AI for Digitizing Industry

Exploring the future

23 January 2020

ARROWHEAD TOOLS

ALMA MATER STUDIORUM UNIVERSITÀ DI BOLOGNA

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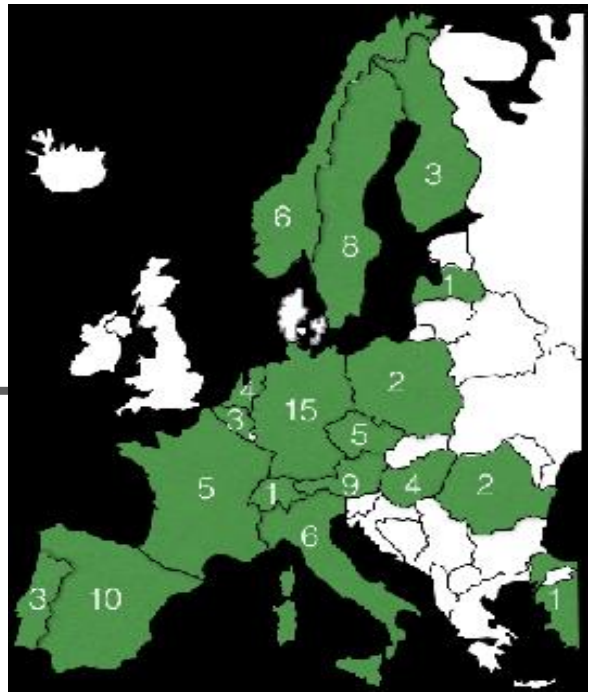
Outline

Quick project review

Positioning the project in the history of interdisciplinary European research in digitalization (FP7 and H2020)

Arrowhead Tools



ECSEL INNOVATION ACTION 2018 CALL

Automation and Digitalisation Engineering project

Largest in Europe

18 countries

81 partners + 7 linked third parties

9.394 pm (241 py/y → 0,92 person-year per working day)

97 M€ budget

MAX Contribution: EU - 22,7/90,7 -National: 25,2/96,9

Duration 2019-2022 (39 months, kick off: May 2019 Goteborg)

Coordinator: Prof. Jerker Delsing,

Lulea University of Technology

Why Arrowhead?
Why Tools?

Arrowhead:

FP7 I*nnovation Pilot Project* (2013-17)

A framework for I/O intensive and cooperative automation

Tools:

Tools supporting the entire life cycle of I/O intensive system of systems for cooperative automation (enablers for sustainable AI applications)

From the italian team perspective

2009-14

Semantic Interoperability
SOFIA

Electric Mobility
Internet of Energy

2013-17

Arrowhead

1. Framework
2. Electric Mobility Infrastructure

2019-22

Arrowhead Tools

1. Generalize the scope
2. Create tools to cover the entire life cycle of the IOT edge in SoS

What is the specificity of Arrowhed Tools?

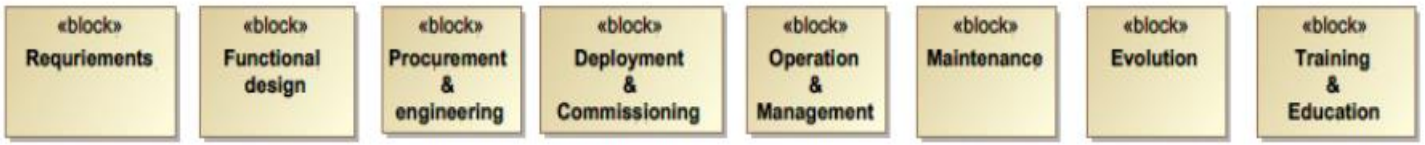
Goal: Moving forward baselines with tools supporting:

- Reduction of engineering costs
- Interoperability
- New services

- Tools are project target
- Use cases are benchmarks to validate the tools

Approach:

- The Arrowhead Framework is the «enterprise bus» that binds all tools
- Tools are targeting the entire engineering process



Countries and main Partners

18 Countries

Sweden
Austria
Belgium
Czech Republic
Germany
Finland
France
Hugary
Italy
Latvia
The Netherlands
Norway
Poland
Portugal
Romania
Spain
Switzerland
Turkey

Some of the 81 partners

ABB
Bosch
CEA
Infineon
Infineon Austria
Philips
ST-Italy
ST-France
Volvo
SINTEF, VTT
LTU, TU/E

