1st Accelerators Technology Sector Workshop

Engineering Design Tools and Processes
Project Management Methodologies and Tools

Chair: Mike Lamont

Interconnecting knowledge, experience, methods, people & data to foster learning & collaboration

CERN

ATS
Accelerators and Technology Sector

Managing the Beamline Configuration in the Experimental Areas

Giulia Romagnoli

CERN

ATS
Accelerators and
Technology Sector

Beamline Component Research

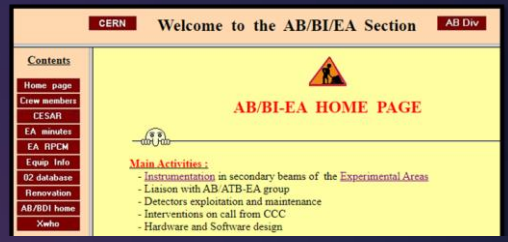
Micro-collimator consolidation, installed in the H8 beamline since??

Engineering specification → “archaeological engineering”

- **ON-SITE RESEARCH:** retro-engineering spare equipment
- **OFF-SITE RESEARCH:**
  - ask people
  - EDMS
  - online folders (dfs, CERNBox)
  - CDD

Thanks to Antonio Alonso, 39th Coffee Meeting, Adventures@Cern, the complete Trilogy!

Beamline Component Research



NA cons

Micro-collimator consolidation, installed in the H8 beamline since??

Engineering specification → “archaeological engineering”

- **ON-SITE RESEARCH:** retro-engineering spare equipment
- **OFF-SITE RESEARCH:**
  - ask people
  - EDMS
  - online folders (dfs, CERNBox)
  - CDD
  - old group webpage
  - design office archives
  - microfilm storage
  - CERN main archives

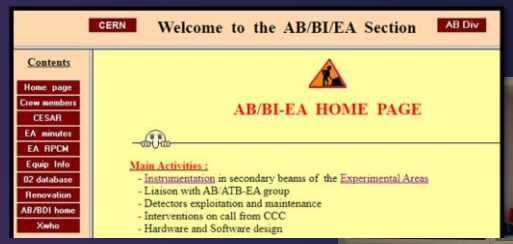
Thanks to Antonio Alonso, 39th Coffee Meeting, Adventures@Cern, the complete Trilogy !

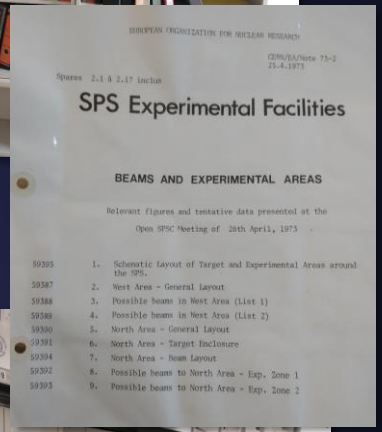
Beamline Component Research

Micro-collimator consolidation, installed in the H8 beamline since??

Engineering specification → “archaeological engineering”

- **ON-SITE RESEARCH:** retro-engineering spare equipment
- **OFF-SITE RESEARCH**
  - ask people
  - EDMS
  - online folders (dfs, CERNBox)
  - CDD
  - old group webpage
  - design office archives
  - microfilm storage
  - CERN main archives





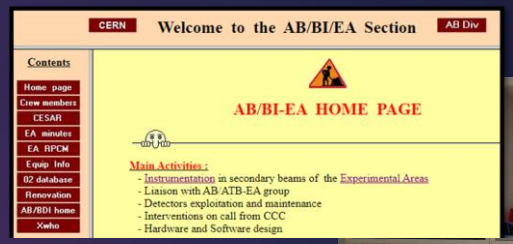
Thanks to Antonio Alonso, 39th Coffee Meeting, Adventures@Cern, the complete Trilogy !

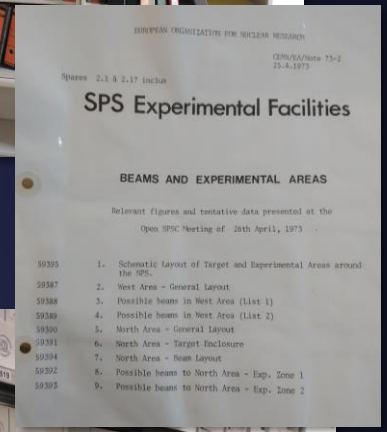
Beamline Component Research

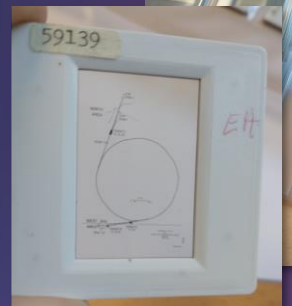
Micro-collimator consolidation, installed in the H8 beamline since??

Engineering specification → “archaeological engineering”

- **ON-SITE RESEARCH:** retro-engineering spare equipment
- **OFF-SITE RESEARCH**
  - ask people
  - EDMS
  - online folders (dfs, CERNBox)
  - CDD
  - old group webpage
  - design office archives
  - microfilm storage
  - CERN main archives





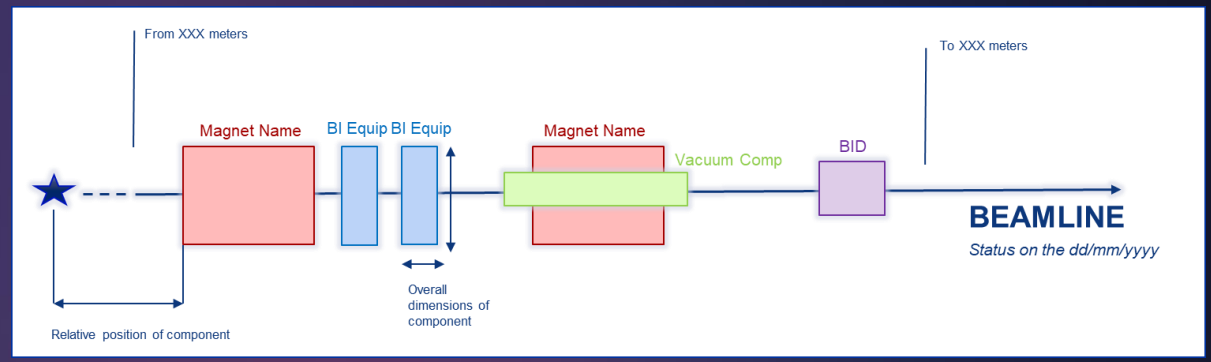


Thanks to Antonio Alonso, 39th Coffee Meeting, Adventures@Cern, the complete Trilogy !

Configuration Management Definition

Managing the beamline configuration means having **a clear and coherent picture of the status of a BEAMLINE at a given point in time**

CM (configuration management) uses engineering tools adopting project management processes



Engineering Tools

- Layout Database
- EDMS
- Geode, GitLab
- Naming Portal
- PLM (Catia, SmarTeam)
- EAM
- AFT, Checklist, ASM
- Panorama, GIS
- JIRA, Confluence
- CERNBox
- Geant4, BDSIM, FLUKA

Project Management Processes

- Quality Management and Control
- Configuration Identification
- Configuration Change Management
- Documents Management and Approval Processes
- Space Management
- Product breakdown structures
- Assets Management
- Product Lifecycle Management

Ensuring long-term detailed documentation, essential for future modifications

Configuration Management in ATS

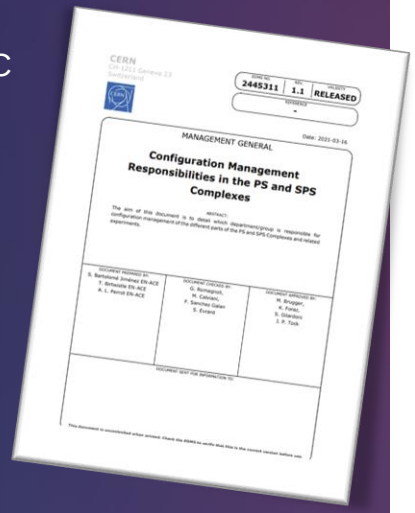
Configuration & Layout Management Team (within EN-ACE-CL) established a framework which has (over many years) matured in collaboration with many equipment/service groups

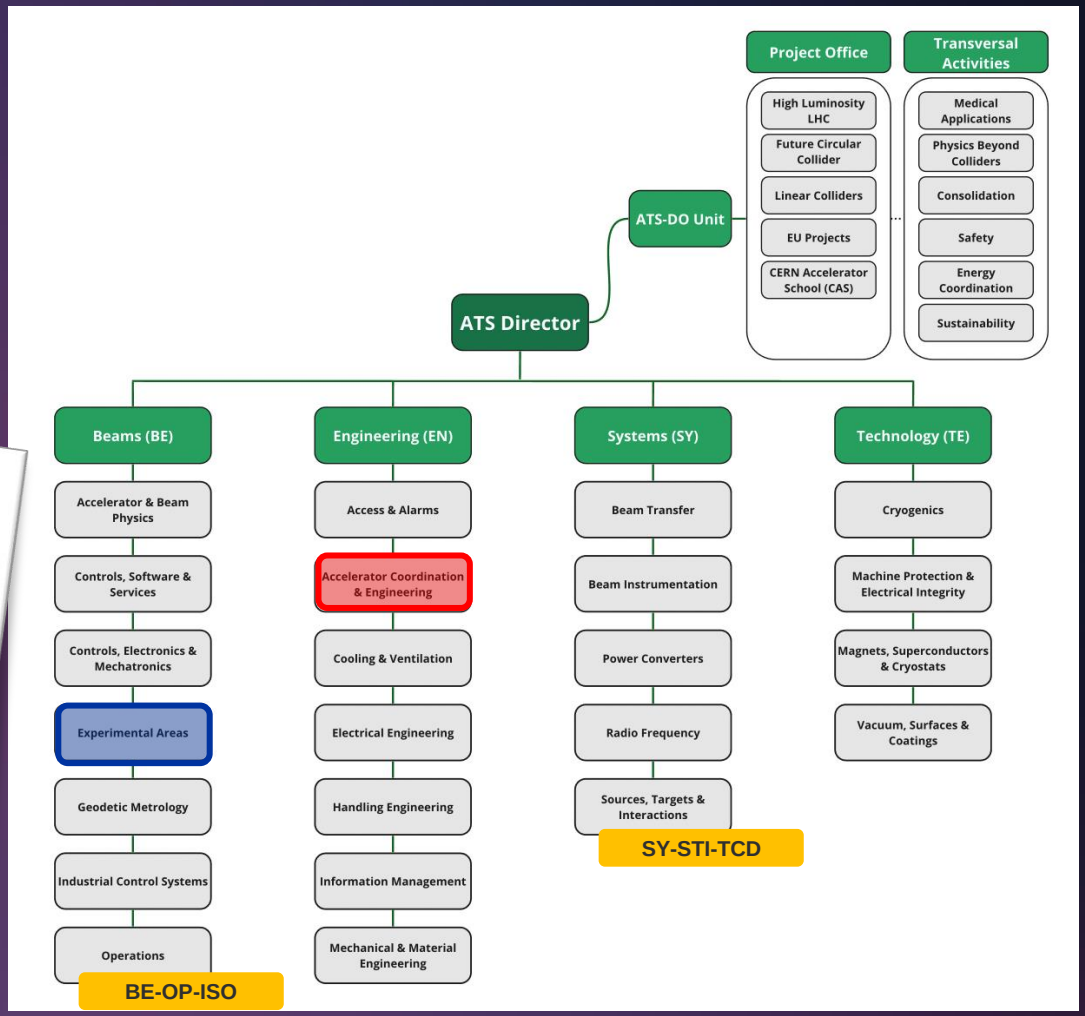
CM is a common effort of all groups and stakeholders

