



CERN: Going Digital with

Asset Lifecycle Management using HxGN

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CERN, Engineering Information Management

What is CERN?

CERN is the world's largest research center for particle physics.

Our mission is to provide scientists with tools to study the building blocks of matter and the origins of the universe.

How: By building and operating huge particle accelerators.

23

Member States

>10k

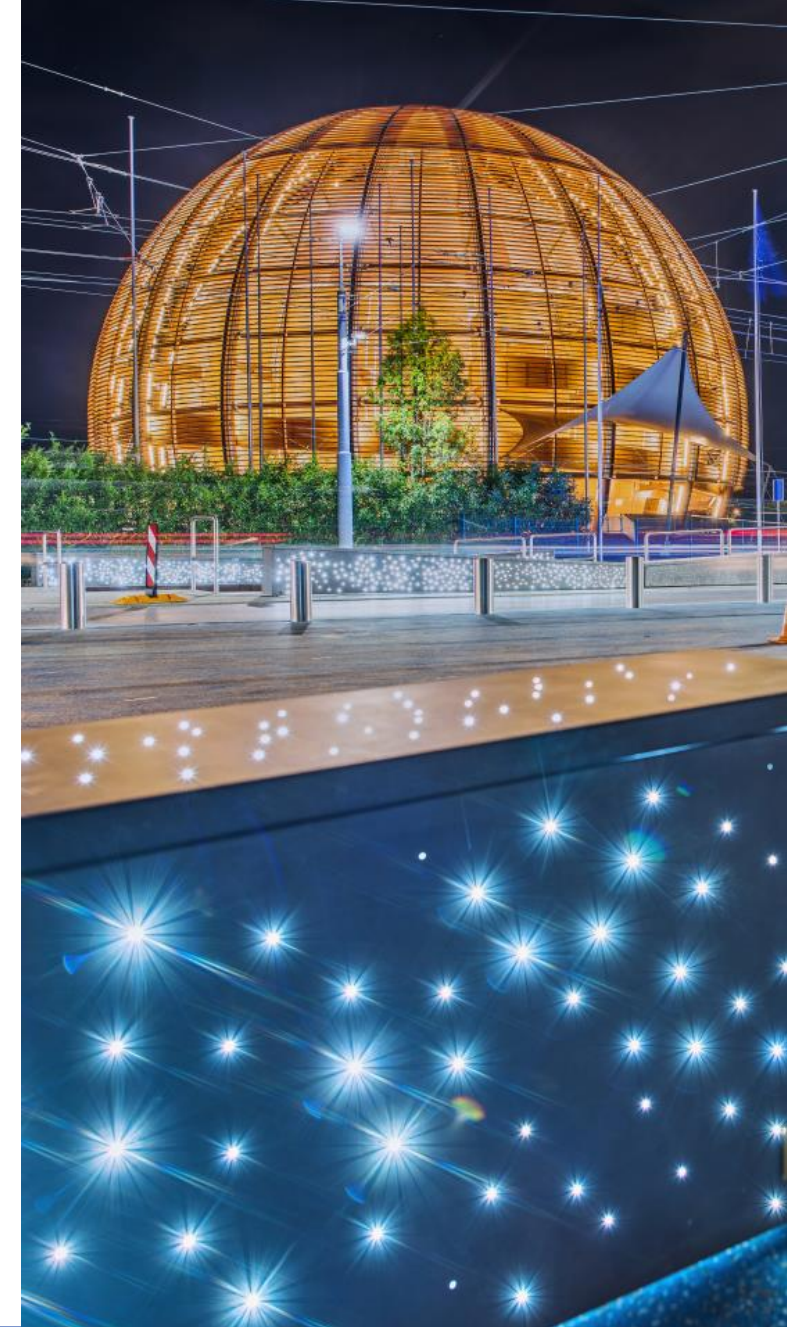
People On-site

>80

Collaborating Countries

1.4 bn

CHF Annual Budget



The LHC

The Large Hadron Collider:

- Located outside Geneva, Switzerland.
- 100 million components
- 27 km circular tunnel
- 100 m below ground
- Speed of particles:
 - 99.999999% of speed of light
 - 11,000 revolutions / second





