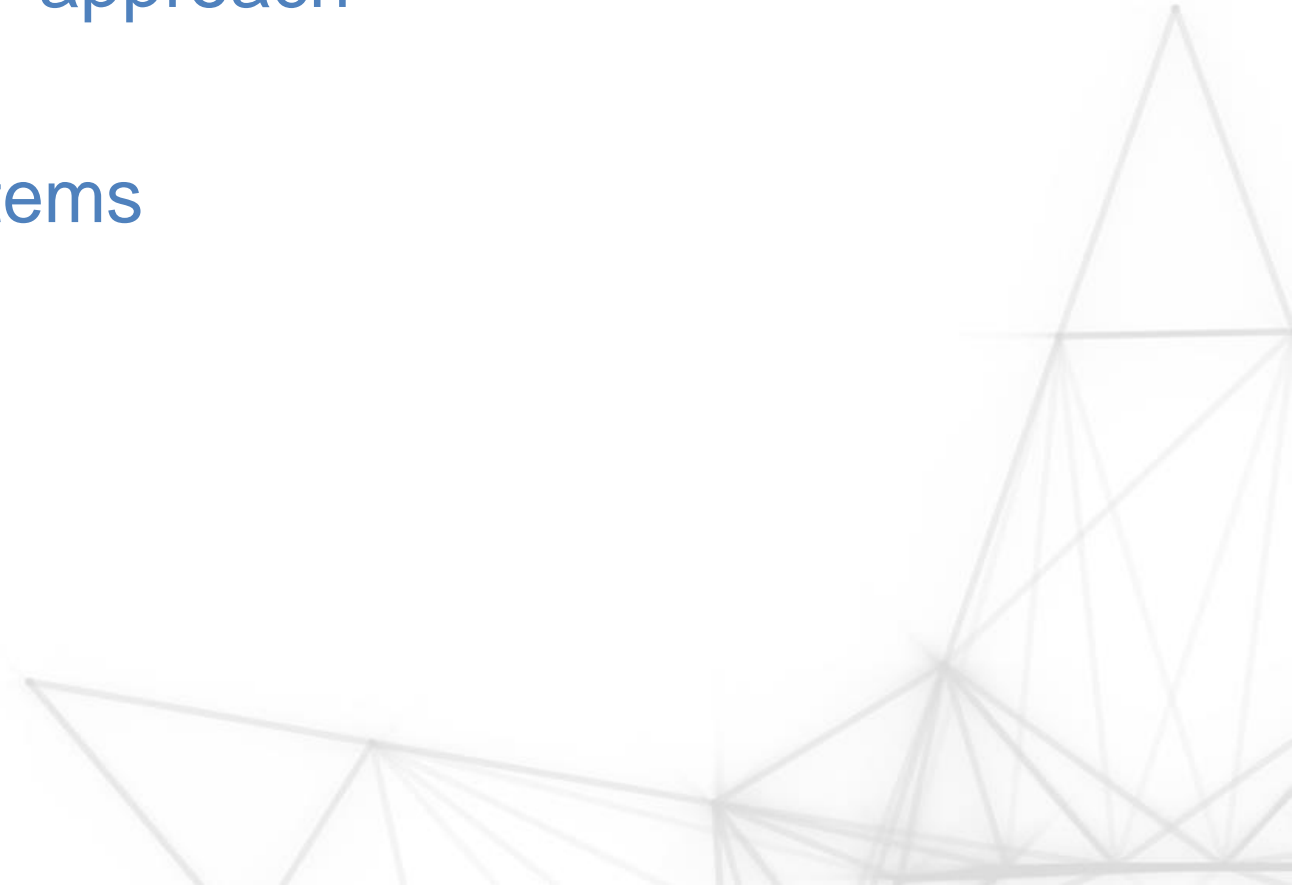


**37th Tango Community meeting**  
**Yves-Marie ABIVEN on behalf of the control team**



- SOLEIL Upgrade
- Control integrated in a global IT approach
- On going work on control systems
- Conclusion





# SOLEIL Upgrade

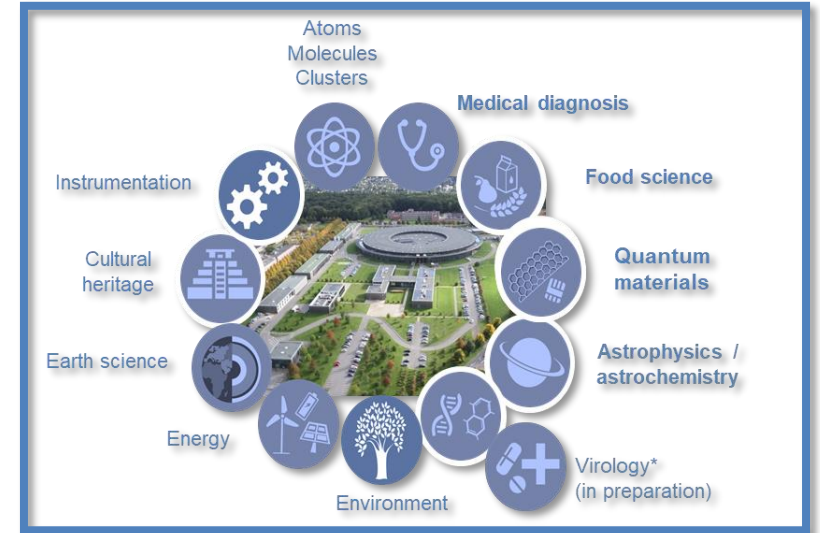


## UPGRADE

### • SOLEIL in a Nutshell



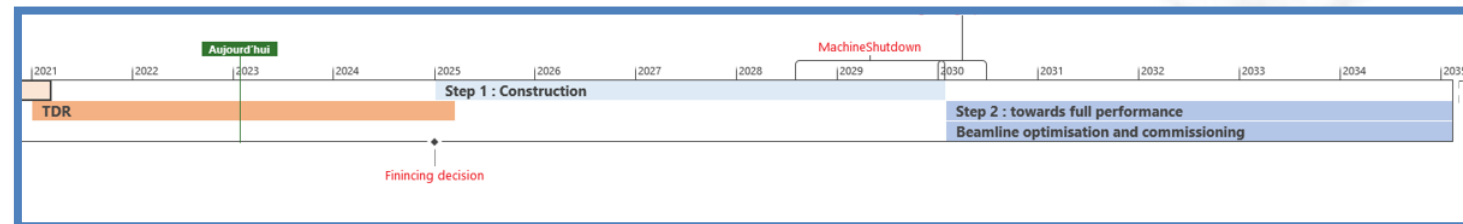
- Storage ring 354m, 2.75GeV
- 29 beamlines
- 9 orders of magnitude in energy from far IR to hard X-rays
- Open to external users in 2008
- ~ 450 staff members
- in 2022 :~ 2746 single users



### • SOLEIL II, Science Drivers

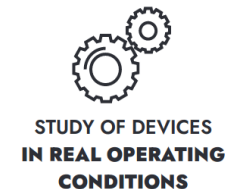
<p><b>Advanced Materials</b></p> <ul style="list-style-type: none"> <li>→ Quantum Materials</li> <li>→ Materials Engineering</li> </ul> <p><b>Qubits, Quantum Computer</b></p> <ul style="list-style-type: none"> <li>Unique combination of spectroscopic and structural techniques over an unsurpassed energy range –nm, &lt;mV, &lt;200 mK, &gt;10ps</li> </ul>	<p><b>Sustainable Energy</b></p> <ul style="list-style-type: none"> <li>→ Production</li> <li>→ Conversion and storage</li> <li>→ Environmental impact</li> </ul> <p><b>Batteries, Biomass conversion</b></p> <ul style="list-style-type: none"> <li>Spatial resolution (few nm), chemical state and physical properties evolution, in situ, operando</li> </ul>
<p><b>Health and Well-being</b></p> <ul style="list-style-type: none"> <li>→ (Re)Emerging pathogens in their environment</li> <li>→ Personalized Medicine, fight against cancer</li> </ul> <p><b>Multi-resistant bacteria, Aging</b></p> <ul style="list-style-type: none"> <li>Innovative procedures for multimodal investigations, living cells, tissues</li> <li>New access modes for clinical diagnosis</li> </ul>	<p><b>Earth and Environment</b></p> <ul style="list-style-type: none"> <li>→ Atmosphere</li> <li>→ Earth surface, oceans</li> <li>→ Lithosphere and solar system</li> </ul> <p><b>Global warming, Carbon cycle, pollutant transfers</b></p> <ul style="list-style-type: none"> <li>Multi-scale analysis of chemical speciation in complex systems, chemical sensitivity at high spatial resolution</li> </ul>