Responsible for configuration management (non-exhaustive):

- Primary beamlines and accelerators: EN-ACE-CL
- Experimental Areas (NA, EA, AD Complex, HiRadMat): BE-EA-EC
- nTOF: SY-STI-TCD
- ISOLDE: BE-OP-ISO

→ **unified approach within ATS sector**





See A-L. Perrot, Configuration Management Responsibilities in the CERN Accelerators, EDMS 2445311

Consolidation Projects in Experimental Areas

CM is embedded in the **Quality & Control Management** processes of the consolidation/renovation projects of EA

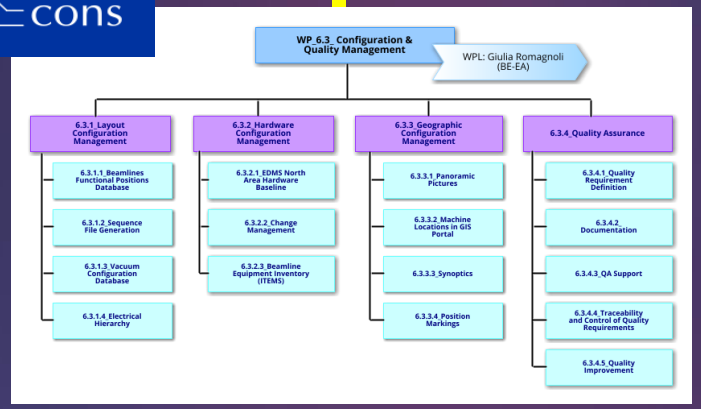
2019

ADCONS / ELENA

HiRadMat

EAST AREA RENOVATION

NA cons



HI-ECN3 Project

The support of the consolidation projects was always essential to make this important step in the experimental areas

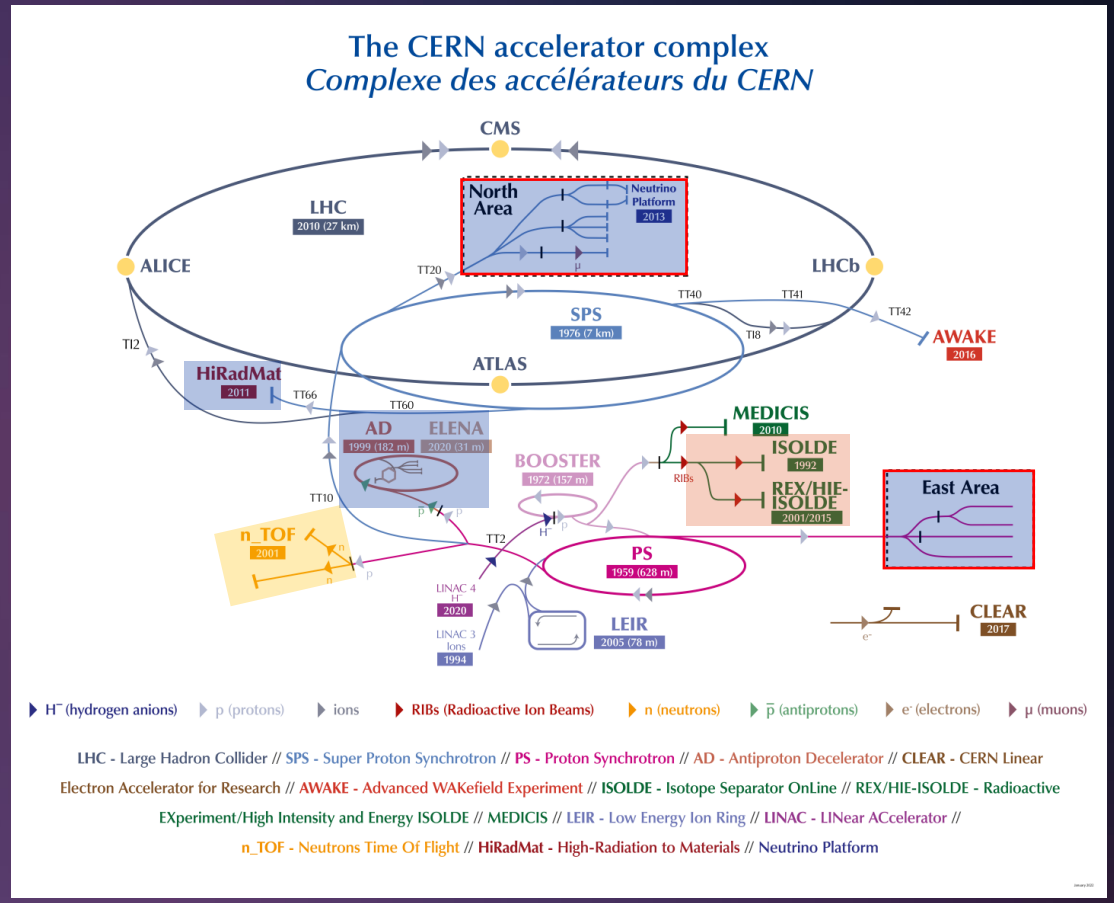
Beamline Configuration in Experimental Areas

North and East Experimental Areas

The beamline configuration is frequently changing and schedule-driven during operation:

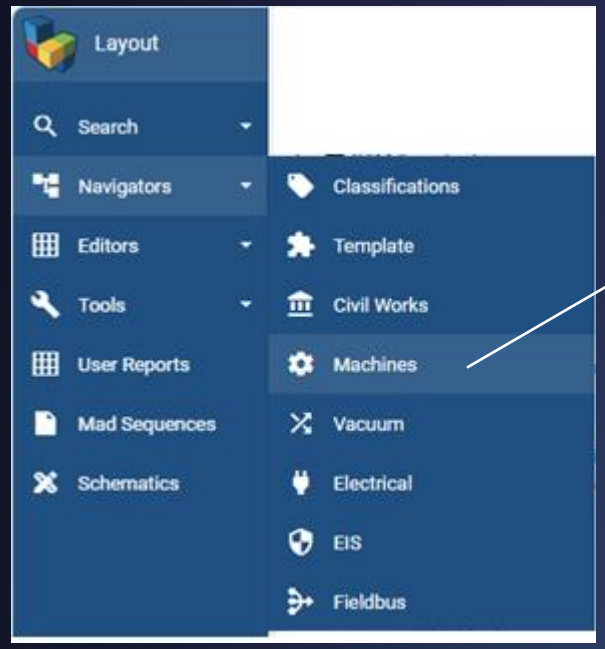
- Proposals of new experiments (lasting from a few months to several years) from SPSC (IEFC/RB)
- Test-Beam Users (changing in some cases on a weekly basis and requiring area modifications)

The scope of **configuration management** process is enlarged to increase reliability & availability of beamline components leading to an increased physics time

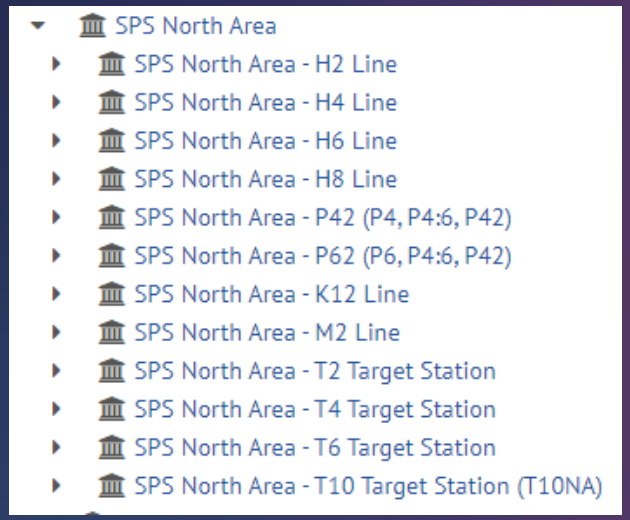


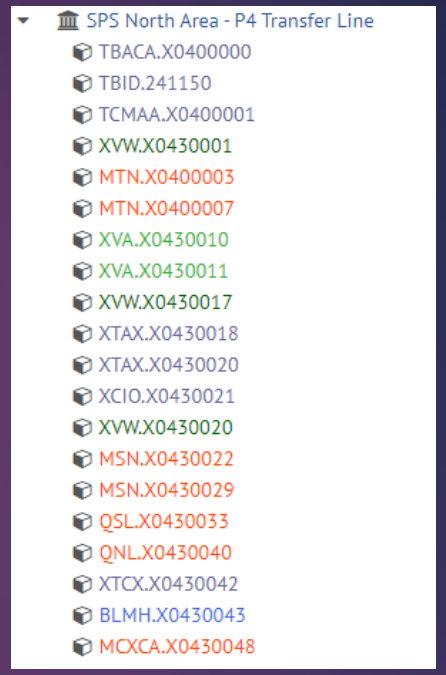
Managing Physical Configurations with Layout

Pascal Le Roux “Managing physical configurations of CERN accelerators with Layout”



Beamline functional position structure is stored time-dependently on **Layout Database** → reference tool centralizing all information and data with links to the other databases





All positions follow conventions agreed with the different equipment groups and stakeholders