Asset Management at CERN



HxGN EAM at CERN in 2024



3.2 M
Equipment

1.8 M Assets
1.2 M Positions
0.2 M Systems

4.6 k Classes
33 k Categories



2.3 M
Document links



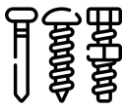
350 k
Work Orders
/ Year



1 M
Checklist Items
/ Year



3600
Annual Users



100 k
Part References



150 k
Store Transactions
/ Year



0
Customizations

Data: The key to “Going Digital”

- Digital Twins, Digital Realities, AR and AI will never unlock their full potential without managed quality data.
- Understand and focus on your **data**:
 - Data Capture
 - Data Quality
 - Data Formats
 - Data linked across systems.
 - Data managed over time.
- With large, complex and expensive assets with long lifecycles, a data focus is not just important - it is a must!
- Our installations are often designed and built by one generation of scientists and used by the next.



Complex Assets with long lifecycles

Key questions we ask ourselves for data in our asset lifecycles:

- **What** to capture: What is needed now and what is needed later?
- **How** to capture: Can mobile devices be used? Can SCADA or IoT automate processes?
- **Which** format to use: How can data be explored, linked and a natural part in handovers between phases?

← 50+ years →

Specification & Requirements

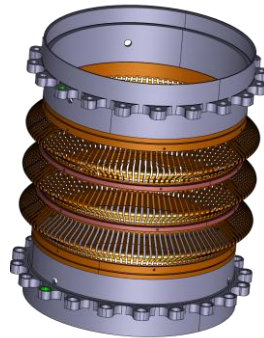
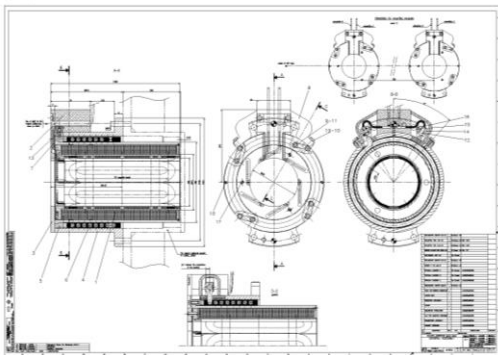
Design

Manufacturing

Installation & Commissioning

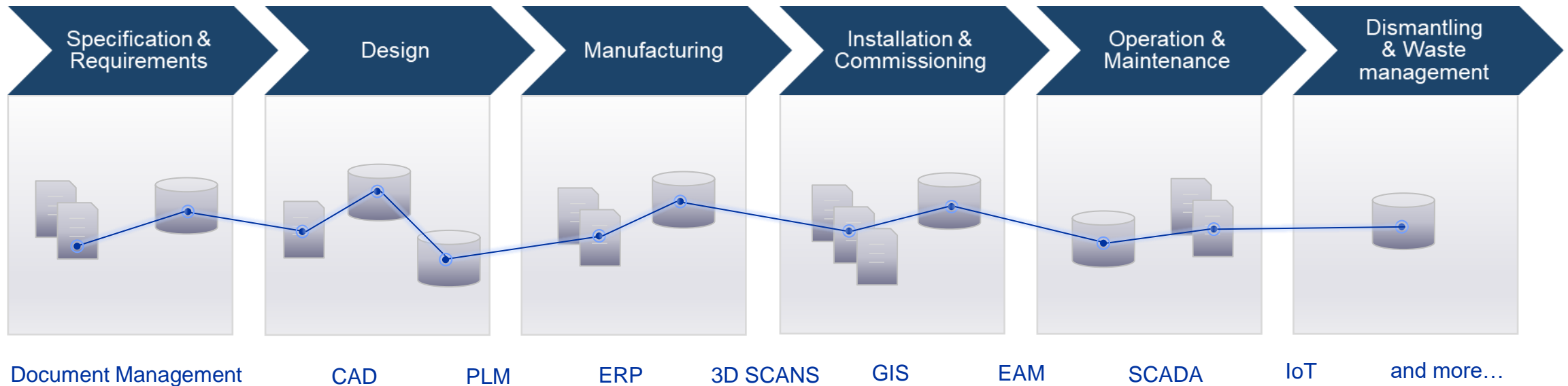
Operation & Maintenance

Dismantling & Waste management



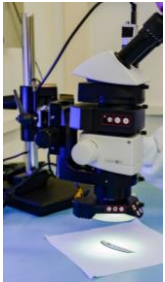
Managing the Digital Thread

- A managed Digital Thread of asset and engineering data, across systems and lifecycle phases, opens many possibilities:
 - Data analysis and correlation of trends or problems previously not possible.
 - Visualizations and simulations and compound data sets.
 - Systematic and automated feedback-loops of data.
 - **The combined, and properly linked, data is worth much more than just the sum of it.**