- Major upgrade of the accelerators and beamlines addresses new scientific and societal challenges.
- The upgrade will bring the unique range of SOLEIL techniques to unprecedented spatial and temporal resolutions.
- **Timeline**

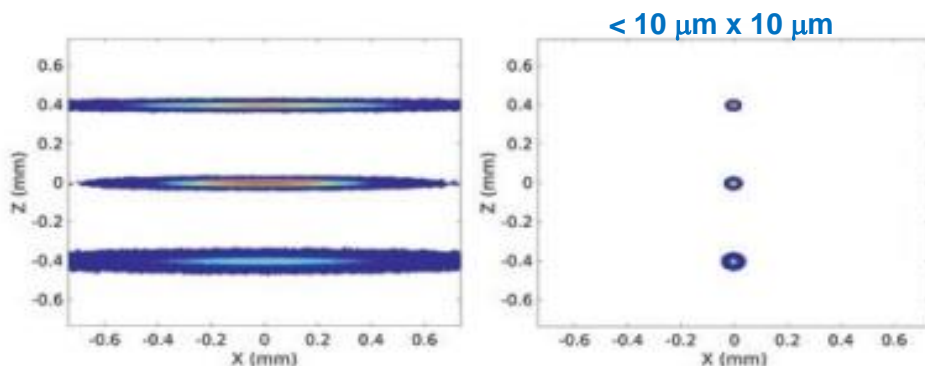


- Better performances for accelerator and photon sources:
  - Reaching an emittance **< 100 pm.rad.**
  - Keeping the same electron beam energy : **2.75 GeV**
  - Preserving a maximum current of **500 mA** in the multibench mode.

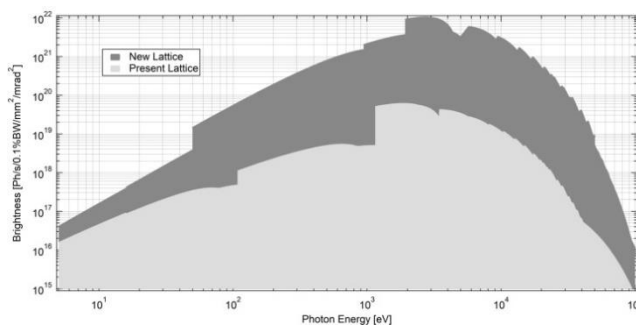
- New access mode with **more efficient use of the SOLEIL Beamlines**



## Beam SIZES

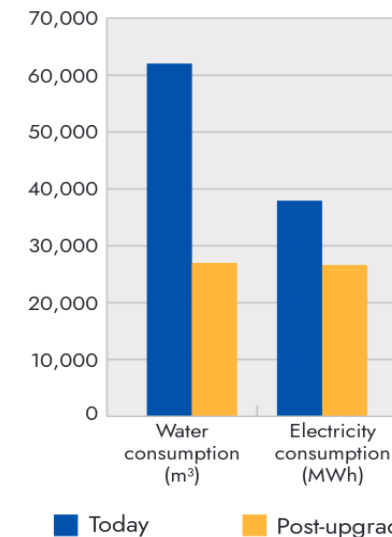


## Brightness



- Green infrastructure**

- Reduction in the facility environmental footprint.
- Lower power and water consumption.
- Reduce operational cost.