Accelerators Naming Portal

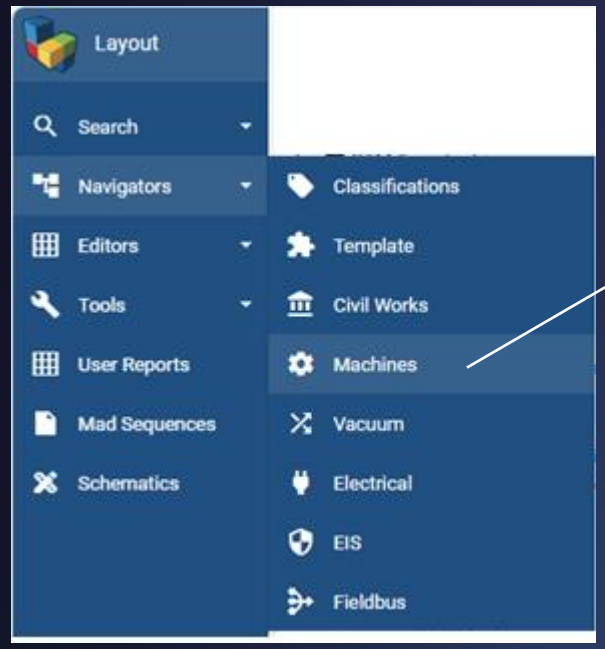
EQUIPMENT CODES

Quality Management Support for the Accelerators & Technology Sector

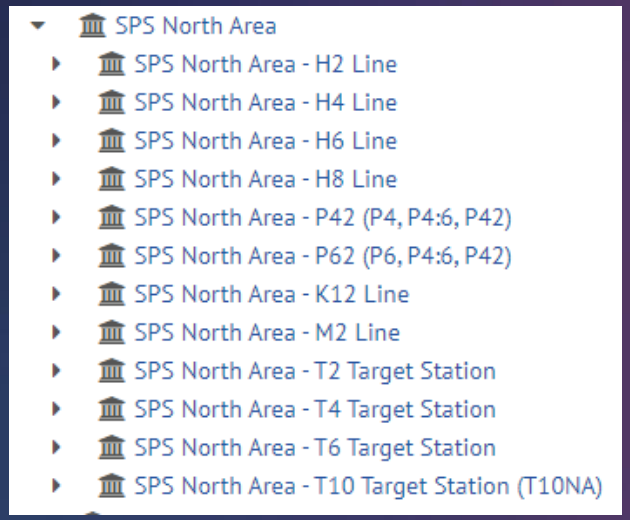
NAMING CONVENTIONS

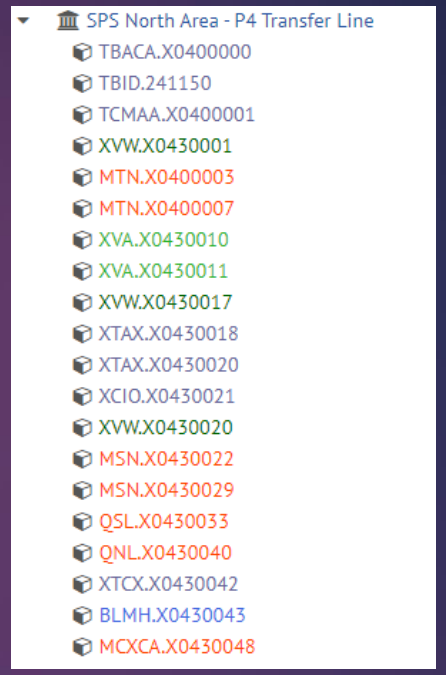
Managing Physical Configurations with Layout

Pascal Le Roux “Managing physical configurations of CERN accelerators with Layout”



Beamline functional position structure is stored time-dependently on **Layout Database** → reference tool centralizing all information and data with links to the other databases





All positions follow conventions agreed with the different equipment groups and stakeholders

Accelerators Naming Portal

EQUIPMENT CODES

Quality Management Support for the Accelerators & Technology Sector

NAMING CONVENTIONS

Beamlines are changing all the time!!

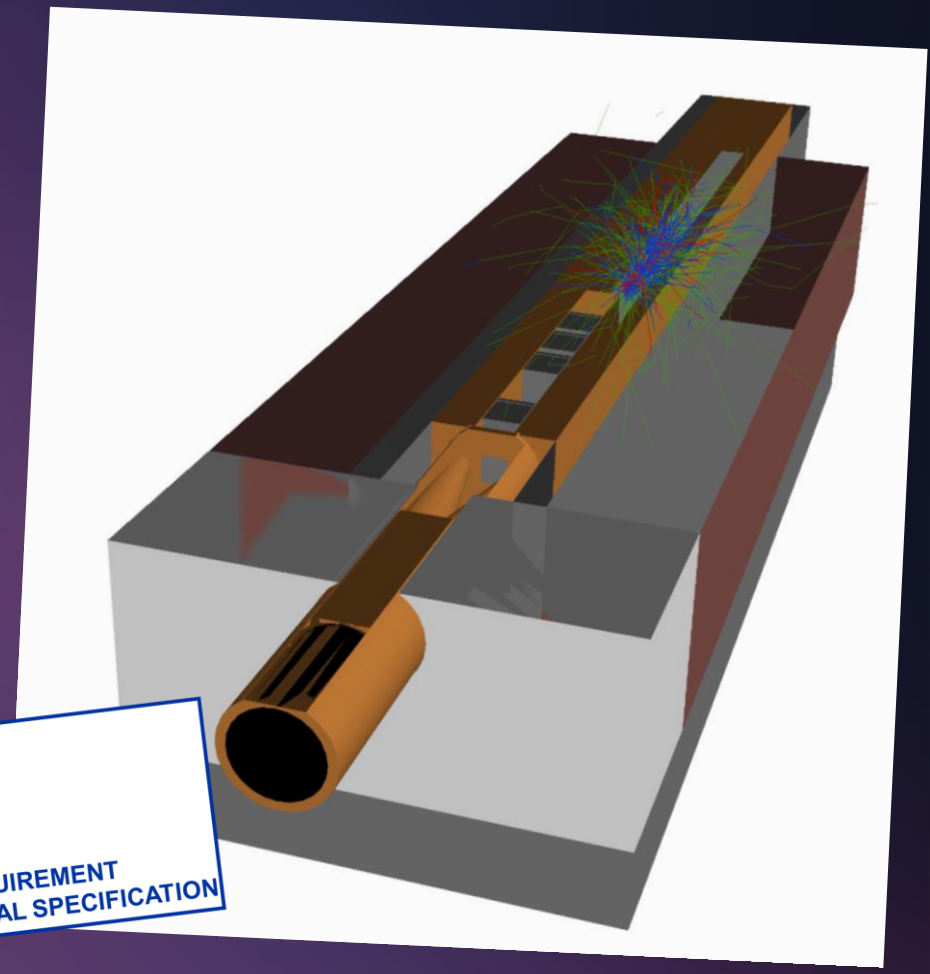
Riccardo De Maria “Building an accelerator, from engineering to alignment” → “Modify a beamline, from engineering to alignment”

Beamline Configuration – Physics Studies

Experimental Areas host a variety of experiments/users asking different settings and special configuration of beamlines → beamline physicists run simulations calculating beam trajectories and optics

The need could be of a different nature (non-exhaustive):

- New component
- Functional change (different configuration)
- Layout change
- Beam-matter interactions
- Radiation protection



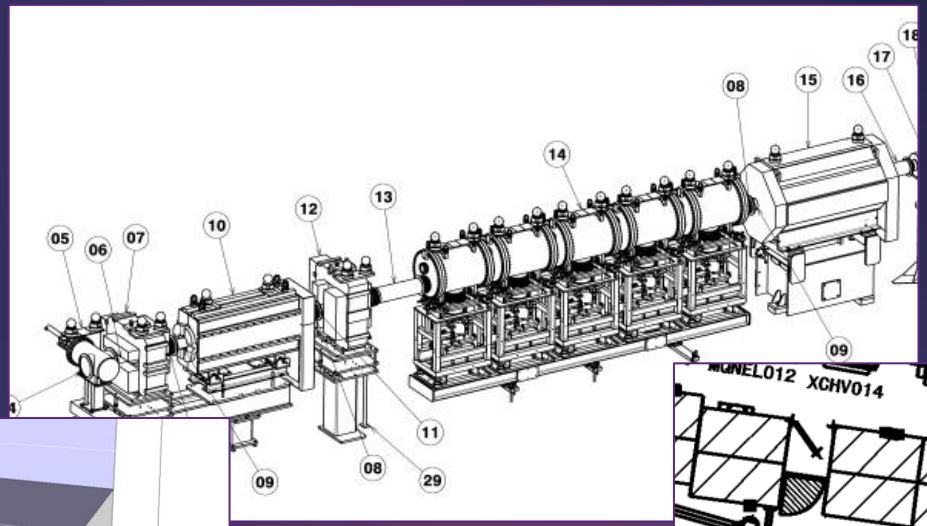
Physics simulations → BDSIM (Geant4) / FLUKA models / MADx

Change of tools in the last years to homogenize and standardize approach with other accelerators

Beamline Configuration – Integration Studies

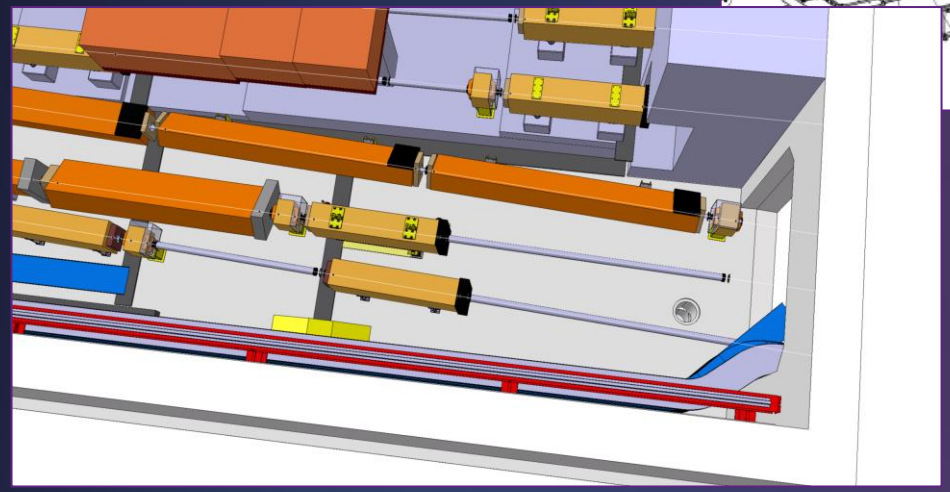
East Area → new models for the new layout within East Area Renovation project

