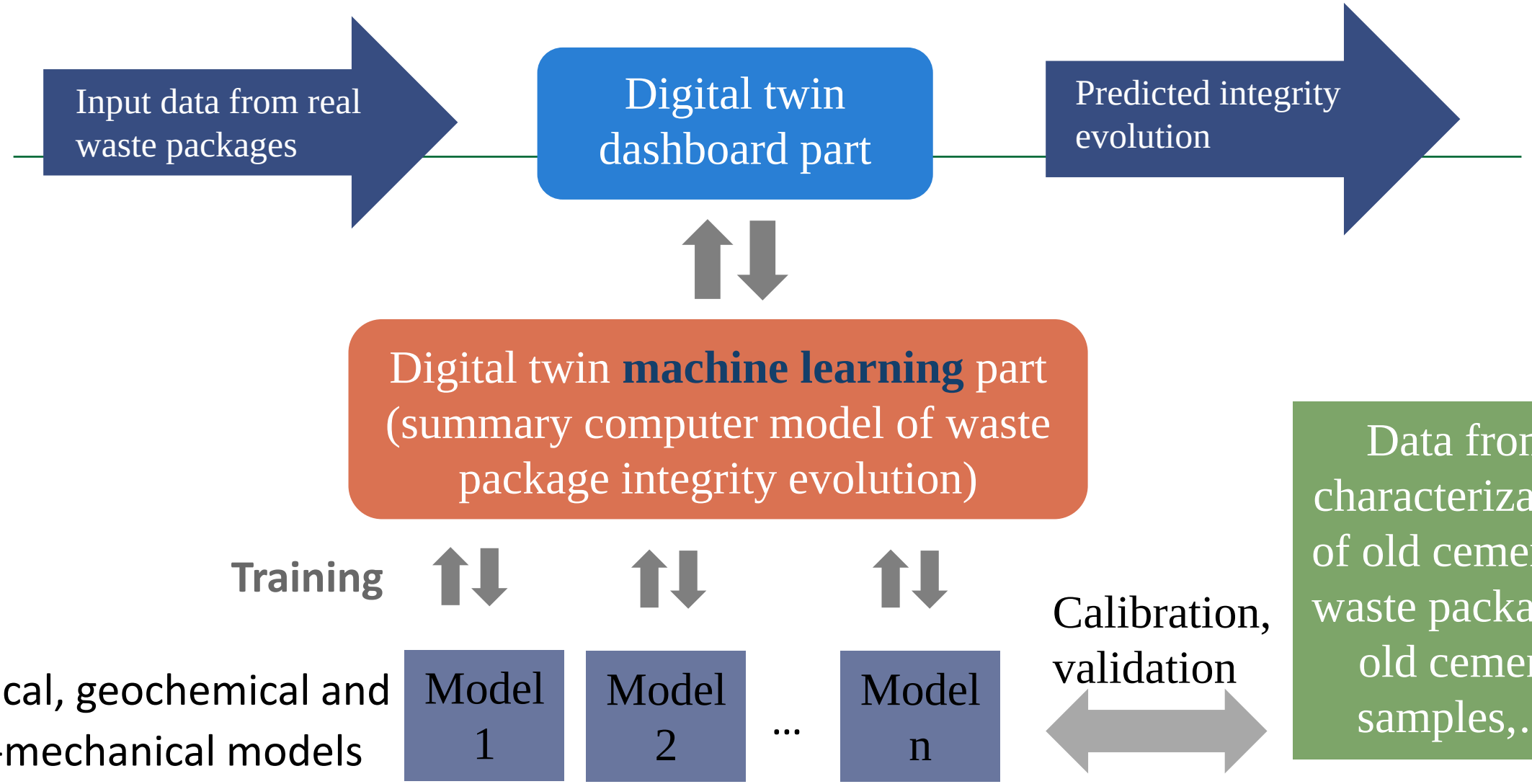
Prediction of Integrity evolution

- Gas production
- Volume expansion
- Canister corrosion
- …

as function of storage time

This project has received funding from the Euratom research and training programme 2014-2018 under grant agreement No 945098.

Digital Twin: approach



This project has received funding from the Euratom research and training programme 2014-2018 under grant agreement No 945098.

PREDIS

Data handling, processing and fusion

This project has received funding from the Euratom research and training programme 2014-2018 under grant agreement No 945098.

PREDIS

“You cannot improve what you can’t measure”

- “It’s completely fine”, “If it’s not broken, don’t fix it”
  - Poor arguments, how to know it truly is fine?
- What is the current status?
- How long will it last?
  - How long time do I have to prepare?
- Foresight tends to be a lot cheaper than hindsight

This project has received funding from the Euratom research and training programme 2014-2018 under grant agreement No 945098.

The problem of too much data

- Modern monitoring methods and sensors are capable of producing ample data.
- The more you measure, the more you know and decrease uncertainty.
- The data-amount can be so vast that humans cannot utilize the full extent without the proper tools.

The goal of T7.5

- Develop and research tools to better understand and utilize the available data.
- Possibility to detect and even predict important features from the measured data.
  - How long will the concrete last
  - What measurements are truly relevant
  - What is the current condition

This project has received funding from the Euratom research and training programme 2014-2018 under grant agreement No 945098.