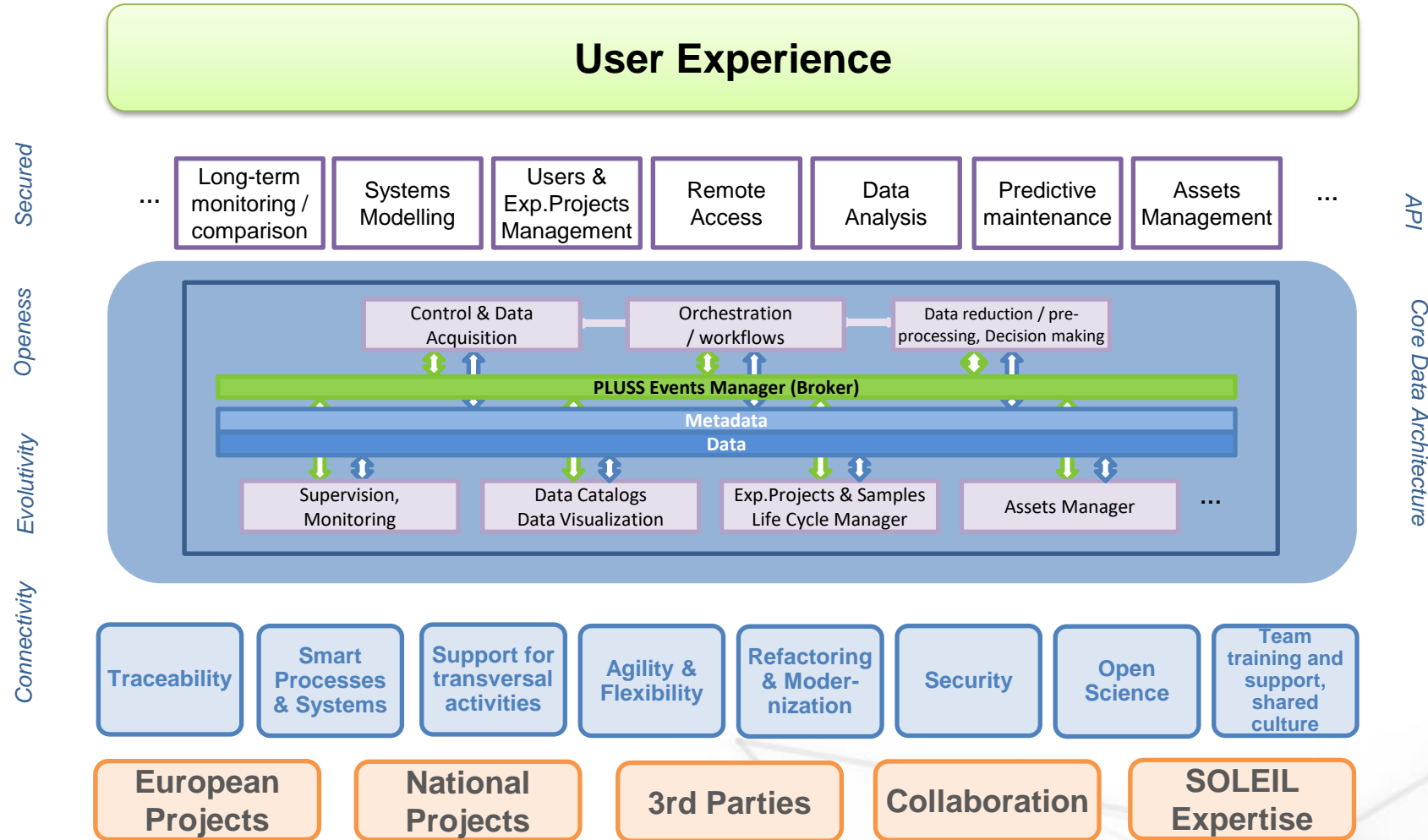


**Control integrated in a global IT approach**

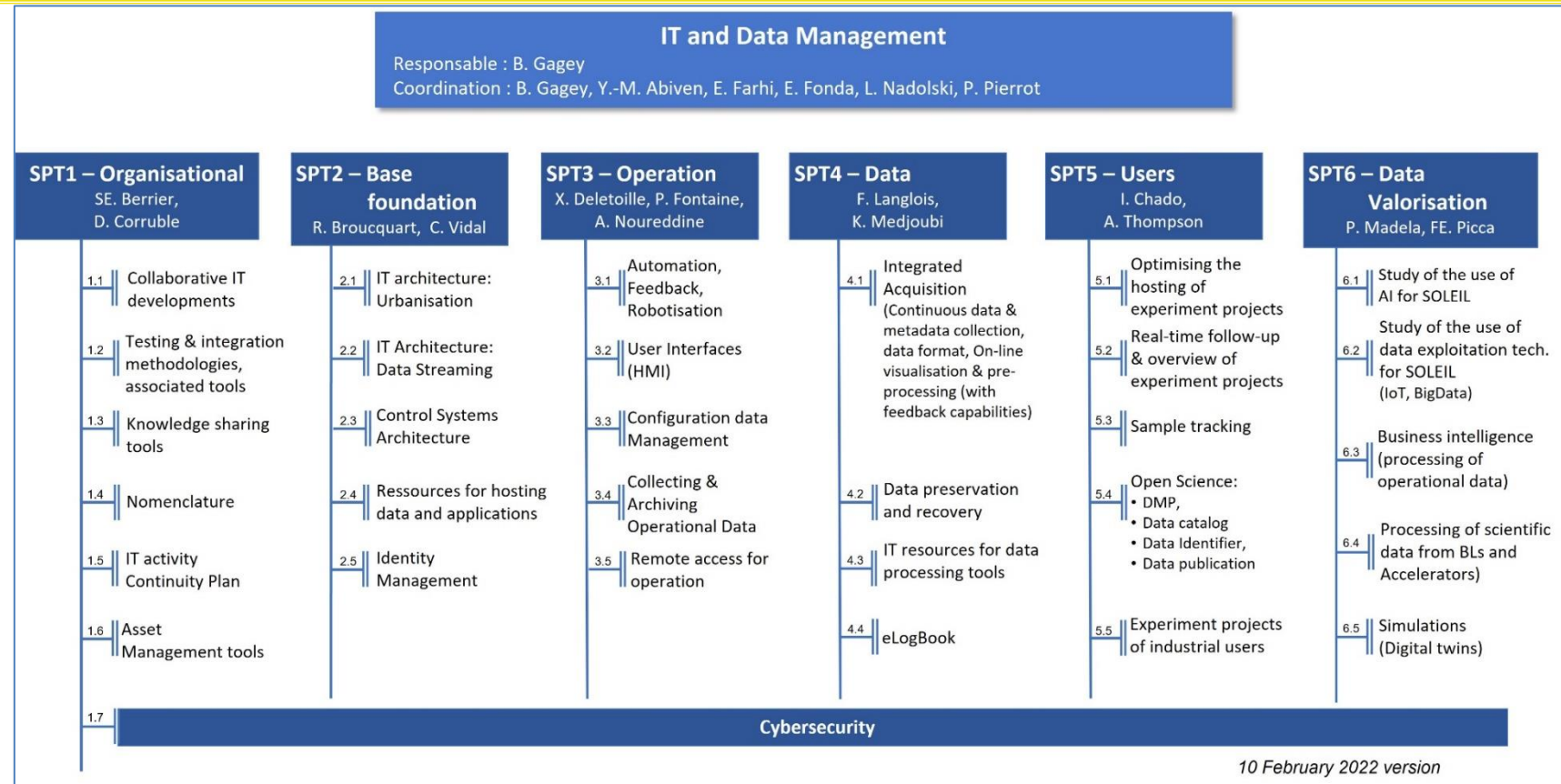


- To improve the user journey.

A Data-Driven approach



# TDR, IT and data management program

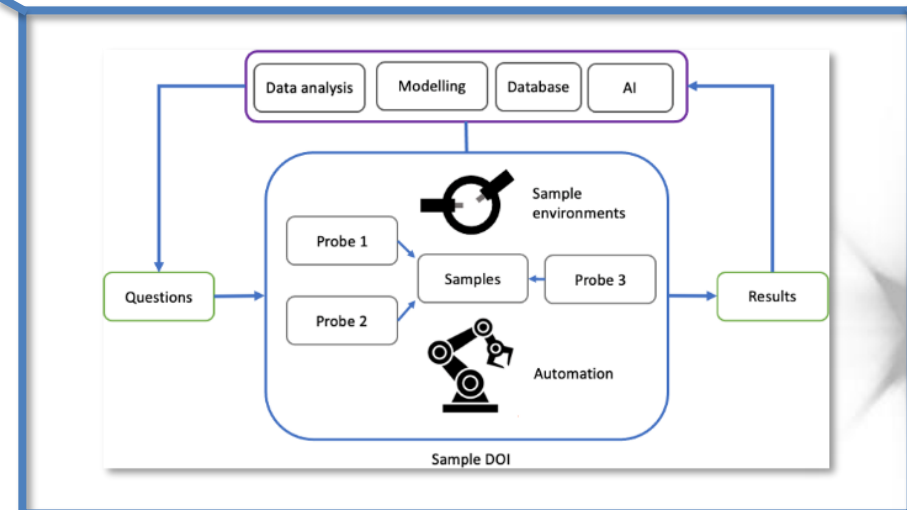
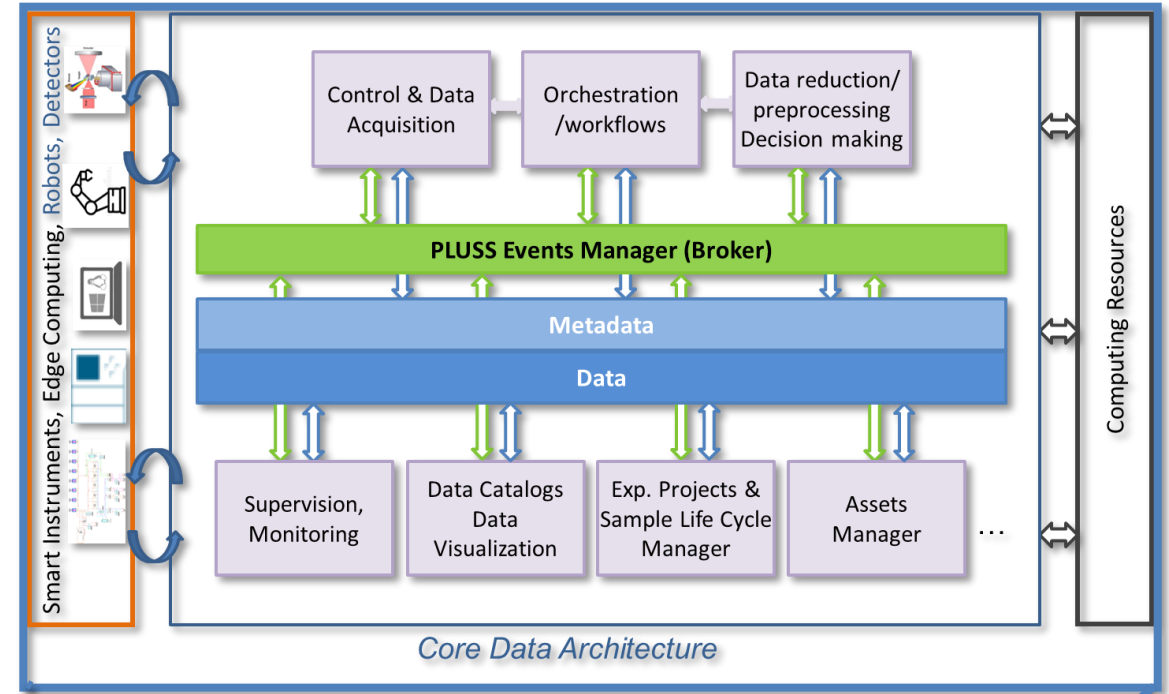


- Transvers program of SOLEIL upgrade to support accelerators and beamlines program
- Transversal cross-disciplinary organization involving accelerators, scientific and computing teams.
- Program manage by a steering committee which report to SOLEIL's board Directors.
- 6 workpackages lead by pair. 38 sub-tasks addressed to improve organisation, control architecture, future operation, Data acquisition, User experience improvement, New Data processing including AI.



# Towards integrated IT and data management infrastructure

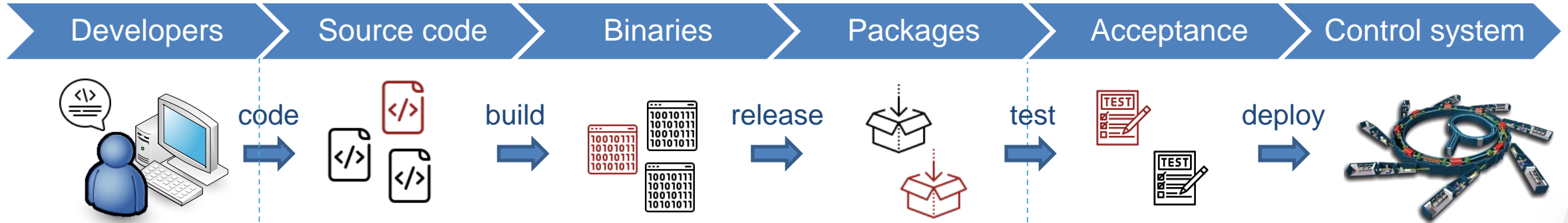
- Automated data management process
- Automated and integrated pipeline between control-acquisition and data processing
- Towards autonomous system



# On going work on control systems

Sampling of diverse work in progress ...