North Area → 3D surveys to build as-built 3D models ongoing in NACONS project

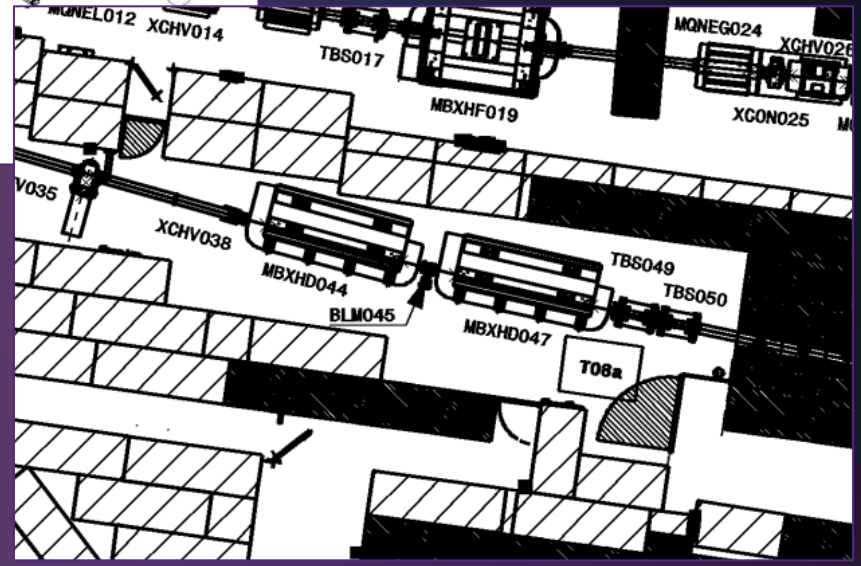


PLM

EQUIPMENT and LAYOUT DRAWINGS



3D MODELS INTEGRATION

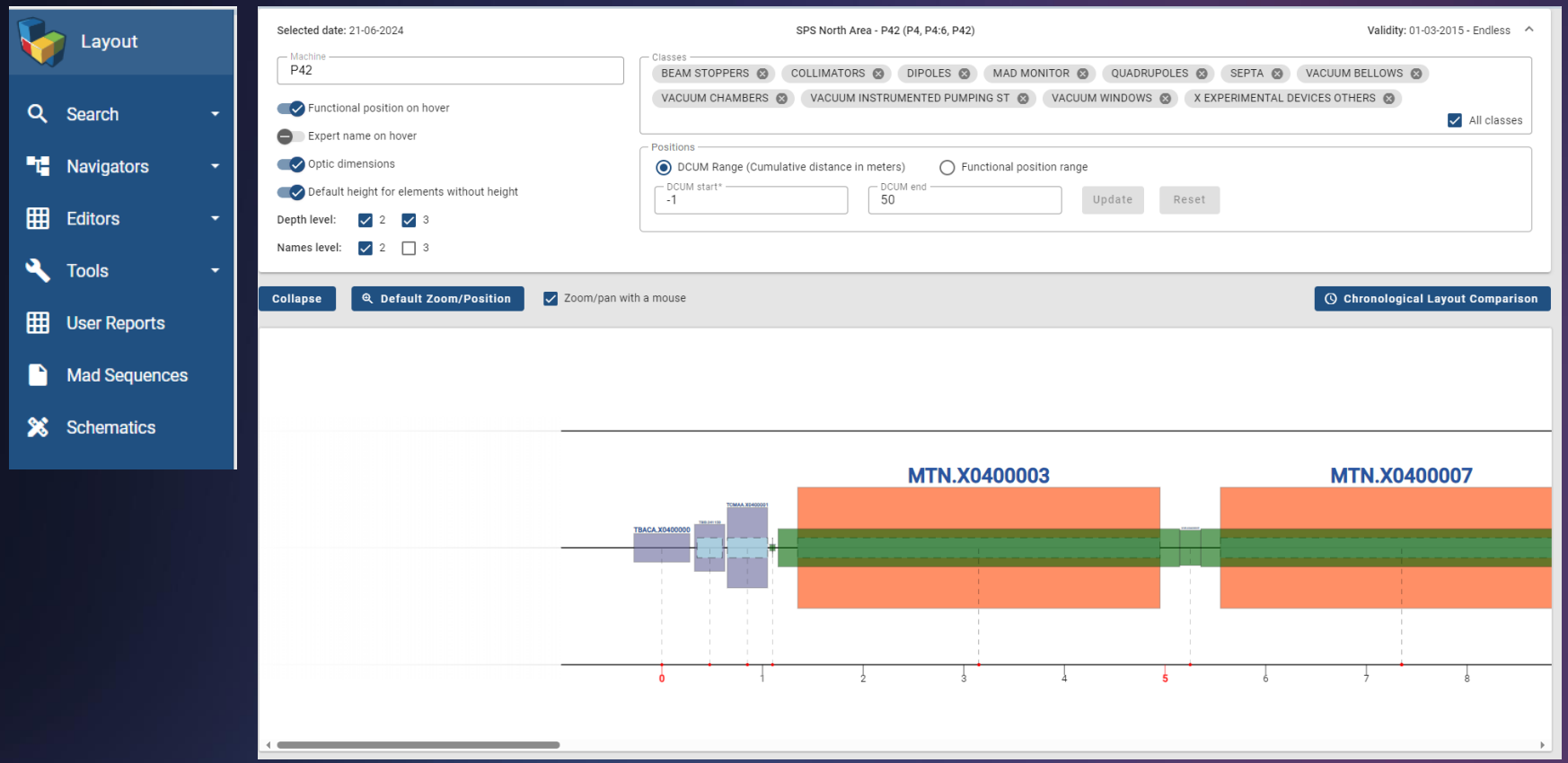


See talk of Claudio Scoero - Transforming engineering processes with the new Product Lifecycle Management (PLM) platform

Beamline Configuration – Schematics

NEW!!

Since experimental beamline areas are continuously evolving, to facilitate beamline coordination and changes of physical configurations, a data-driven time-dependent schematics is under study to provide an intuitive overview of the beamline automatically linked to Layout Database structure.



Work in progress of BE-CSS, BE-EA in NACONS WP6.3

Thanks to Anastasiia Moshenska

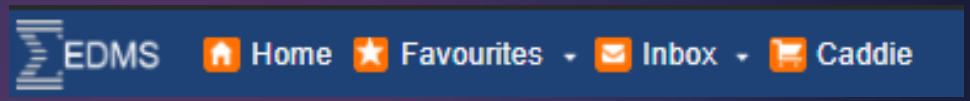
Change Management

- ECR + Document Management (User requirements, Engineering Specifications, Eng reports, Safety Documents)
- Registering possible new names on Naming Portal
- Creation of new type/item
- Update of Hardware Baseline Documents/Drawings/Items
- Update of LAYOUT DATABASE position and beamline structure
- Creation of NEW MAD sequence file
- Asset Management

Document Quality Management

Documents are stored and organized inside

EDMS - CERN's Engineering Data Management Service



→ documents are circulated and approved through official EDMS processes by **DOCUMENTS MANAGERS**

Procedures ad quality processes are listed inside the Quality website of ATS sector

TEMPLATES are available inside the Quality CERN website: Templates (cern.ch)

Confluence, CERNBox, JIRA are tools used in quality project management for documents sharing, minutes, project organisation, tracing actions

Document Quality Management

Document managers of BE-EA are helping authors to correctly treat/circulate/store their documents

NEED FOR A CHANGE

Author wanting to create/save/register a document in EDMS

ECRs, Specifications

DOCUMENTS MANAGERS

Official circulation of documents with EDMS processes

HB Documents, "official approval process" documents

DOCUMENTS MANAGERS

Official circulation of documents with EDMS processes

EATM
APPROVAL

IEFC
APPROVAL

Document involves discussions on:
Budget, Resources, Operation constraints
Conflicting experiment requirements

IEFC
Informed

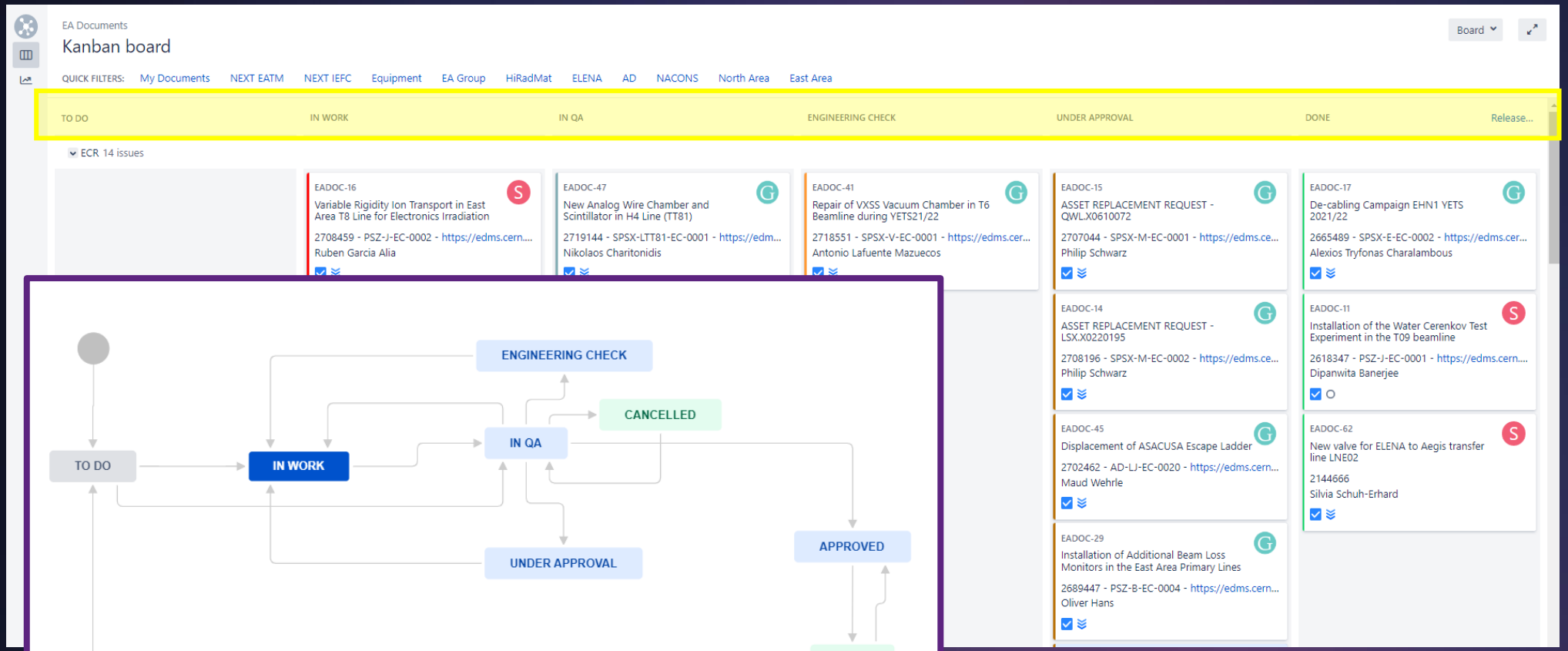
Document approved
with minor implications