Some of the domains of the 21 usecases

Energy

Manufacturing

Smart City

ARROWHEAD

Use cases and motivation

Task 7.1 (ULMA)
Integration of electronic design automation **tools** with product lifecycle tools (REUSE, U3CM, BEIA, ROP)

Task 7.3 (ARCELIK)
Rapid HW development, **prototyping**, testing and evaluation (EDI, UTIA)

Task 7.4 (DAC)
Configuration tool for autonomous provisioning of **local clouds**

Task 7.6 (3E)
Deployment and configuration (Sirris)

WP7
Use cases: reduction of solution engineering cost

Use cases: data exchange between IoT/SoS and legacy engineering tools

WP9
Interoperability Across Secure SMART Industrial Applications

Task 7.5 (BOLIDEN)
Deployment engine for production related sensor data (LTU and BnearIT)

Task 7.2 (ST-I)
SoS Engineering of IoT edge devices

Task 8.1 (CAMEA)
Automated Formal Verification
BUT, EXPLEO, AIT, CVUT

Task 8.2 (PHC)
Engineering processes and tool chains for digitalised and networked diagnostic imaging
PHC, TUE, Technolution

Task 8.3 (ASML)
Interoperability between (modelling) tools for cost effective lithography process integration (ICTG, TUE)

Task 8.4 (LBB)
Production preparation tool chain integration (LQT, POD, LTU)

Task 8.10 (EUROTECH)
SoS engineering of IoT edge devices - service integration, data fusion and orchestration functions (ST-I, IUNET, POLITO, REPLY, BEIA, ROP)

Task 8.5 (FAUT)
CNC machine automation
MON, IKERLAN

Task 8.6 (ACCIONA)
Machine operation optimisation
dotGIS, AITIA, BME

Task 8.7 (SAP)
Digital twins and structural monitoring
Jotne, NTNU, HIOF, Tellu

Task 8.8 (FARR)
Elastic Data Acquisition System
(IKERLAN, MON)

Task 8.9 (ABB)
Data-based digital twin for electrical machine condition monitoring
(VTT)

Task 9.1 (KAI)
Support quick and reliable **decision making** in the semiconductor industry

Task 9.2 (IFAT)
Smart **Diagnostics Environment** for Contactless Module Testers

Task 9.3 (VTC)
Virtual **Commissioning** of a Cyber-Physical System for increased flexibility

Task 9.4 (IFD)
Production Support, Energy Efficiency, Task Management, Data Analytics and Smart **Maintenance**

Task 9.5 (IFAT)
Linking Building Simulation to a Physical **Building** in Real-Time

Task 9.6 (BOLIDEN)
Secure sharing of IoT generated data with partner ecosystem (LTU, BnearIT)

Task 9.7 (REPLY)
SoS Engineering of **IoT** edge devices

Italian team in Arrowhead Tools (2019-22)