## 2 Software factories



### C++

- 466 projects
- 3 packages

### Java

- 76 projects
- 16 packages



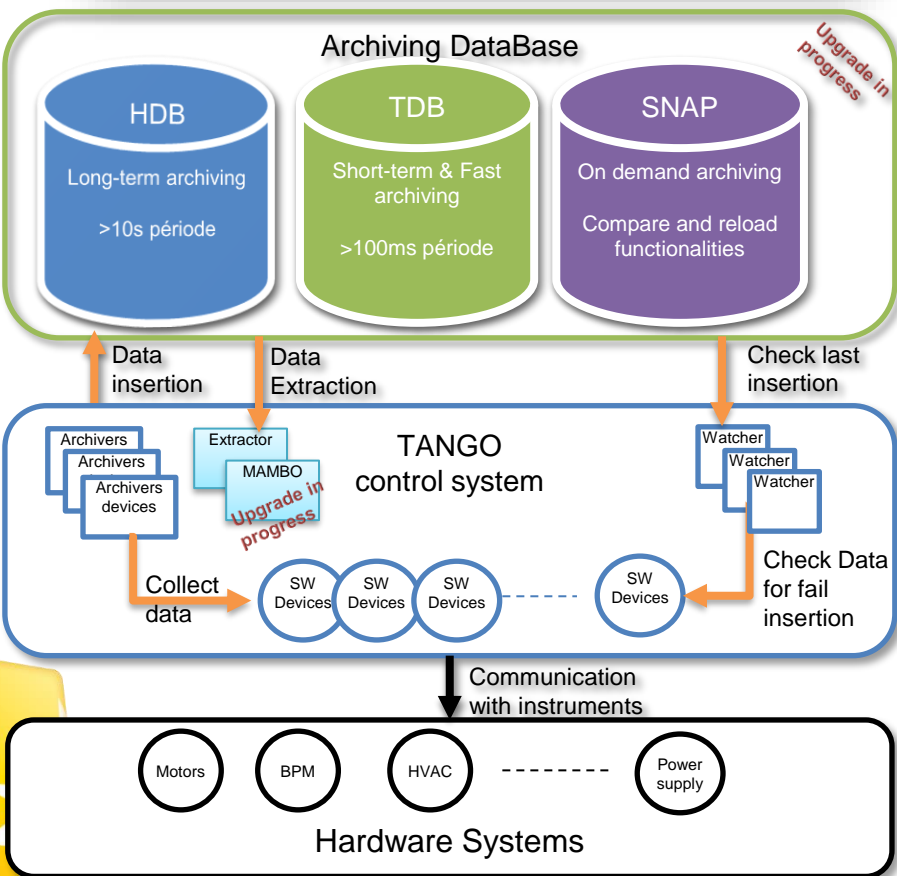
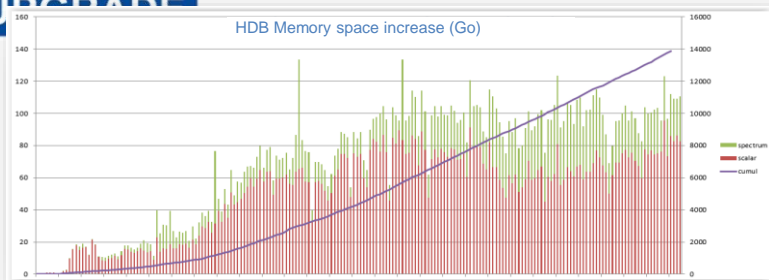
### Short term

- Replace **Maven** by **Conan** for C++
- Migrate to **64-bits** binaries as standard for C++
- Support of **C++11 and above**
- Migrate to **latest LTS OpenJDK** (OpenJDK 11 and 17)
- Include **code analysis tools** and **testing tools**
- Update software factory components

### Future

- Support of **future platforms** and **newest standards**
- Extend CI/CD to other developments: **python, embedded software**
- More automation in **deployments**

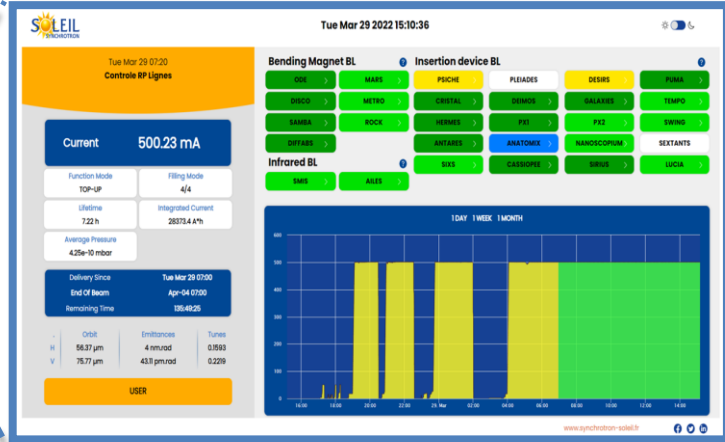
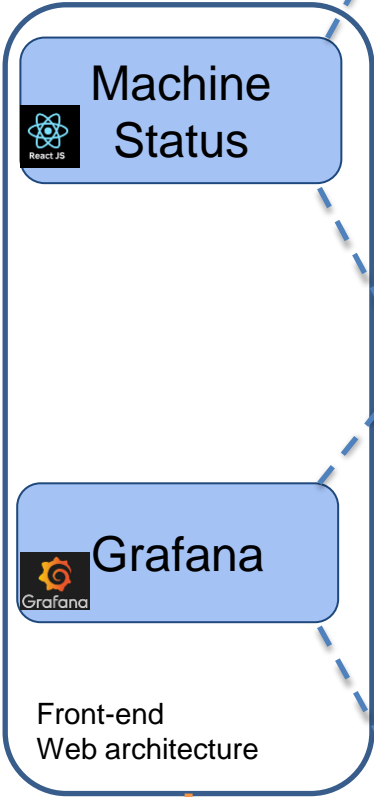
See detailed presentation during Tango Meeting



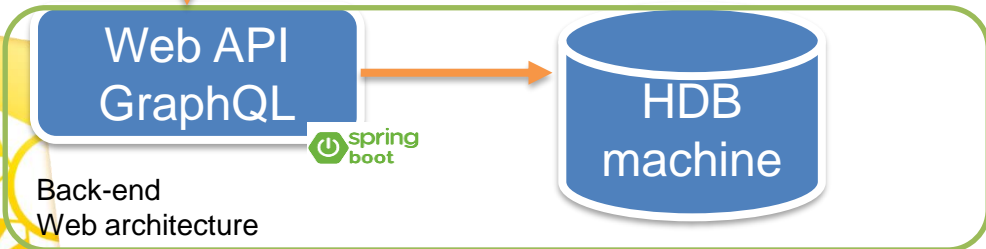
- Improving Database (DB) management towards SOLEIL II
  - **Maintaining** the existing Archiving System **operational**
  - Managing its **obsolescence** (architecture, Java Swing) & will to **get rid of Oracle DB**
- Expected on accelerators for SOLEIL II
  - **10 times more data, 10 times faster collection**
  - **Longer term data retention**
  - Main sources of data: BPMs, BLMs, power supplies, post-mortem systems, Feedback Systems, 2D images, pulsed magnet signals
- Ongoing work

MOC	<ul style="list-style-type: none"> <li>• Managing servers end of life, end of Oracle licenses renewal, optimized and improved archiving monitoring and maintenance of TANGO devices</li> </ul>
R&D	<ul style="list-style-type: none"> <li>➔ To update HDB /TDB with timeseries DB including new web architectures for operation.</li> <li>• Timescale (timeseries extension for PostgreSQL) tested and chosen after sharing experience with ESRF and others.</li> <li>• Knowledge developed ; Tests on the Accelerators have allowed to validate the choice before extending implementation.</li> <li>• Implementation in progress</li> </ul>