EATM
For information

EATM (Experimental Areas Technical Meeting)

LHC Injector and Experimental Facilities Committee (IEFC)

Document Approval Process Management

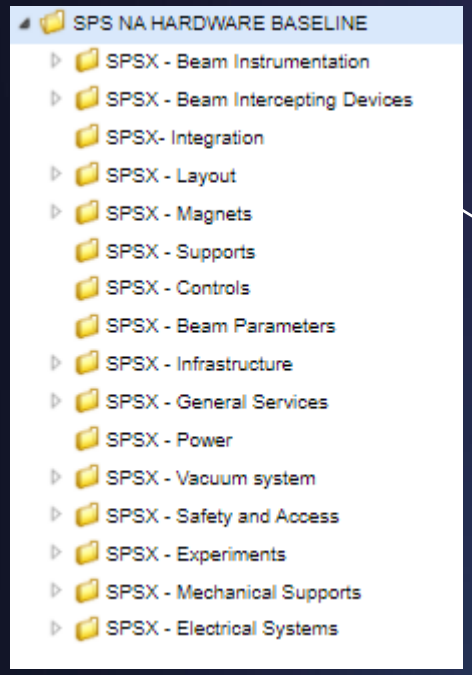


WORKFLOW STATUS

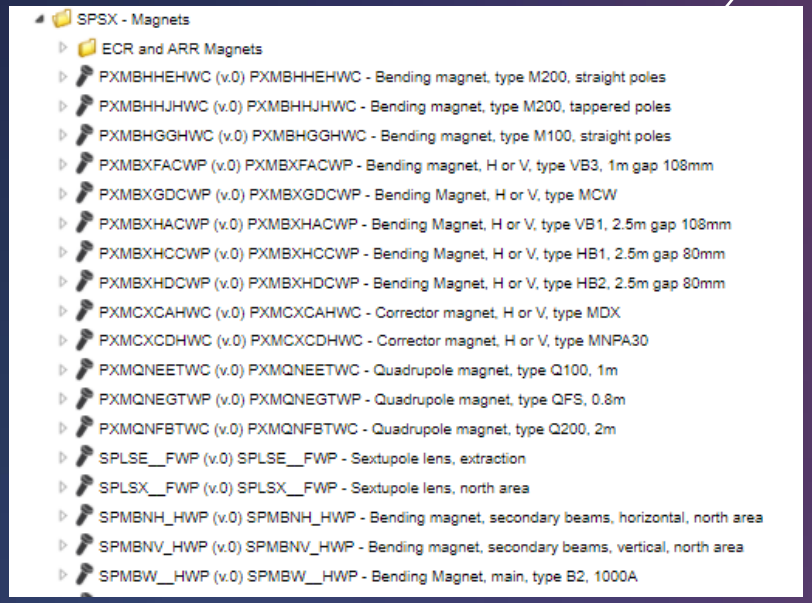
All documents treated by the document managers are stored inside a JIRA project, where a Kanban board is used to have an overview of the documents circulating and to monitor the documents status

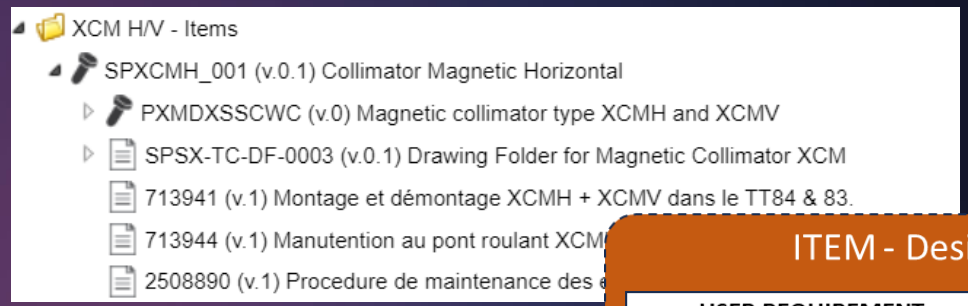
JIRA PROJECT for EA Document Circulation
Experimental Areas Documents - CERN Central Jira

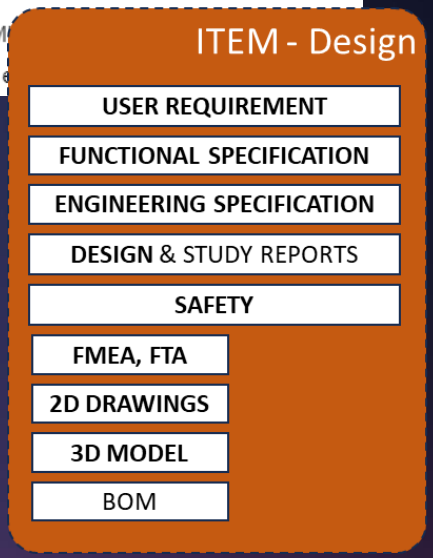
Hardware Baseline - ITEMS



HARDWARE BASELINE = product breakdown structure on EDMS per experimental area, collecting ITEMS & important documents







Change Management

- ECR + Document Management (User requirements, Engineering Specifications, Eng reports, Safety Documents)
- Registering possible new names on Naming Portal
- Creation of new type/item
- Update of Hardware Baseline Documents/Drawings/Items
- Update of LAYOUT DATABASE position and beamline structure
- **Creation of NEW MAD sequence file**
- Asset Management

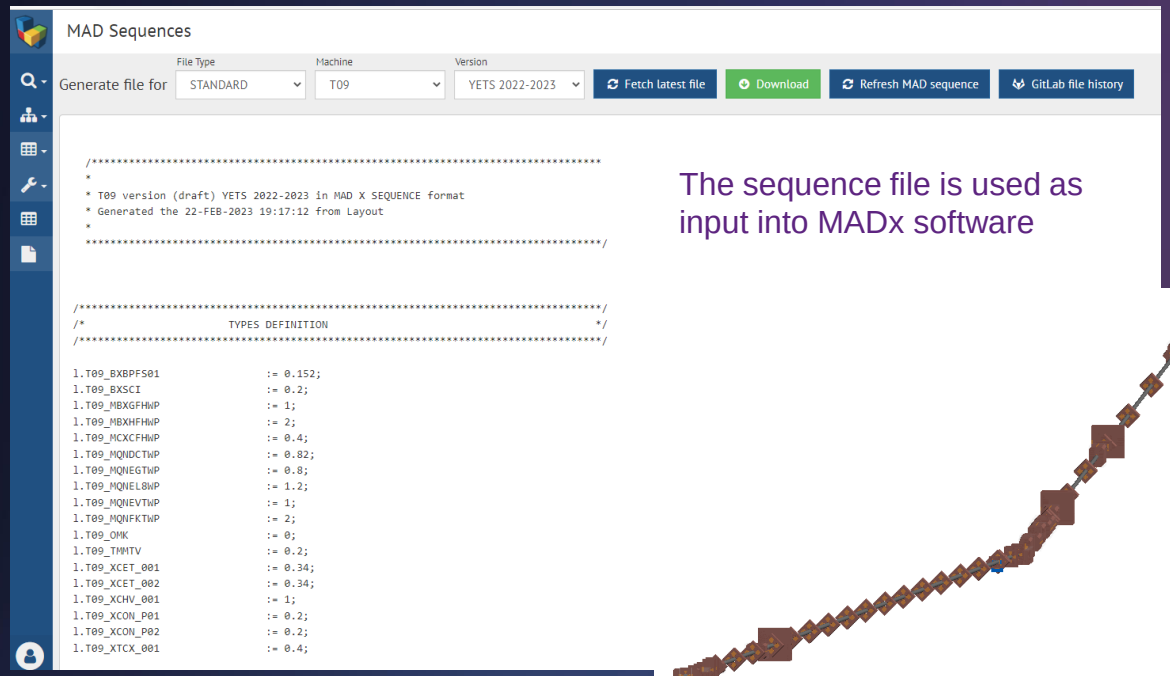
Beamline Sequence File

Automatic extraction from Layout of beamline sequence file with:

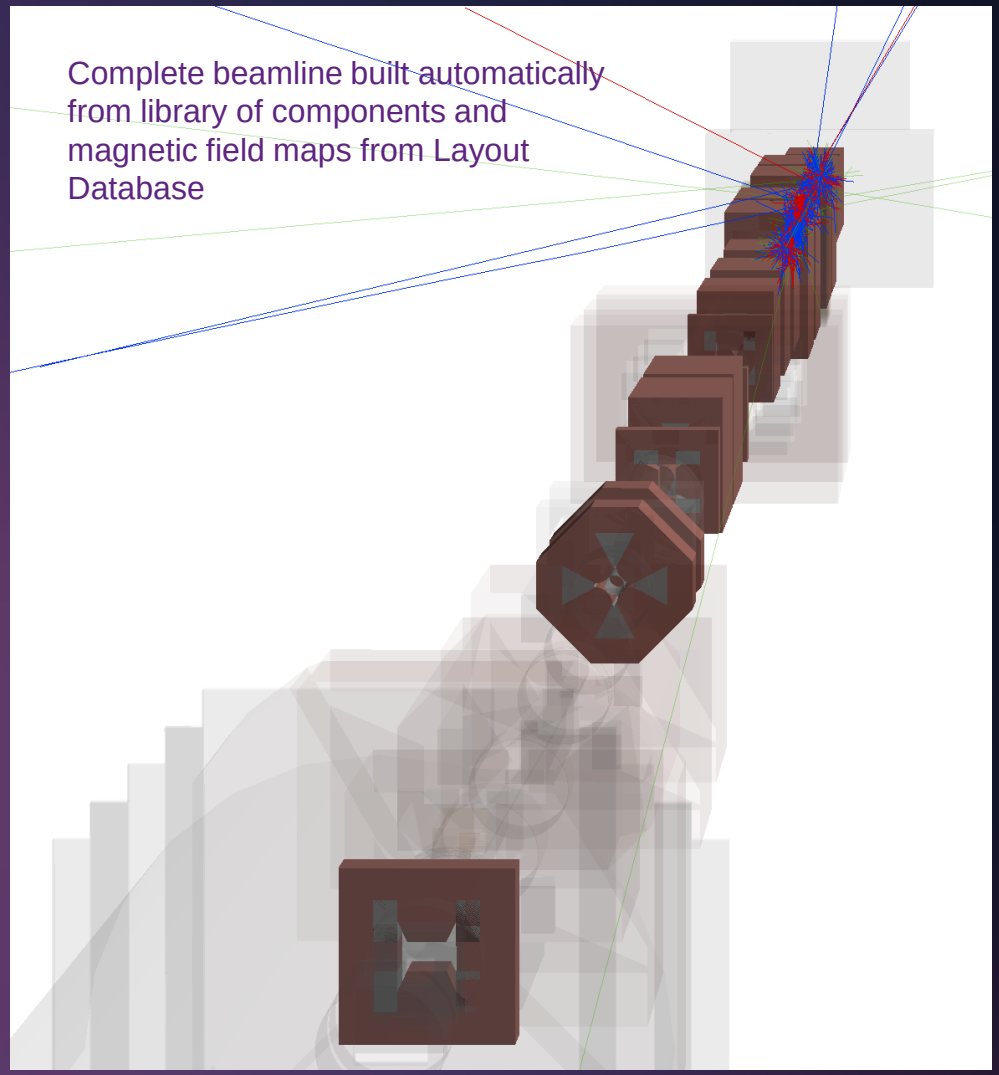
- Functional positions and expert names
- Element types and classes
- DCUM (cumulative distances) and optic lengths of elements
- Strength/angle variables and values
- Apertures