Focus: System of systems Engineering of IoT edge devices

4 Regions

Sicilia
Lombardia
Piemonte
Emilia Romagna

5 Partners

STM
EUROTECH
REPLY
POLITO

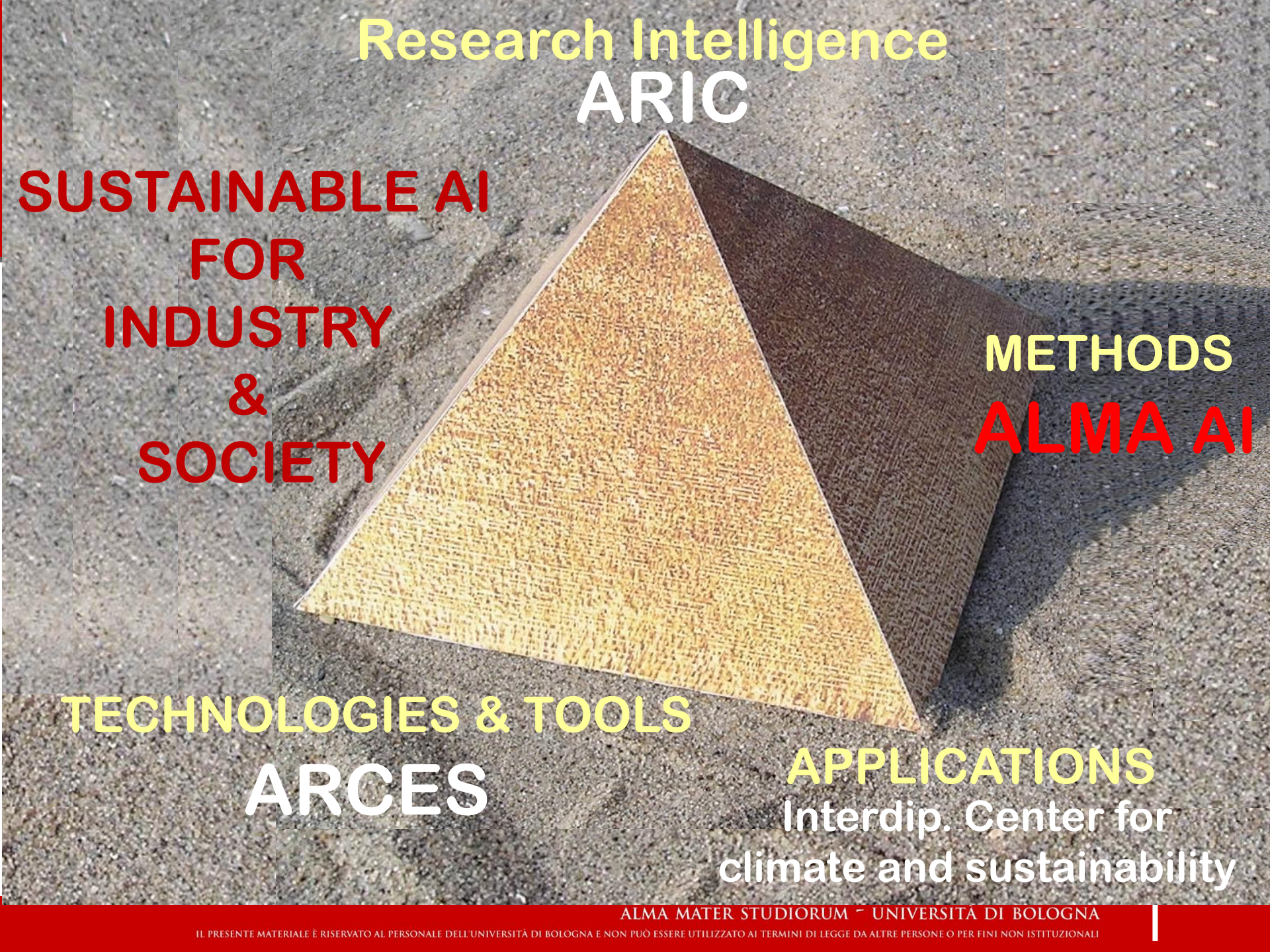
IU.NET →

4 linked third parties

UNIPI
UNIMORE
POLIMI
UNIBO

Vertical alliance calibrated for maximum innovation and impact

Build an integrated technological pillar to enable sustainable AI applications



ARCES: technological pillar targeting **sensing, data collection and edge processing** for sustainable AI applications

ARCES was founded by 4 Departments and hosts:

- two joint labs with large enterprises:
  - On technology and circuit design: With STM (since 2001)
  - On embedded systems: With RFI (since 2018)
- an interdisciplinary Phd program on environmental/structural monitoring and risk analysis (**24** PhD students)

Six multidisciplinary research teams contribute
With tools *for the engineering process of IoT edge devices*

Project structure

WP10 - Standardisation
WP11 - Dissemination and Exploitation
WP12 - Management

WP7	WP8	WP9
Use cases: reduction of solution engineering cost	Use cases: data exchange between IoT/SoS and legacy engineering tools	Use cases: Interoperability Across Secure SMART Industrial Applications