UPGRADE



Dashboard for insertion device monitoring



## ➤ Ongoing work

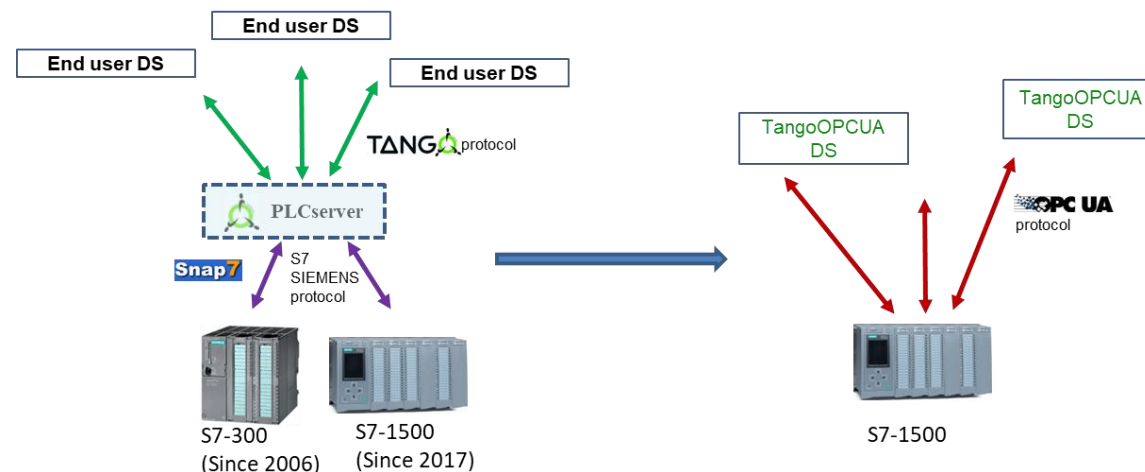
- Survey to refine requirements
- Mapping existing tools
- **Prototyping WEB-based architecture on top of Archiving System**
  - Microservice: API GraphQL to extract data
  - Grafana
  - WEB technology Framework React.JS for web HMI
- Successful tests with great interest from accelerators teams
- Packaging in progress for an operational implementation
- Studies to include security management, high-availability operation and microservice architecture



OPCUA more and more available with number of hardware and industrial software

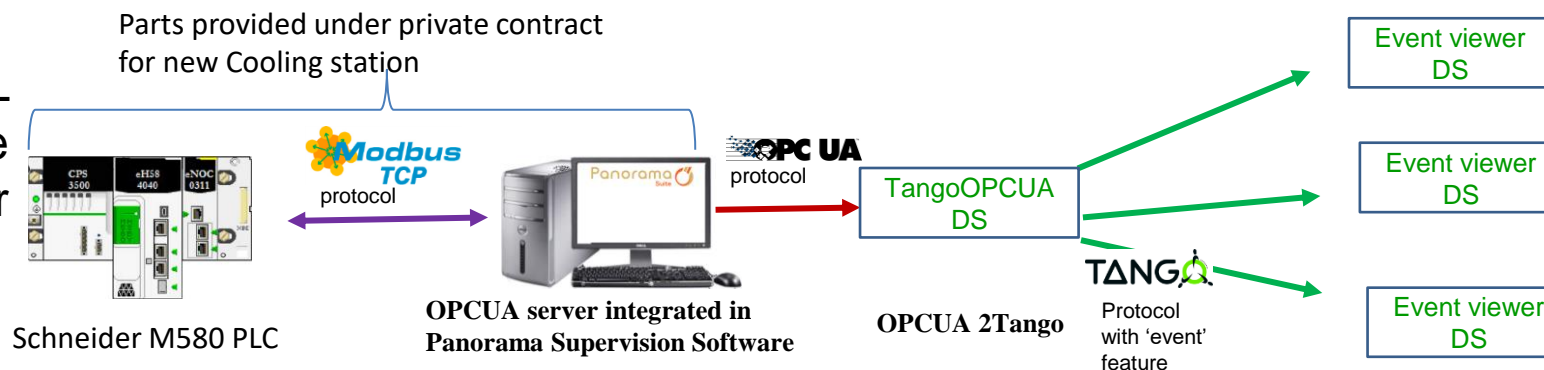
❑ Case 1: PLC with embedded OPCUA Server

- OPCUA protocol replaces 'PLCServer' and PLC protocols
- Unique device server OPCUA



❑ Case 2: distribute data from a third-party software

- Current use case at SOLEIL regarding the upgrade of the cooling station (Honeywell or PANORAMA Supervision)



Will be detailed during next ICALEPCS

This standardization defines a robotic standard (6 axis robot arms) on both hardware and software.

## Hardware



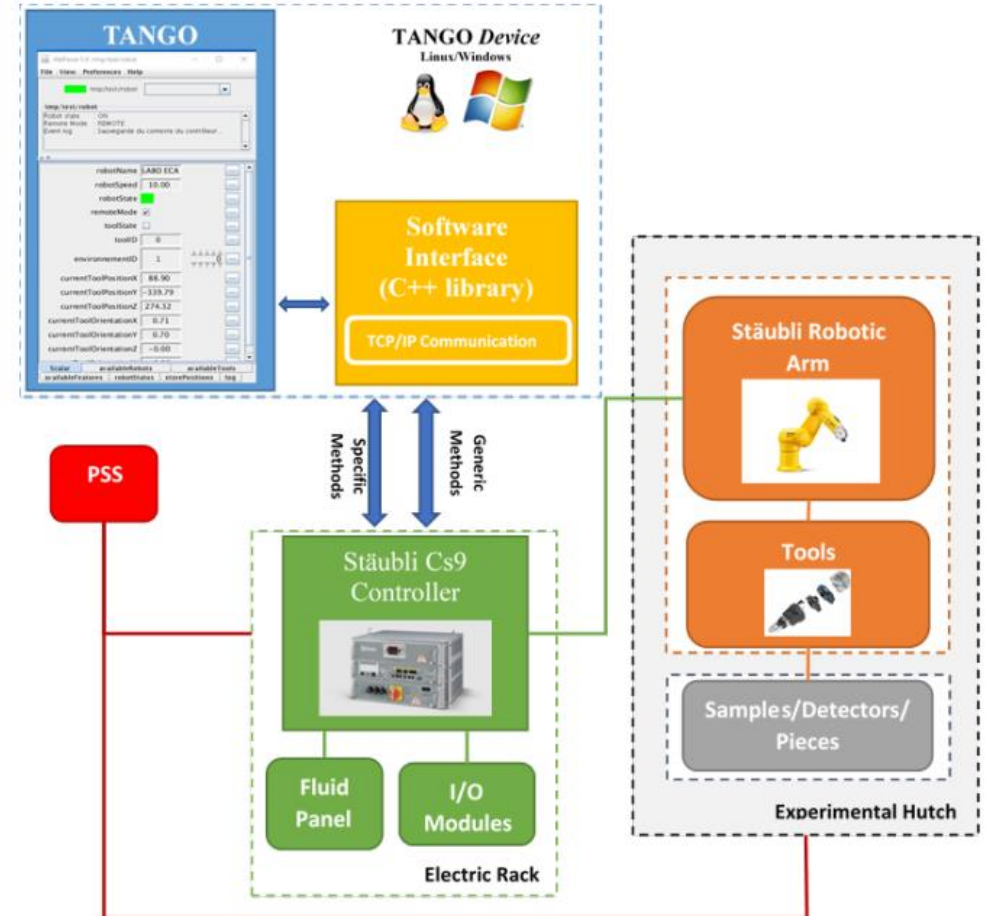
Brand: Stäubli

Controller: Cs9

## Software



- C++ Library
  - Link between the Cs9 controller and Tango
- Generic Methods:
  - Genetic attributes and commands
- Specific Methods
  - Application-specific tasks.



A robot to **automate the 3D positioning of a detector** without human intervention inside the hutch.