CERN GITLAB

BEAMLINES SEQUENCE FILES



The sequence file is used as input into MADx software



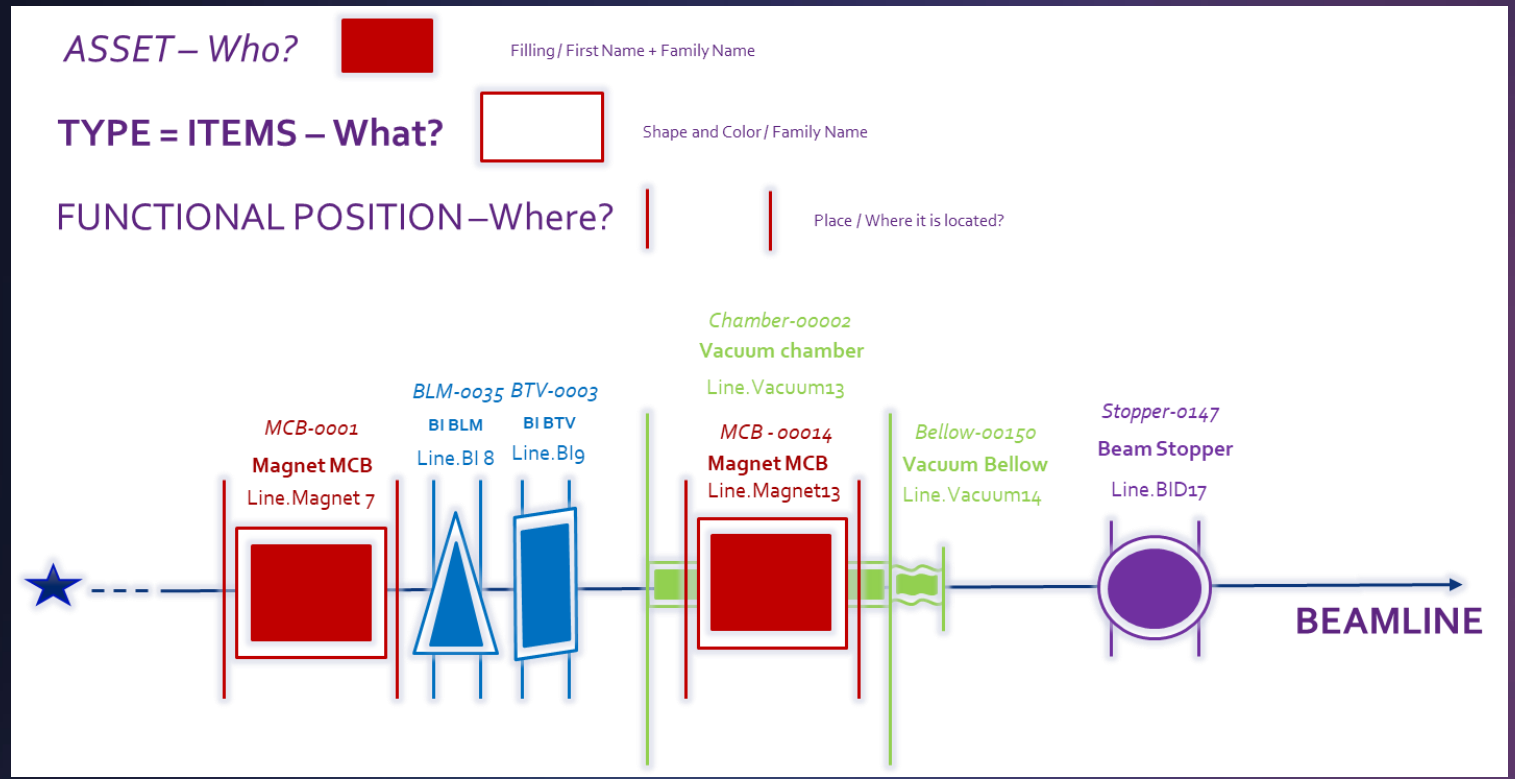
See talk of Riccardo De Maria - Building an accelerator, from engineering to alignment

Change Management

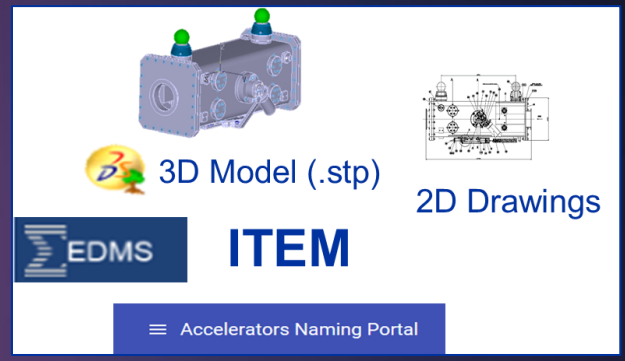
- ECR + Document Management (User requirements, Engineering Specifications, Eng reports, Safety Documents)
- Registering possible new names on Naming Portal
- Creation of new type/item
- Update of Hardware Baseline Documents/Drawings/Items
- Update of LAYOUT DATABASE position and beamline structure
- Creation of NEW MAD sequence file
- Asset Management

Assets Management

ASSETS = physical instances of an ITEM



The CM scope includes also asset management of beamline equipment like collimators, supports, absorbers, dumps, vacuum, beam instrumentation…



Asset management tool = EAM

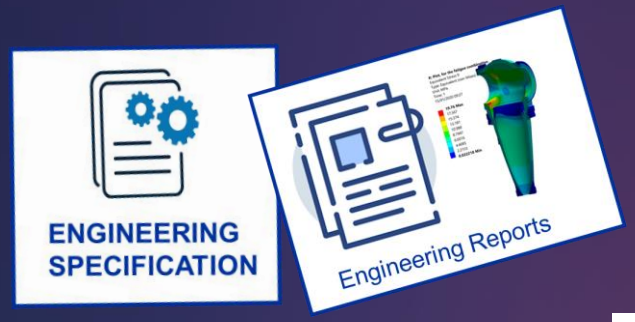
EAM

EAM Light

Reliable and Optimized Beamline Component

Product Lifecycle Management

- NEED
- STUDY/DESIGN
- PRODUCTION
- TESTS
- INSTALLATION
- OPERATION
- DECOMMISSIONING / REX



JIRA — Equipment actions follow-up

For LS3, major importance is given to follow-up of the procurement, manufacturing, installation and readiness tests.
Which is the most suitable existing tool?
EDMS? MTF? EAM? Track-it? Jira?

EAM

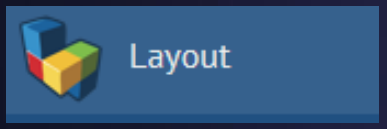
EAM Light

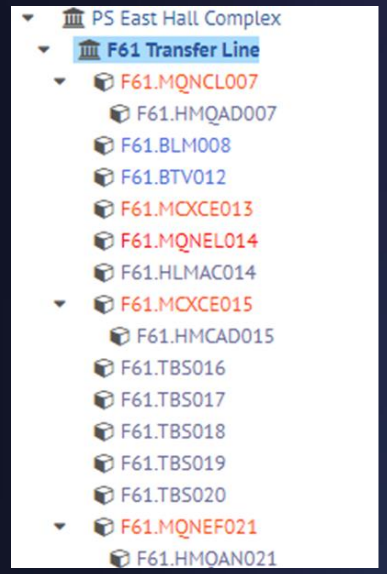
Asset management tool used also for work orders, preventive and corrective maintenance, …

Failures are ‘frequent’, careful preparation/analysis from teams concerned is often required → Projects are essential to ensure study advancement in parallel to operation

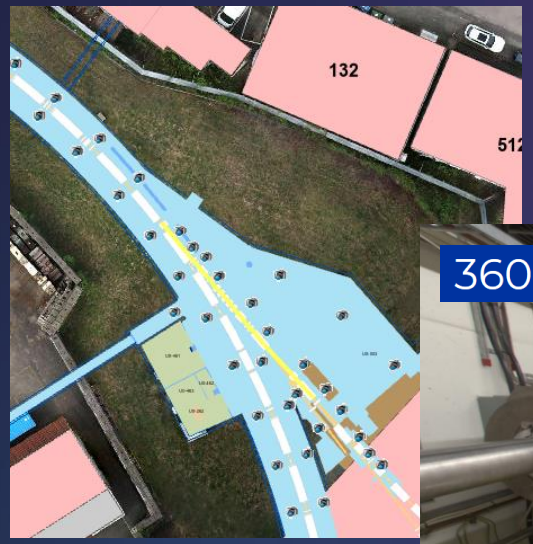
See talks of Andrea Boccardi - Developing electronics boards through standardisation, specialised tools and collaboration
Jean-Louis Grenard - Improving future designs by learning from radioactive waste-management experiences
Andrew John Lees - Engineering design tools and processes for cryogenics