Examples of Hexagon technology used

Leica
Microscopes



Leitz Infinity



Hexagon
Absolute Arm 85



Leica AT960



Leica RTC 360 Leica BLK 360



BricsCAD



Leica T-Probe III



Spatial Analyzer



Leica
Truview

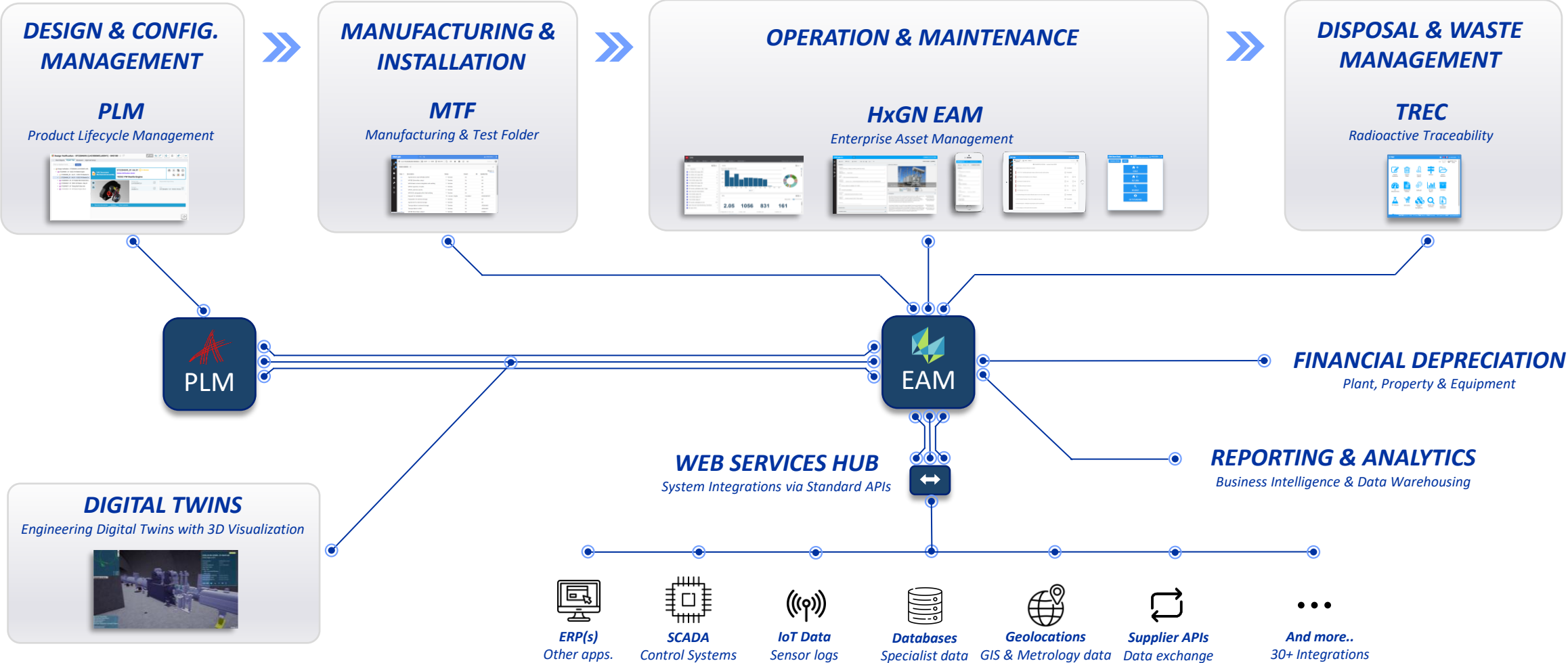


Cyclone
360



HxGN EAM

Our Digital Asset Management Platform

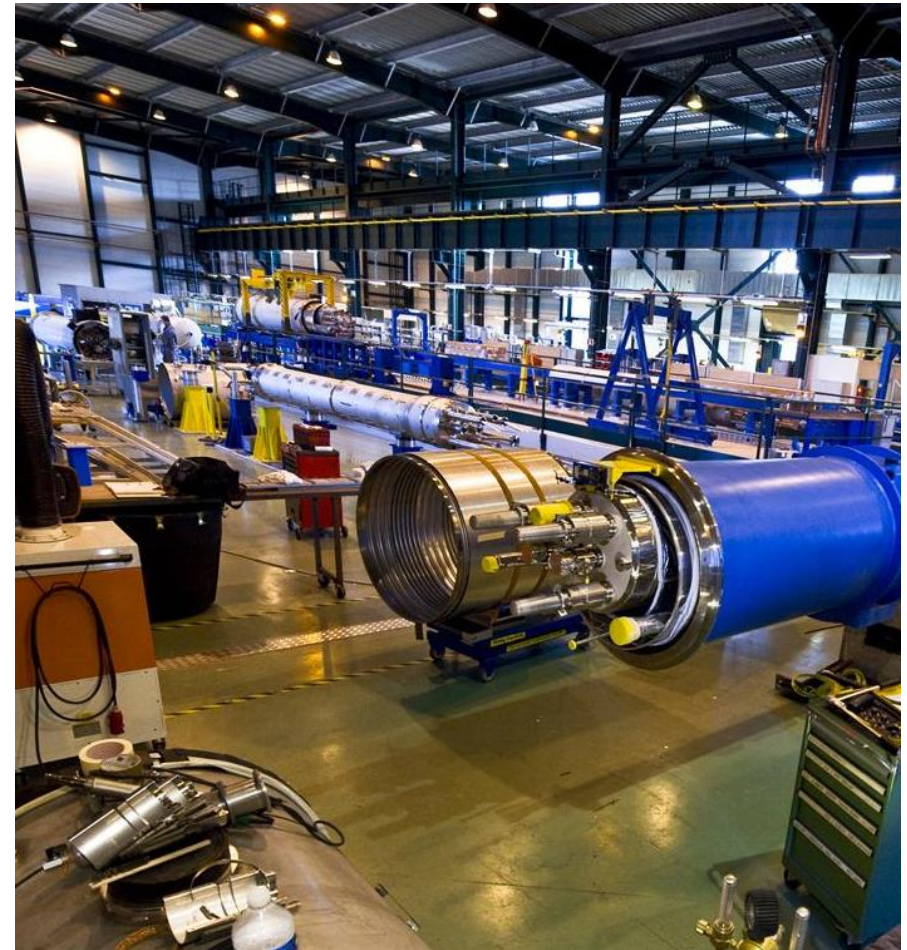


Manufacturing & Testing: EAM on the shop floor

- Manufactured Assets are registered and labelled on the shop floor. (At CERN or at manufacturer.)
- Data is mainly registered using mobile devices and kiosks, but also via Excel imports.
- Progress of activities is tracked with EAM and followed-up with reports and large information screens.

Examples of EAM functionality used:

- **Equipment Configurations** (templates) to register Assets with structures and links to design data in PLM.
- Structured **Standard Work Orders** to define sequences of Work Orders.
- **Checklists** to capture quality test results and calibration data. (Incl. signatures for approvals.)
- **Non-Conformities** to document potential quality issues and their resolution.



Maintenance: EAM in the field and beyond

- Basically all maintenance activities are managed and documented with EAM – including sub-contracted maintenance!
- Invoices for sub-contracted maintenance are not paid for if the intervention is not documented and approved in EAM.
- Heavy use of mobile devices. (Mainly consumer grade tablets & phones.)

Examples of functionality used:

- Heavy use of **PM Schedules** and **Routes** for preventive maintenance.
- **Projects** and integrated (interactive) Gantt charts for planning and work preparation.
- **Checklists** are used a lot, also to guide technicians through the maintenance steps.
- **Warrantees** to avoid “unnecessary” repairs.
- **GIS** integration to located equipment.
- **Case Management** for operational log books.
- **Contract Management** for invoicing/cost controlling of work.