Stäubli TX2-160 Robot



Motorized Translation



Detector Tool:

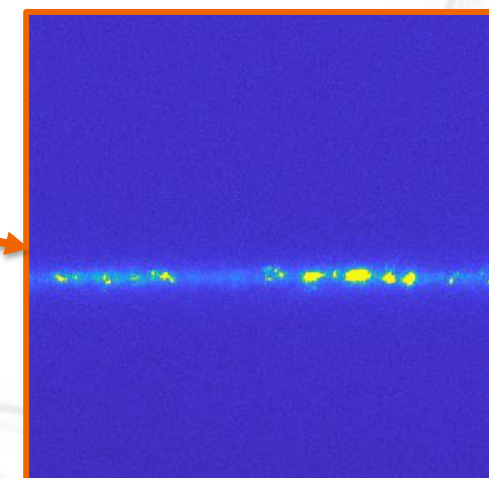
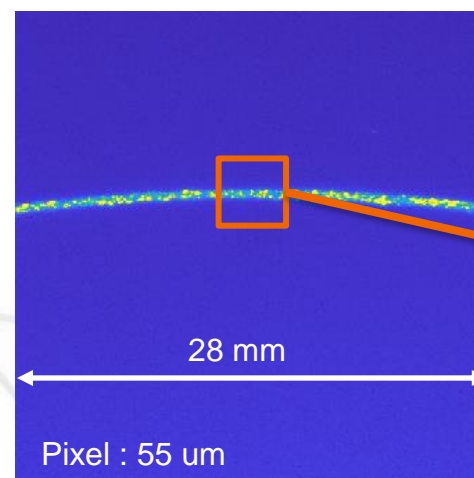
- Merlin Detector
- Safe collision sensor
- Pneumatic rotation

- The distance of the detector to the sample ranges from 50 cm to 555 cm.
- The maximum value that the detector can move once it is in the desired position is  $\leq 0.01$  mm over a period of **48 hours** !.
- **Nowadays** the **accuracy** of the detector in the whole robot workspace ranges from  $\pm 0.18$  to  $\pm 0.26$  mm in cartesian position and  $\pm 0.5^\circ$  in angular position.

### Scanning X-ray Diffraction Microscopy

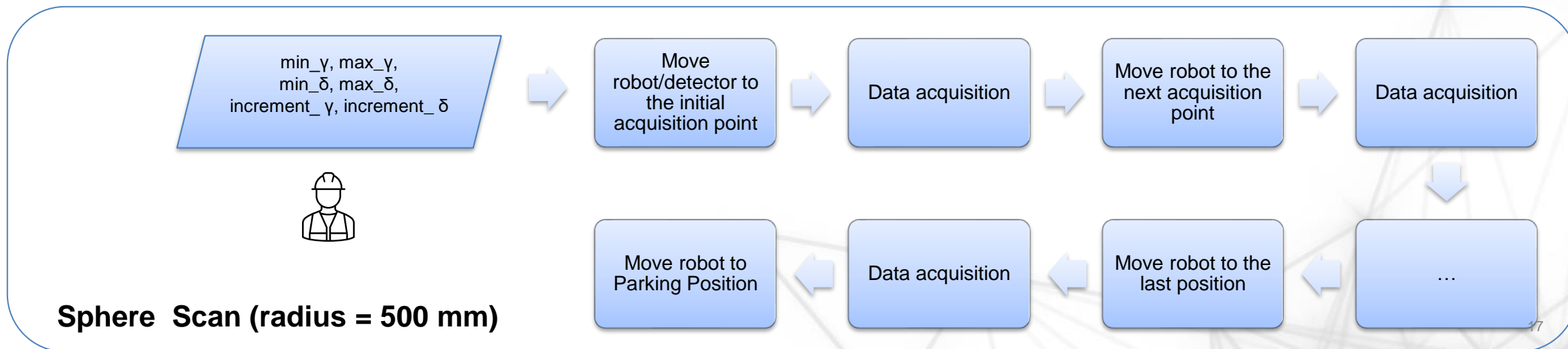
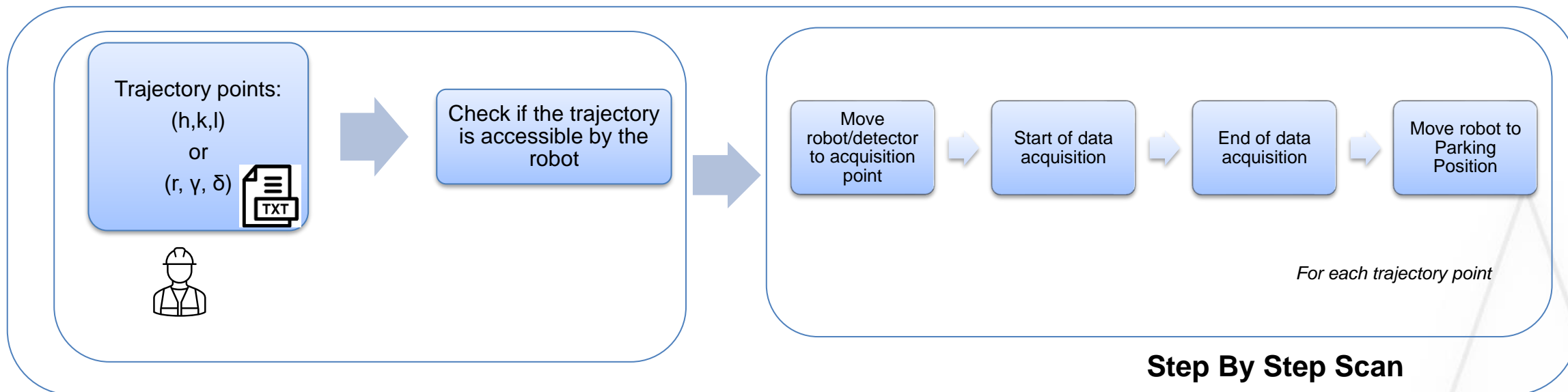
det—sample distance : 500 mm

det—sample distance : 3700 mm

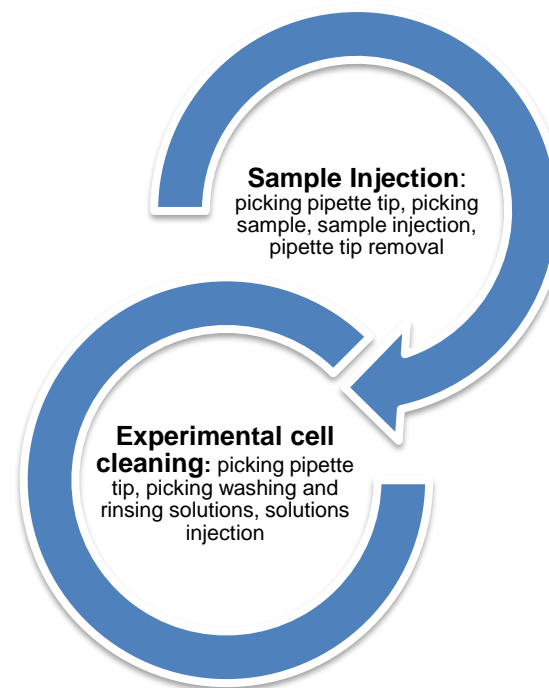
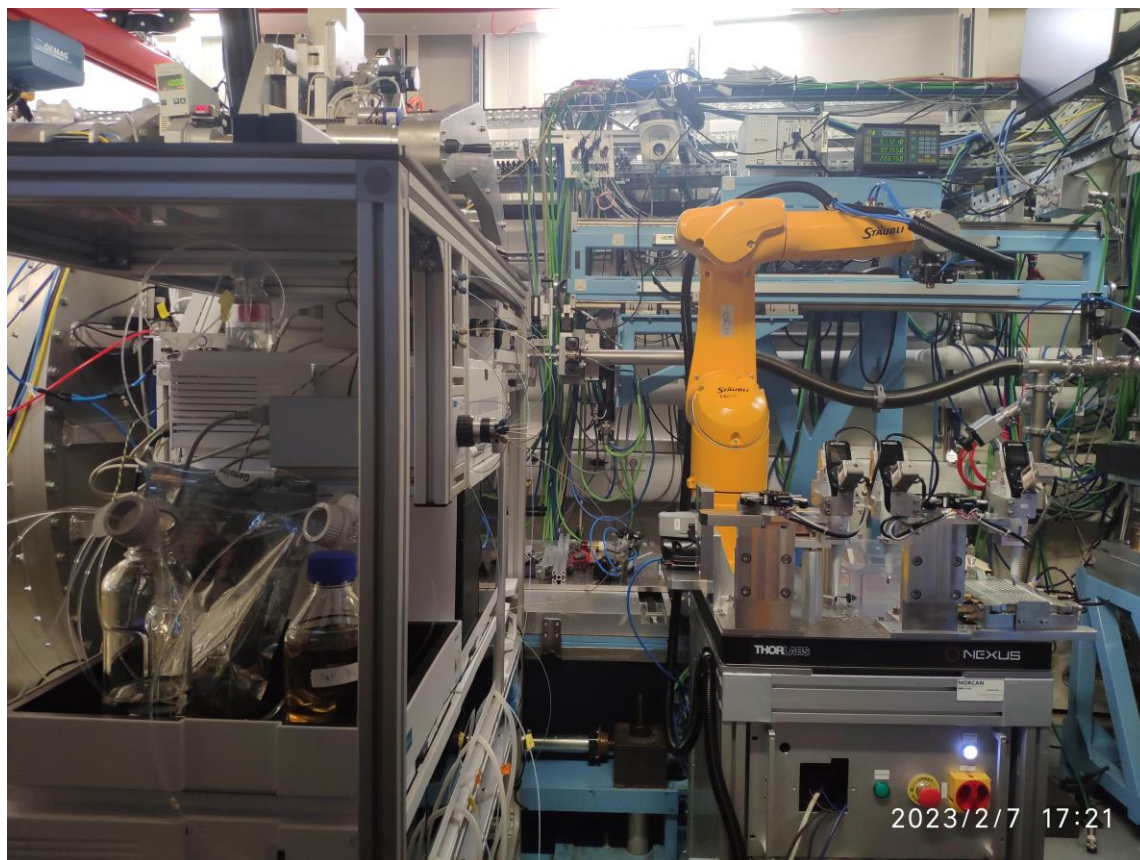


Under commissioning!