WP1 - Requirements and state of the art

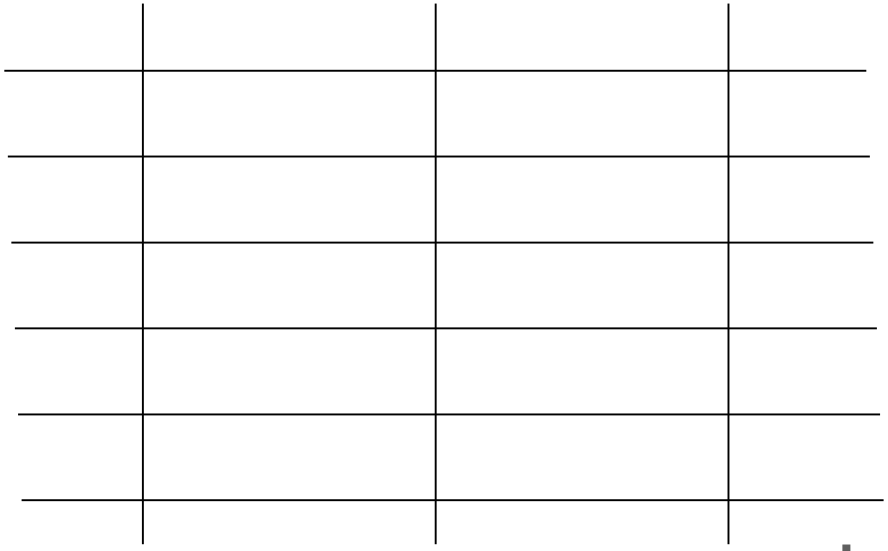
WP2 - Digitalisation engineering process

WP3 - Digitalisation framework

WP4 - Tools chain architecture

WP5 - Tool technology

WP6 - Training



KPIs on → Cost reduction interoperability services

Use Case Example
"SoS engineering of IoT edge devices" (ST-I)

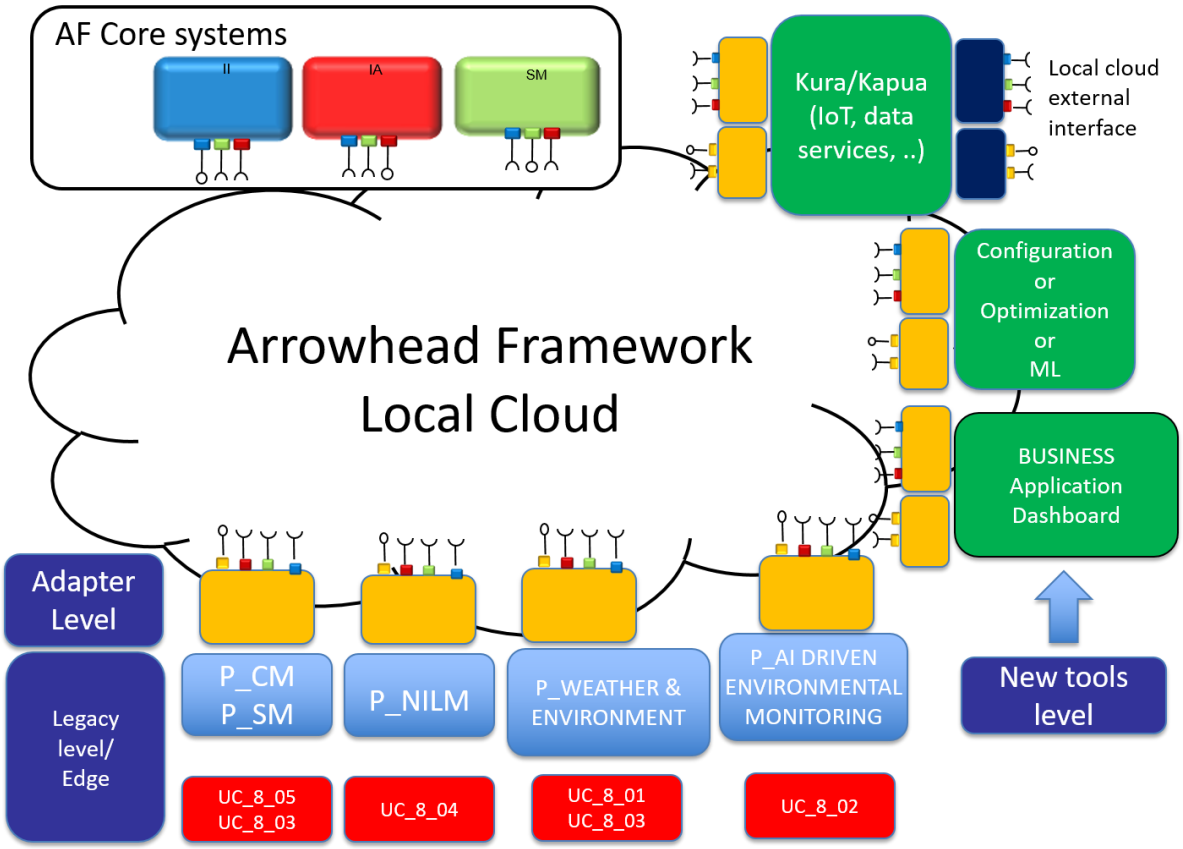
Specific topics addressed by tools:

- Design of piezoelectric MEMS
- Applying RISC-V architecture with vector processing capabilities
- Unobtrusive load signature analysis from single energy consumption trace
- Energy harvesting, sensor integration, data fusion and distributed reasoning in energy optimization applications
- Integration of the AF with W3C Web of Things
- Deep learning based tracking
- Vibrations monitoring and anomaly detection in structures

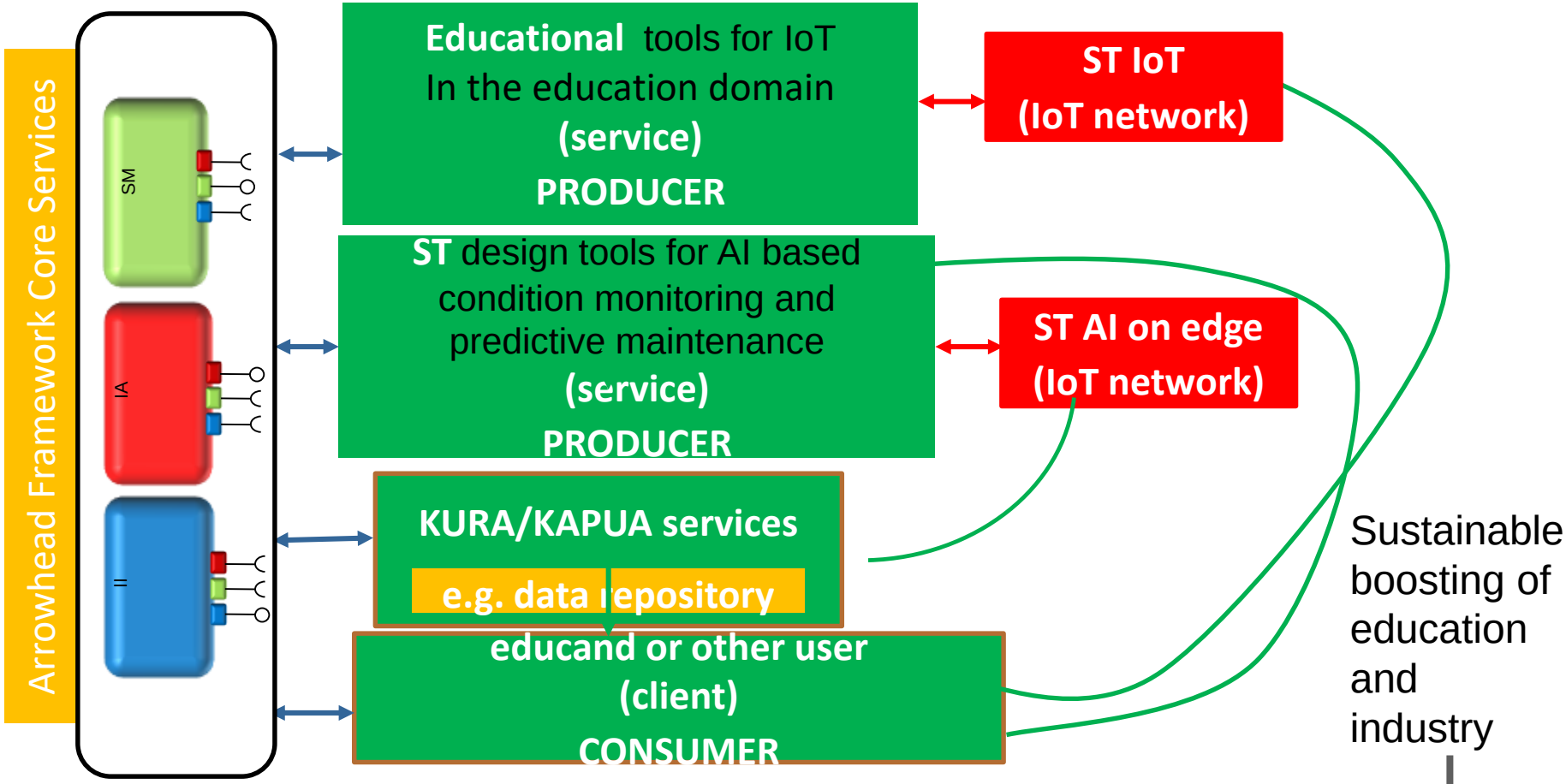
5 demonstrators

- Environmental monitoring
- AI based scene monitoring
- Structural health Monitoring
- Not Intrusive Load monitoring
- Condition Monitoring