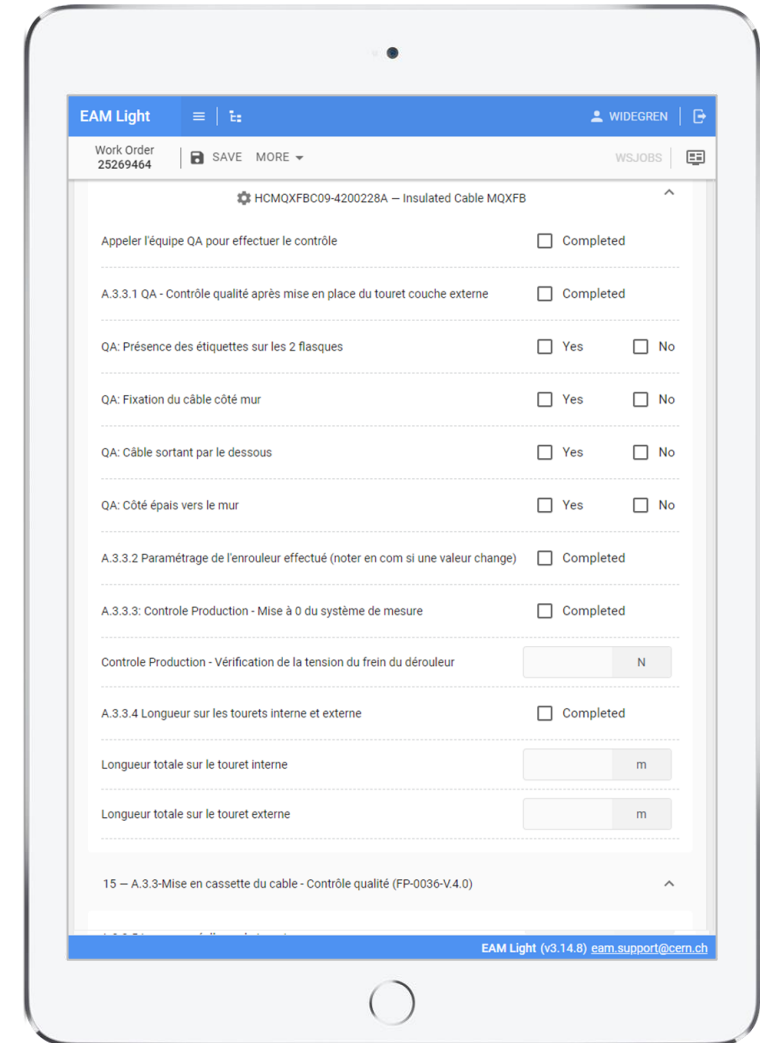


Maintenance: Explosive adoption of checklists

- Important tool for capturing structured data:
 - Replacing paper everywhere.
 - Replacing Work Order comments.
 - Replacing separate instruction sheets.
 - Extensive use combined with equipment structures and classes.
 - Over 2300 task plans with active checklists.
 - Over **1 million checklist items completed per year**.

Mainly used via the simplified EAM Light user interface.

- EAM Light was developed at CERN but is made Open Source and now available to all HxGN EAM users.
 - www.cern.ch/eam-opensource
 - www.github.com/cern-eam