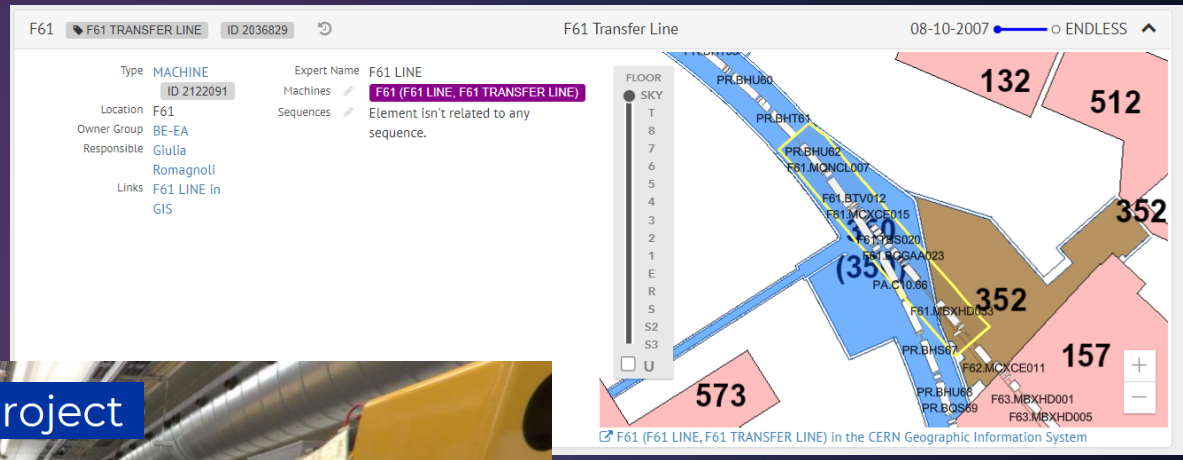
CM in Installation and Alignment





Space management
Functional positions on Layout are linked to GIS and machine locations are defined



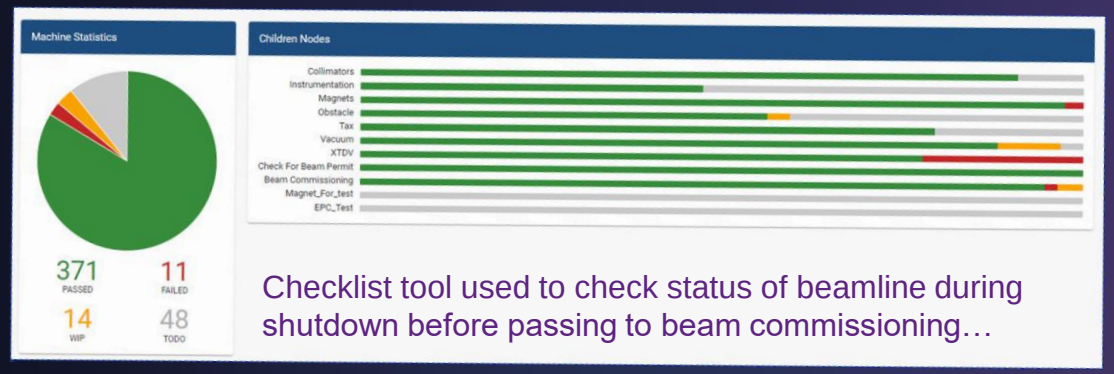


Panoramic pictures are available to facilitate planning of interventions during beam operation
Concerned areas are sometimes (highly) radioactive → access is limited during operation

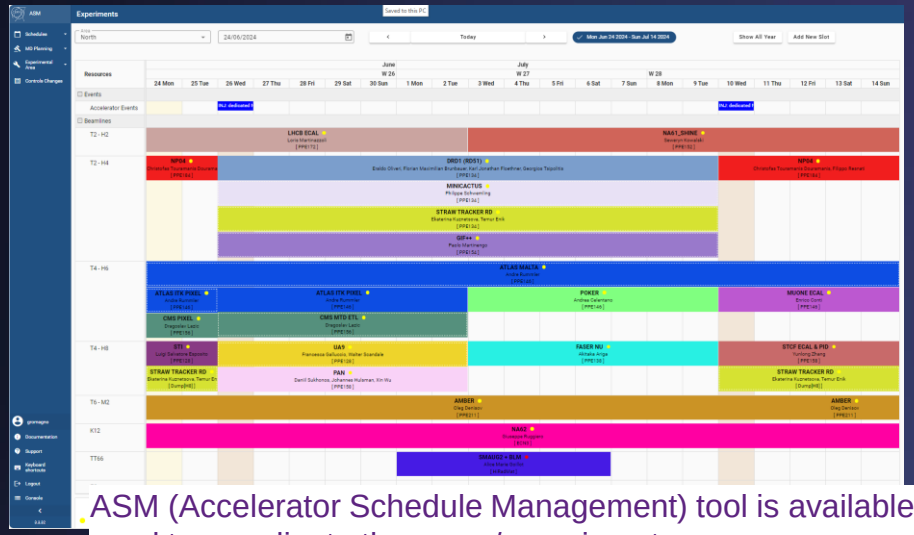
Cumulative positions DCUMs are exported to the survey database to allow the alignment of the elements

SURVEY DATA

Beamline Operation

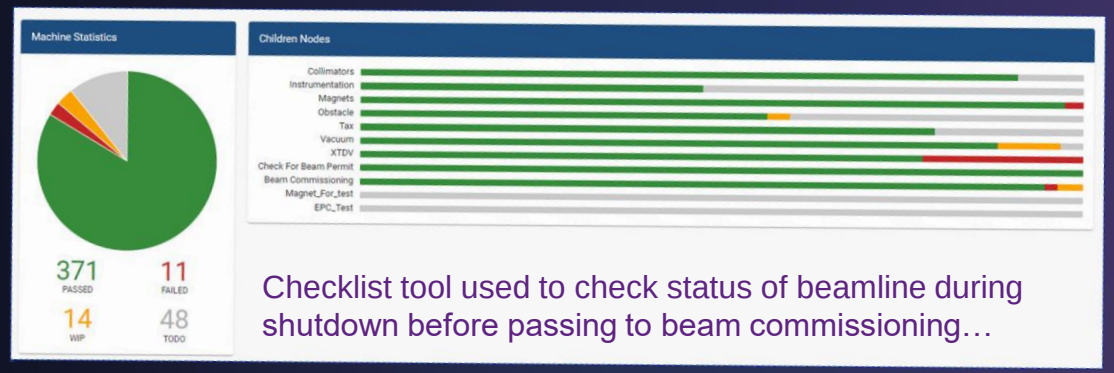


Checklist tool used to check status of beamline during shutdown before passing to beam commissioning…

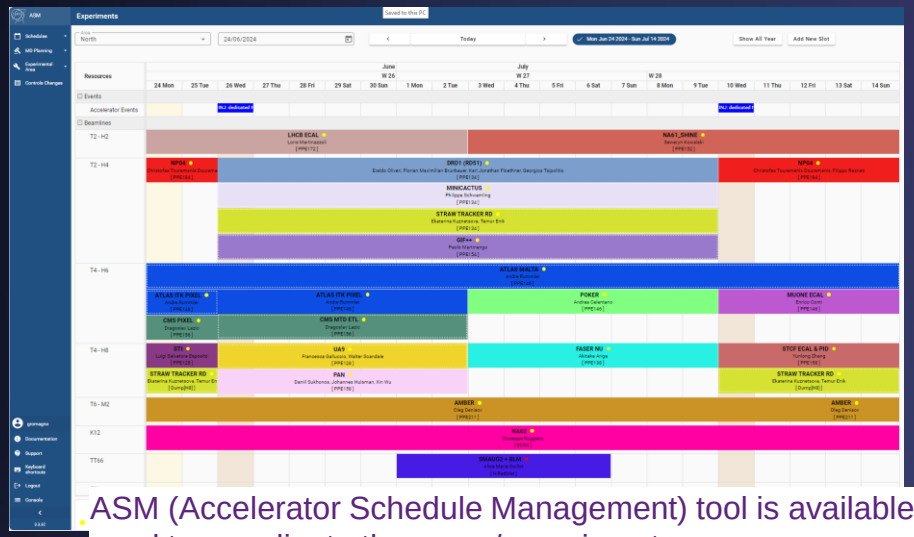


ASM (Accelerator Schedule Management) tool is available and used to coordinate the users/experiments

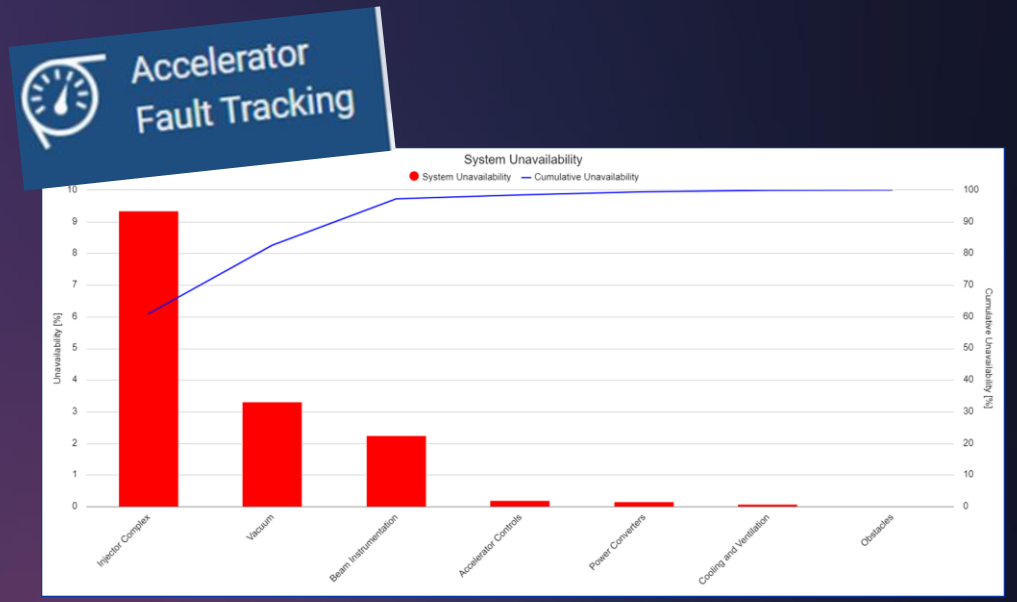
Beamline Operation



Checklist tool used to check status of beamline during shutdown before passing to beam commissioning…



ASM (Accelerator Schedule Management) tool is available and used to coordinate the users/experiments



AFT used by equipment/service groups and beamline responsible to declare faults and monitor availability and performance of the machine