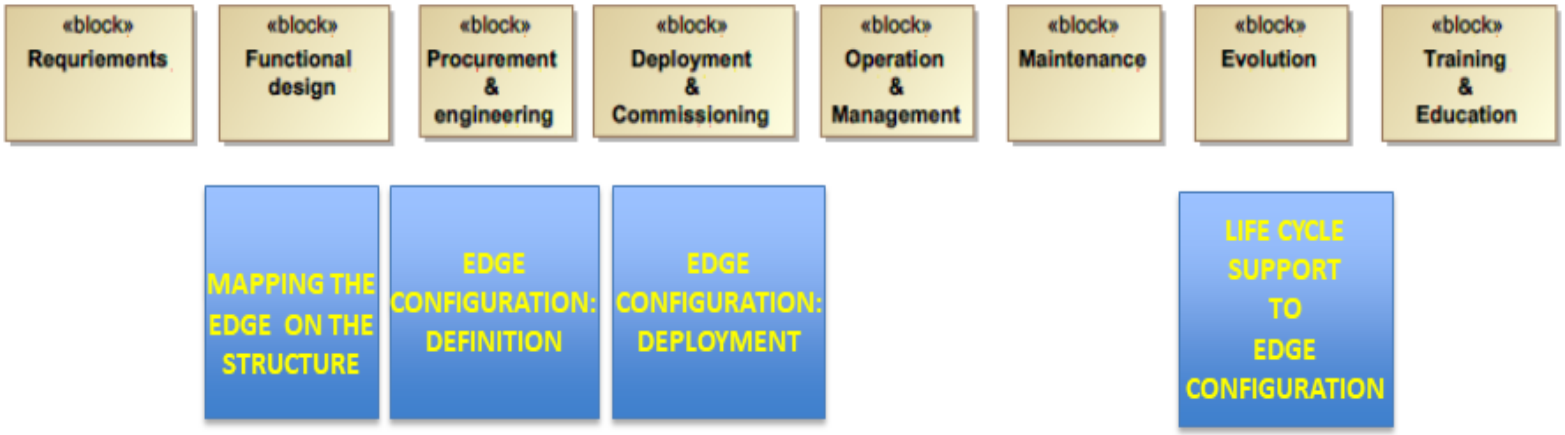
Helicopter view



Smooth merging of use cases targeting different domains



Tool chain

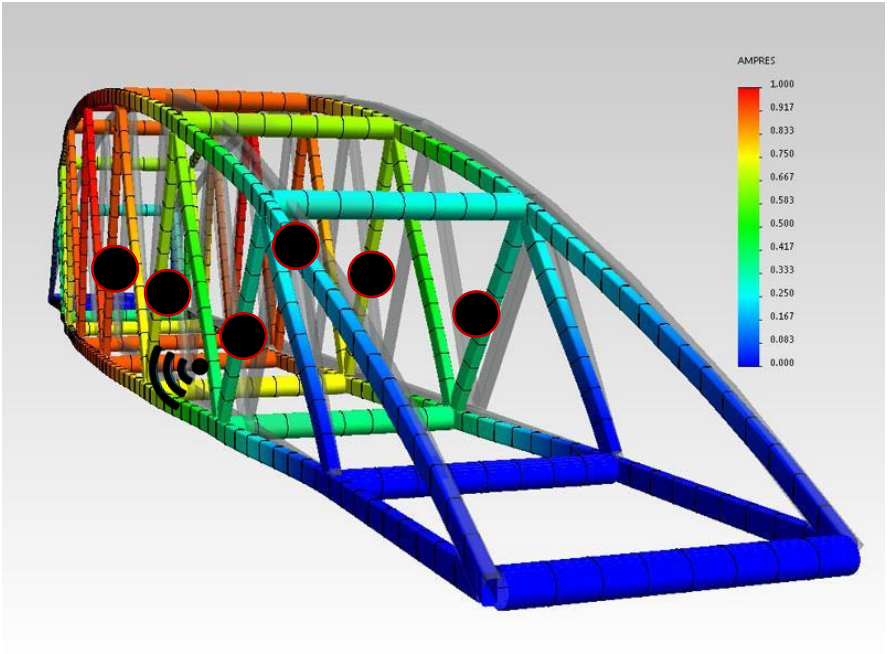


Interoperable data flow among the tools for sustainability

Design time tool

This tool maps the sensing infrastructure on the structure to be monitored

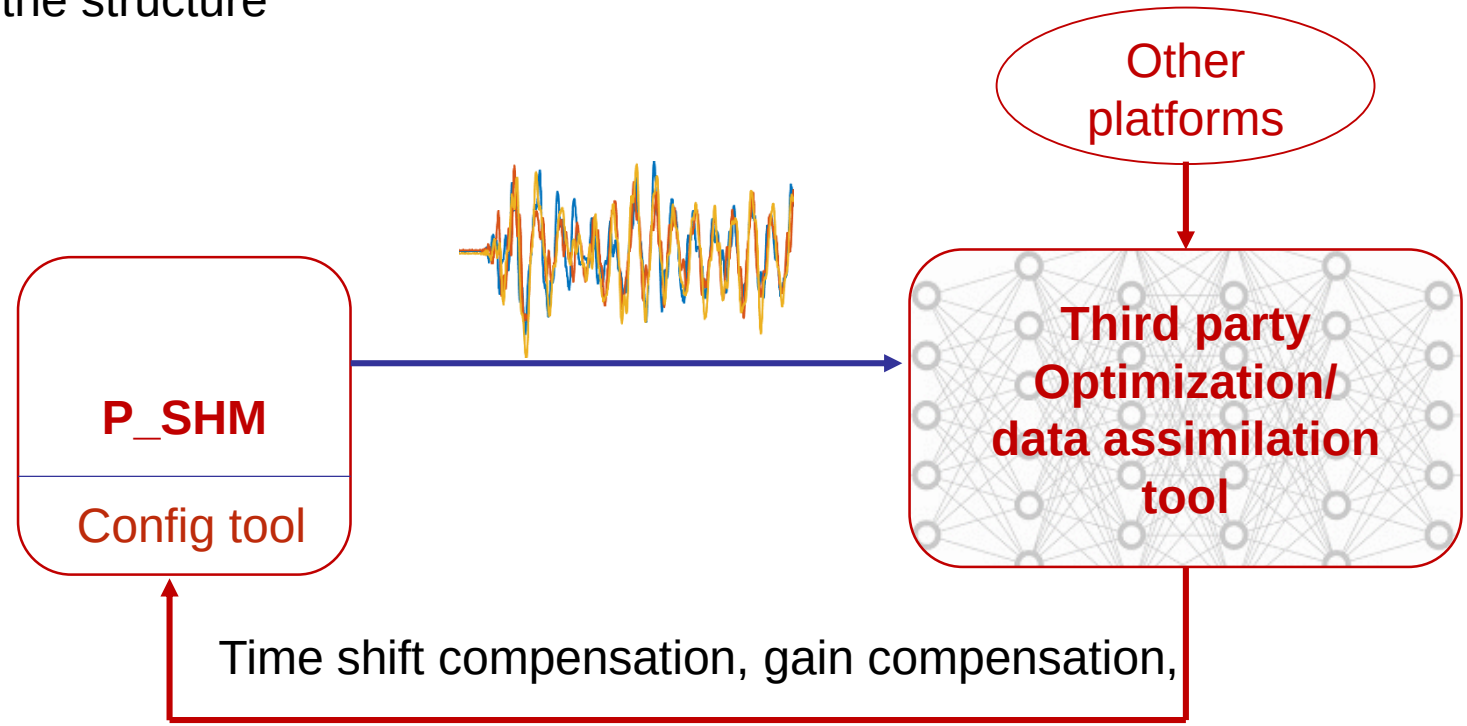
- Sensing infrastructure mapped onto the Structure
- Sensor position optimization
- Visual design tool



● Smart Sensor

Evolution time tool

The SHM system optimizes its performance on-the-go during the natural life-cycle of the structure



Conclusions

With its large european and calibrated partnership Arrowhead Tools aims to:

- Increase sustainability of digital applications
- Increase european competitiveness
- Create an additional lake of serendipity for innovation and new behaviours

This is the project expected contribution to the «European digital transformation»