Maintenance: Data from SCADA & IoT

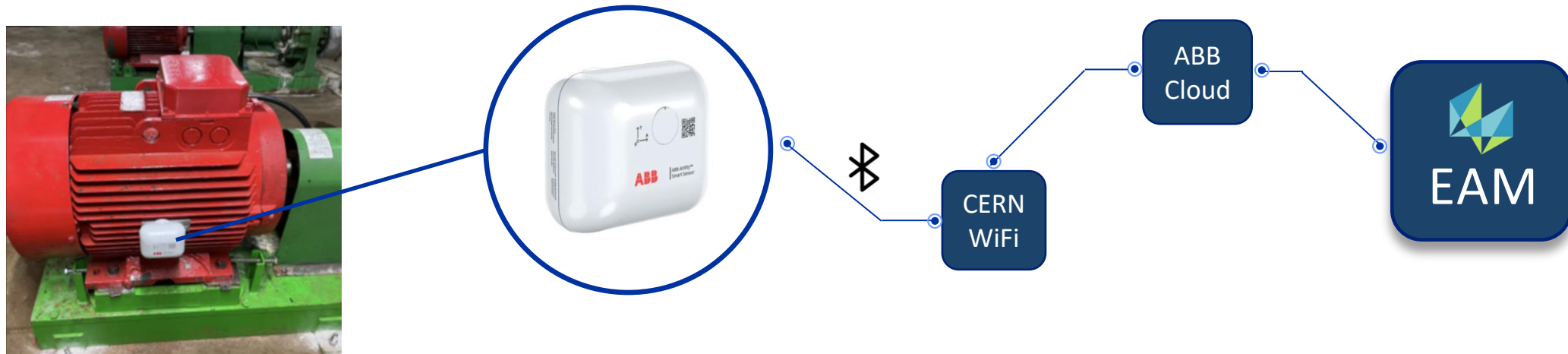
- We are since many years mapping SCADA meters with EAM meters, using a User Defined Screen to define "sampling" method and frequency.
- Currently several groups are in the process of installing more IoT devices communicating over the LoRa network.
- *Example:* One of CERN's 371 overhead cranes.



The screenshot shows the EAM software interface for configuring SCADA Data Mappings. The top navigation bar includes 'EAM', 'CERN', 'Work', 'Materials', 'Equipment', 'Purchasing', 'Operations', and 'Administration'. The main content area is titled 'SCADA Data Mappings' and contains a 'Record View' section. This section is divided into two main parts: 'Meter in Infor EAM' and 'Meter in SCADA'. The 'Meter in Infor EAM' section includes fields for 'EAM Meter' (HMH-PA-01317-1-0), 'Meter Description' (HMH-PA-01317-1-0), 'Meter UOM' (h), 'Equipment Description' (PALAN TAIM 5T (SUR PR-760)), and 'Equipment' (CRPA-01317). The 'Meter in SCADA' section includes a field for 'NXCAL Variable' (PA-01317_UXC55_IOT-1-0). Below these sections is the 'Update Configuration' section, which includes fields for 'Period' (1), 'Period UOM' (DAY), 'Decimal' (2), 'Last Manual Update' (27-JAN-2023 00:00), 'Last Automatic Update' (20-MAY-2023 00:00), and 'User' (VERCOUTB). A 'Meter active' checkbox is checked at the bottom right.

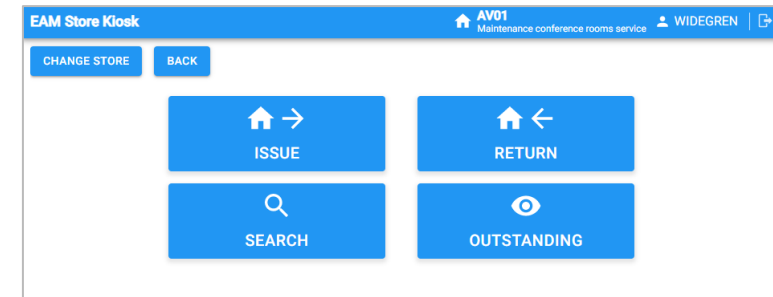
Maintenance: Data from Smart Sensors

- In some cases, in-house analyses or algorithms are developed for data-driven maintenance. In other cases, we rely on services from equipment manufacturers.
- *Example:* Smart Sensors installed on electrical motors communicating information concerning maintenance and energy consumption to EAM via ABB cloud service.