## Two modes of scan:







- ✓ Automatic switch from 6 axes robot to HPLC\* system.
- ✓ Up to 384 samples.
- ✓ Robot cycle time for the whole process: 1 min targeted.
- ✓ Commercial off-the-shelf programmable pipettes.
- ✓ Camera and laser to measure the position of the experimental measurement cell.
- ✓ Automatic tool changer between the sample pipette tool, the cleaning tool and the HPLC system tool.

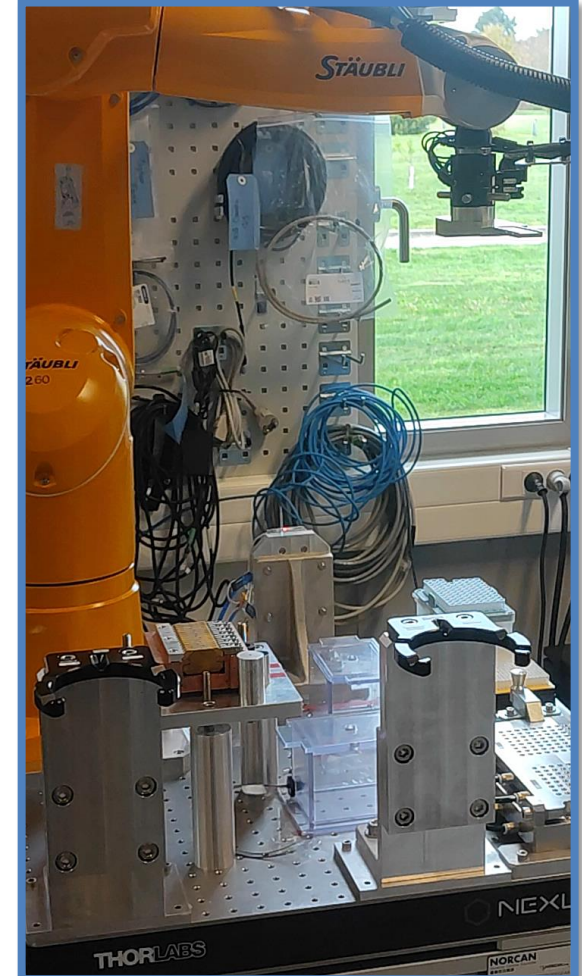
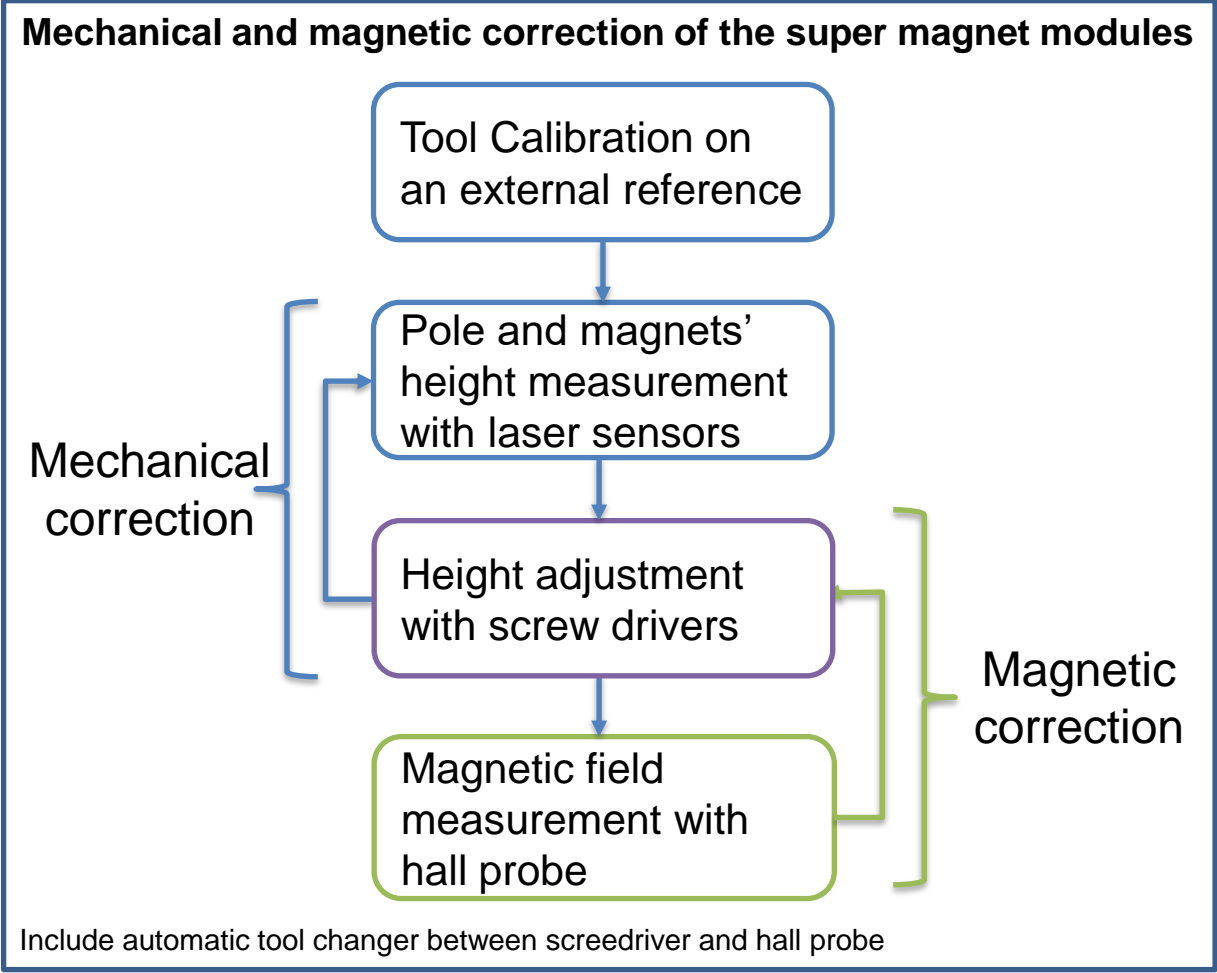
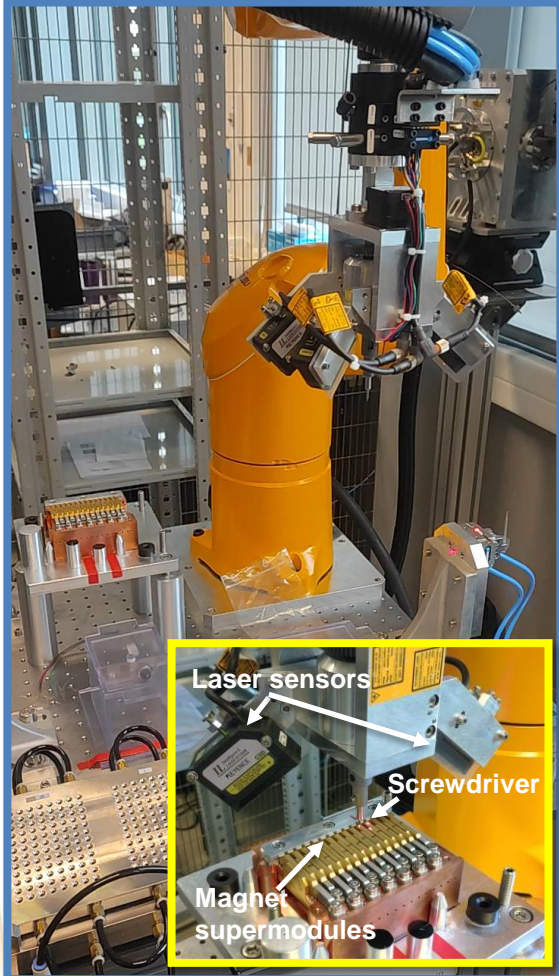
Under development !