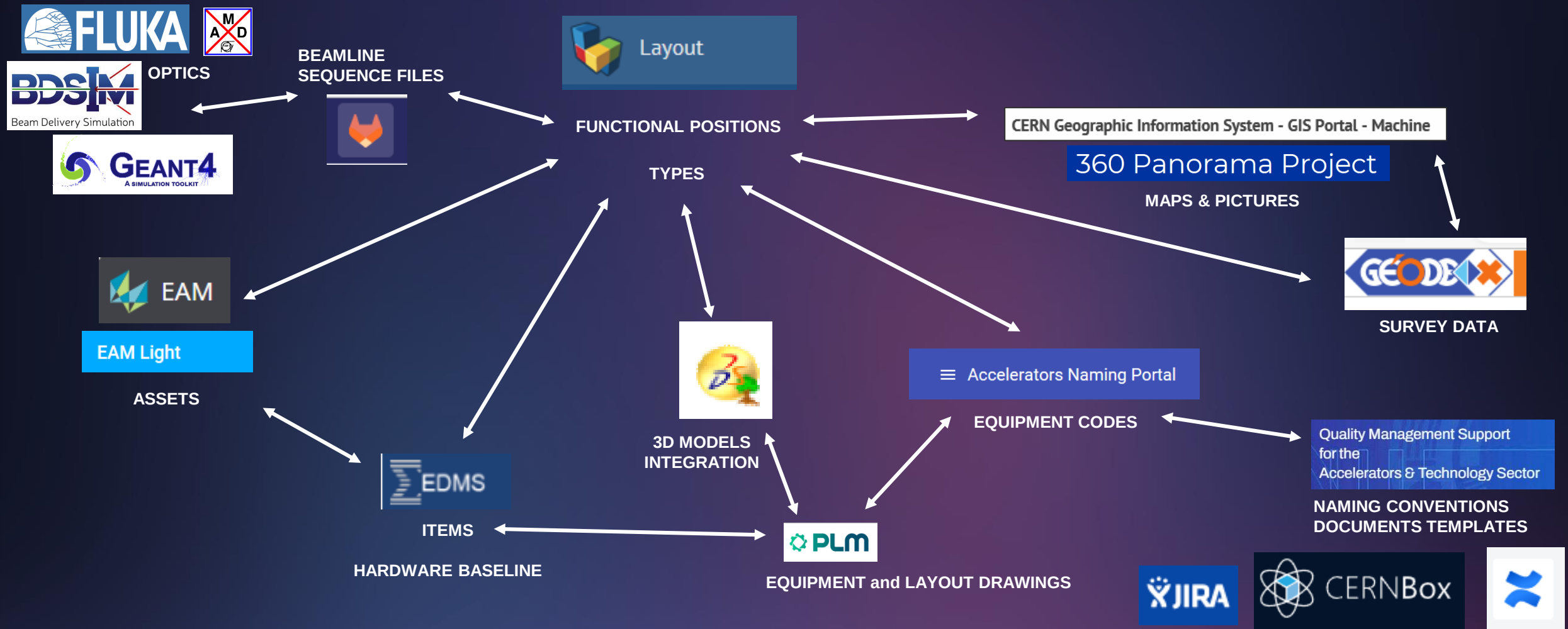
NEW Feature:
Faults are linked to Layout functional positions → automatic WO is created in the asset EAM page

Work Order	Equipment	Description	Status	Creation Date ↓
33580474	XCHV.X0611013	Generated by AFT fault with id: 1004360	R - Launched, Lancé	17-Jun-2024
33346405	XCHV.X0611013	Generated by AFT fault with id: 964733	R - Launched, Lancé	15-Apr-2024

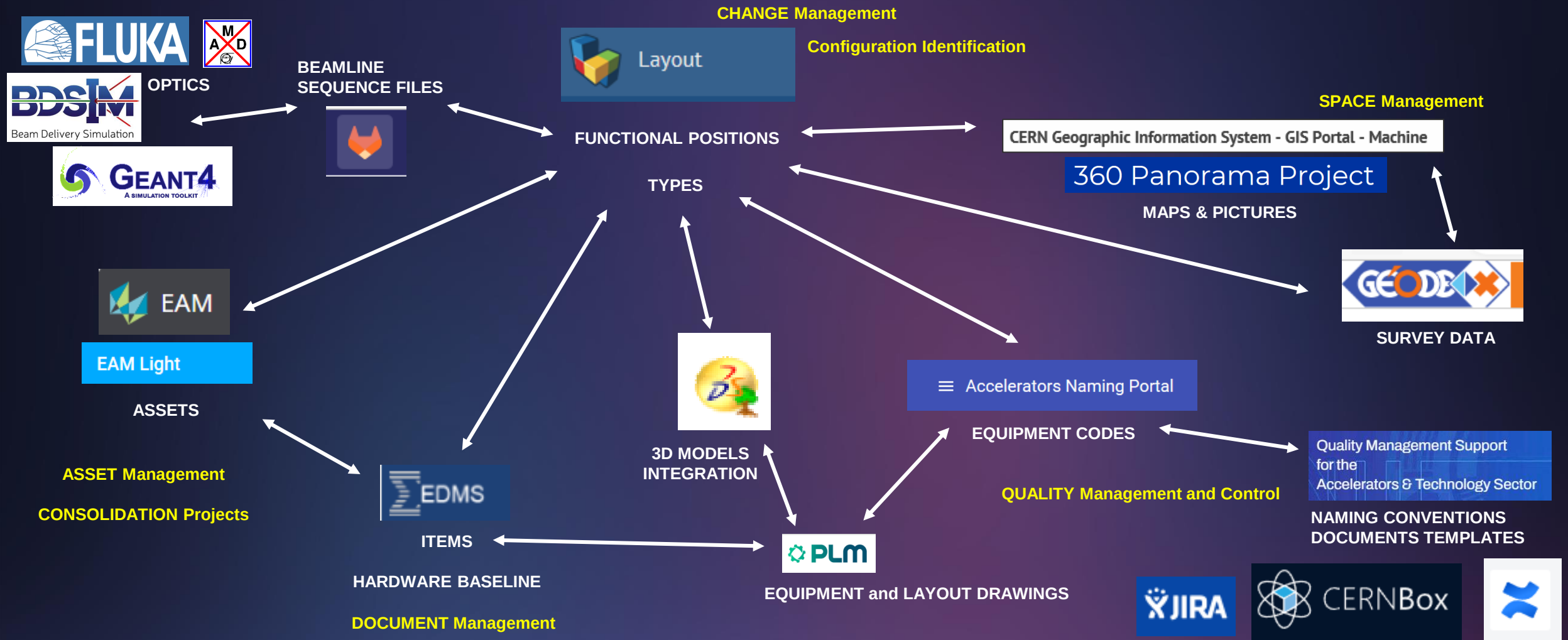
For AFT to be effective: essential to carefully analyse and update the content (weekly reviews with strong effort from stakeholders)

Register and follow the operation faults provide essential information for **future consolidations & upgrades**

Configuration Management Engineering Tools



Configuration Management Processes



Beamline Configuration Management - Summary

Beamline configuration management is a complex rigorous strategy!

Why do we use it?

- establish an agreed framework, allowing multiple equipment/service groups to efficiently collaborate
- maximize quality in the engineering change process, having the overview of the beamline at any time
- ensure long-term detailed documentation, essential for future modifications

Lesson learned and disclaimer:

- Setting up CM strategy with existing beamlines is a lot of work! (sometimes still difficult to adopt)
- Difficult to retrieve and digitalize information, find old drawings, build up as-built 3D models and specifications…

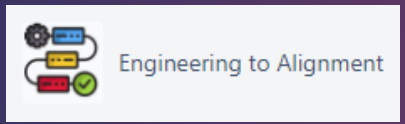
In the Experimental Areas, the groups/teams have come a long way, but there is always room for improvement, …

Beamline Configuration Management – Next Steps

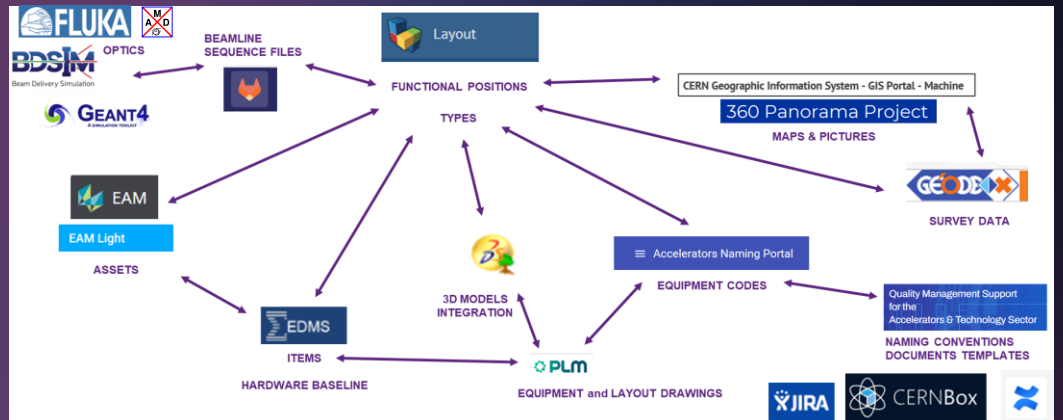
Evolution for the future in experimental areas:

- NACONS (Phase-I and Phase-II) and HI-ECN3: as-built configuration identification and change management
- PS/SPS user schedules (test-beam) integrate with ASM tool
- Automatic link of CESAR and Layout
- Improve schematics to cope with frequent changes
- Improve equipment readiness review in view of LS3

and furthermore:



- E2A project “improve the workflow from engineering to alignment in accelerator complex”
- Increase automatic links between engineering tools used
- Share experiences, expertise, challenges, methodologies and solutions



Thank you!!

BE-EA

BE-ABP, BE-ASR, BE-CEM, BE-CSS, BE-GM, BE-OP, TE-MSC, TE-VSC, EN-ACE, EN-EL, EN-MME, SY-ABT, SY-BI, SY-EPC, SY-STI

CERN

ATS
Accelerators and
Technology Sector

REFERENCES

1. G. Romagnoli, Guidelines for Identifiers of Beamline Equipment in the Experimental Areas, EDMS 2355703
2. A-L. Perrot, Configuration Management Responsibilities in the CERN Accelerators, EDMS 2445311
3. G. Romagnoli, Configuration Management and Operational Aspects in Experimental Areas at CERN, Accelerator Reliability Workshop (ARW) 2022, Newport News US, EDMS 2821653
4. B. Feral, CONFIGURATION MANAGEMENT BEST PRACTICES, EN Workshop, EDMS 2786915
5. Feral, B., Birtwistle, T. W., Bartolome Jimenez, S., Perrot, A. L., & Musso, A. (2022). Configuration Management Best Practices (No. CERN-ACC-NOTE-2022-0033)