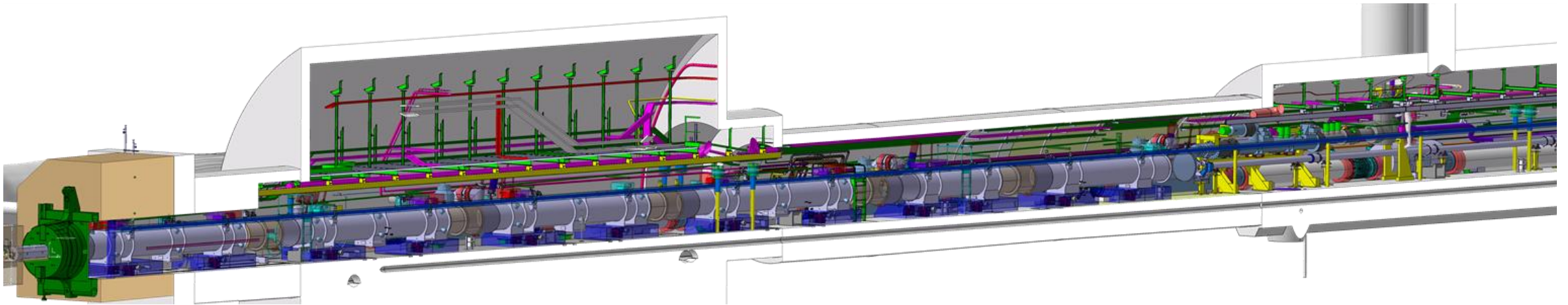
Stores Management: Spare parts

- Successfully implemented for both large and small storerooms.
- Up to 150.000 store transactions per year.
- Integration with GIS to locate stores and bins.
- Integration with ERP for purchasing and transports.
- Use facilitated by a simplified store kiosk interface.



EAM, CAD & 3D Visualisation

- We believe there is a huge potential in combining EAM equipment data with CAD and different visualization tools. Some examples:
 - 3D viewers as alternatives to find/search for assets rather than in an EAM list.
 - VR tools to prepare and practice interventions, including safety aspects from EAM.
 - AR and mixed reality to support maintenance personnel in the field.
- At CERN we have large amounts of 3D data (CAD, point clouds, 360 photos), EAM data and many other specialized data sources.



Visualising and Navigating the Digital Thread

The image shows a 3D CAD model of a complex industrial assembly, likely a particle accelerator component, rendered in a light blue/purple color scheme. The model is viewed from a perspective angle. Several UI elements are overlaid on the scene:

- Top Left:** A small inset window showing a top-down view of the assembly with green lines and a red dot. Below it, a coordinate display shows X: 2,145.4, Y: 2,691.0, and Z: 2,360.6.
- Top Right:** A dark blue panel titled "Layout Element" containing metadata for "DFBX_0013D: DFBXB - IP1 RIGHT SID" and "DFBX Right of IP1".
- Bottom Left:** A teal panel with a list of settings: "Show Panoramas", "Highlight Beamlines", "Clipping plane", "Mannequin", and "Show integration instead of layout" (checked). Below this is a "Delineate Area" button.
- Bottom Right:** A "Hide UI" button.
- Right Panel:** A table of statistics and metadata.

DFBX_0013D: DFBXB - IP1 RIGHT SID DFBX Right of IP1	
Aras Document	ST0028325_01&a.01
Layout ID	104672
Last Intervention On	21/11/2006 00:00
Open Work Orders	4
NCRs: Total	4
NCRs: Closed with Warning	0
NCRs: Open	3
Document last modified by	Nicolas Joannon
Responsible for model	Nicolas Joannon
Model last modified on	2021-01-27 13:48

Open with: [Icons for various applications]

New Digital Possibilities

- **Immersive 3D design** process with extended possibilities of virtual prototyping and simulations.
- **3D navigating & reporting** as alternative to a classic search engine and to visualize surrounding hazards, non-conformities or measurements.
- **Virtual Reality (VR)** for design reviews, approvals and preparations of intervention.
- **Augmented Reality (AR)** for better supporting operation and maintenance tasks.
- Continuous comparison between **Reality** and the optimized Digital Twin to detect anomalies and potential problems.
- Automated / Robotic interventions enabled by and based on the **Digital Twin** data.
- And much more...

Blending & Navigating between Reality & Digital Realities



Design:	Specifications, drawings, 3D CAD, simulations, analyses
Manufacturing:	Manufacturing steps, Quality tests, Non-conformities
Installation:	Equipment data, alignment, positioning and measurements
Maintenance:	Maintenance history, preventive/predictive plans, spare parts
Operations:	SCADA, IoT feeds, cameras, simulations, etc

Machine Learning

Conclusions

- HxGN EAM has proven to be highly configurable, scalable and open for integrations towards other systems and processes.
- We continue to expand the use of EAM throughout the organization and have big plans for the future.
- EAM is an integral part of our Engineering Platform, which will allow seamless navigation between design and as-built information.
- EAM will become an even more important cornerstone in our IT landscape when now moving forward towards creating Digital Twins of our installations.





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