- **Robotisation:** part of a roadmap for machine and beamlines. Based on STAUBLI robots standardized in 2019
- **Included in global automation strategy** under development in IT and Data management program
- **Measurement bench complementary from the one developed in 2021**

Control and insertion Teams

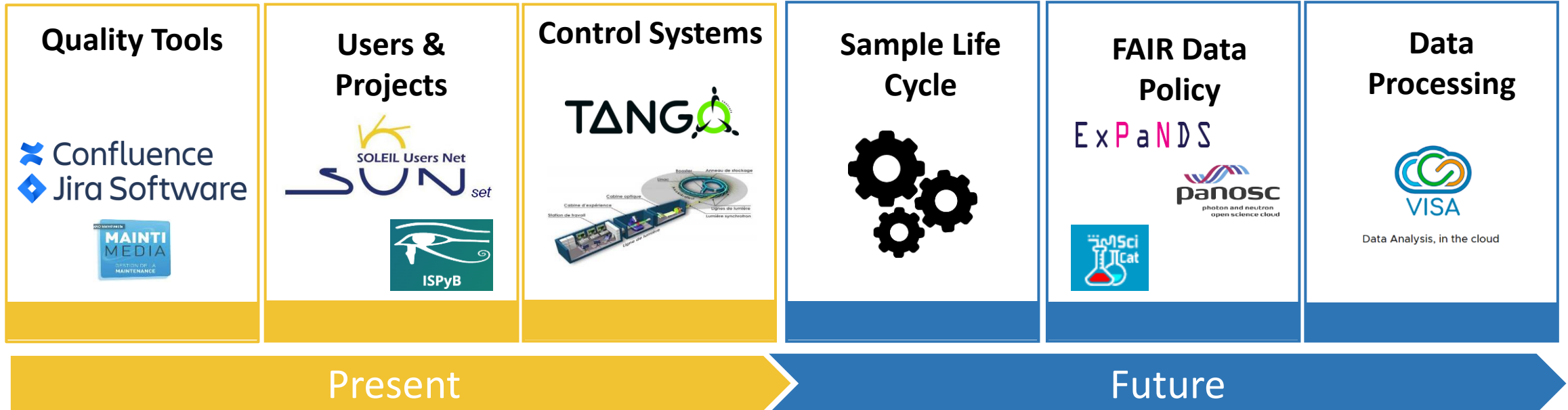
Under development!



**conclusion**



# Continuous Digital Transformation :A more complex IT future

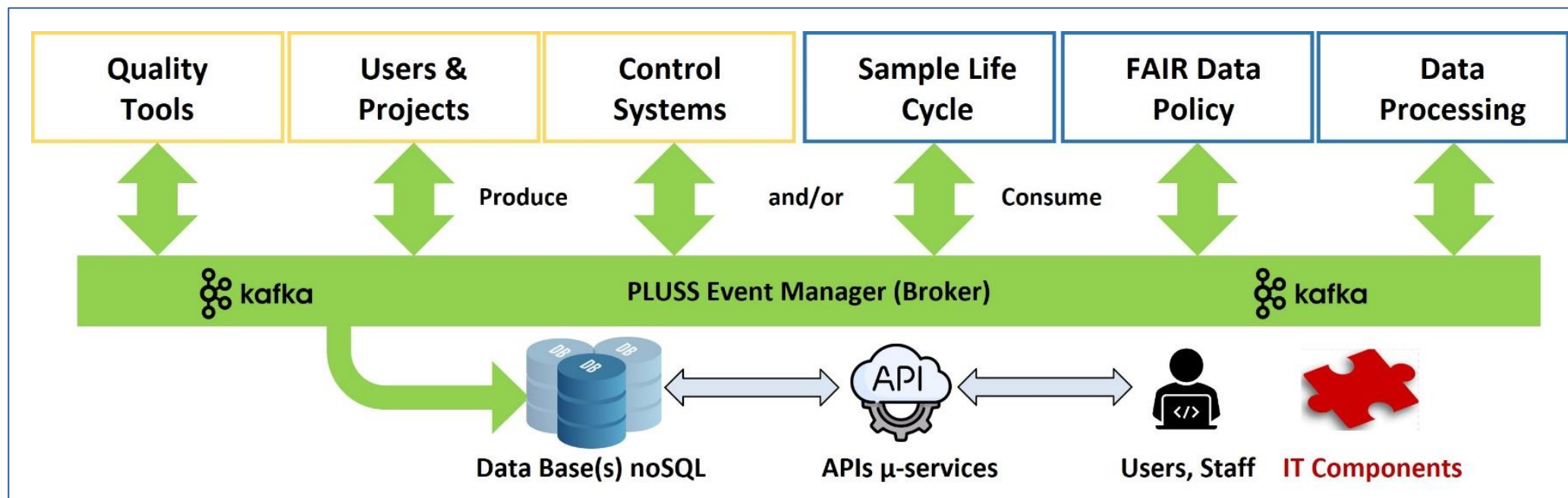


- *Heterogeneous*
- *Siloed solutions*

- *Cross-functional processes*
- *Digital everywhere*

## UPGRADE

**PLUSS Project : Federating the IT systems by "standardizing" exchanges, taking into account the existing solutions and making easier the integration of new services**



→ End of 2022, 1<sup>st</sup> implementation for exchanges between Incident Management Tool (JIRA) and CMMS (MAINTIMEDIA)

→ 2023 :

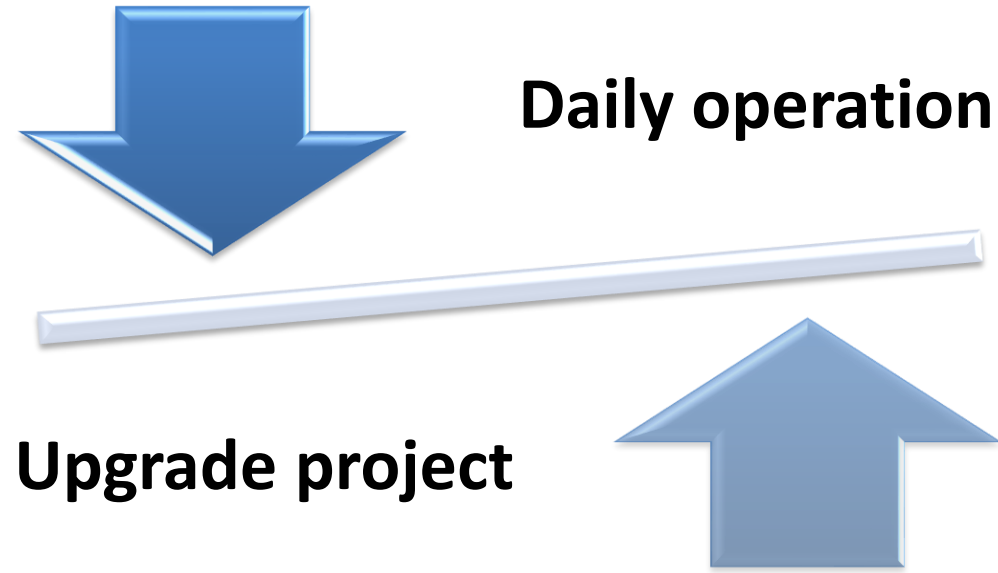
- ✓ Sample Lifecycle: specifications in progress considering outputs of Digital LEAPS/STARS project
- ✓ Data Catalog: SciCat integration to PLUS

Will be detailed during next ICALEPCS



- Accelerators program
  - FOFB upgrade ongoing (Based on ChimeraTK from DESY MSK team)
  - Power supplies control based on FGC from CERN
  - On going discussion to identify new requirements
- Infrastructure program
  - GTC of the new cooling station on going
  - Beginning of Dismantling discussions
- Next steps – Evaluation, Development or improvement -
  - Taurus considered for HIM
  - Tools to enhance automation in the data-driven strategy.
  - Integrate control system in the microservice strategy.
  - Improve Systems and data interoperability.
  - Application using advanced technology for control and operational business.





**Architecture and technology Transformation**

**complexity/reliability/maintenability**

**Collaboration**  
**Strong community**



Thank you !

