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

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Accelerators and Technology Sector

Concluding remarks ENG1

J. Oliveira, M. Taborelli

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- **The present path from the conceptual beam optics to the physical machine**
  - MAD-X to position the optics and compute beam physics
  - Design ⇔ layout drawings iteration with equipment owners for real size details: exchange of information through discussions and e-mails remains necessary, “manual check” of apertures, definition of alignment targets, synchronization of changes
  - No automatic updates in case of modifications

- Move toward data-driven generation of the layout drawings enabling an automatic translation from the layout database data towards to automatic generated drawings and MAD-X insertion files, automatic aperture checks of the layout database, etc…

This needs:

- Formal data management structure team
- Ensuring data Quality Assurance
- Establishing single data source coming from E2A.
- Defining protocols, information hierarchy (time and logical links)

- **The CERN Layout Database** documents the physical configuration in space of CERN infrastructure and its evolution in time (what, where, when, interfaces with…)
  - Requires/ enables exchange of data CERN wide including specific data (civil engineering, mechanics, electronics, magnetics, optics, vacuum, cryogenics….)
  - Structure and hierarchy (Classes, functional positions, Controls, naming convention)
  - Links to other databases (Enterprise Asset Management (EAM), GIS, Panorama, EDMS, MTF…)

- **Product Lifetime Management (PLM) tool**:
  - Centralised single source of all information of the equipment along its lifetime : all in one source !
    - engineering design data (MultiCAD)
    - manufacturing and test results, more than CERN-wide (external collab.)
    - history of changes
    - in interaction with other CERN databases (EDMS, EAM…)

  - Toward: **Digital twin** for visualization in the machine environment: from layout + CAD + PLM +….
    - Useful for interventions on site, their planning, training, crosscheck.

- Toward: a more global approach, **the digital thread**, a data driven architecture linking data gathered during design and lifetime of the physical object with all its properties and history.

- **Proof of principle of digital thread and twin on mechanics.**
- **Digital twin** includes the behaviour of physical components in operation
  - Start from measured data, measured behaviour by physical sensors
  - Build a model
  - configure and train the model twin with virtual sensors
- More than simulations: reaction to unpredicted situations extrapolating from existing data points.
- At the scale of FCC project with this tool it would be possible to mimic the behaviour of the magnetic axis with real conditions applied, since this can become critical for operation.

More in General:

- Removing manual information exchange and going towards automatic and controlled one
- Improving data validation on data-driven processes.
- Centralising data on one single source of truth
- Going beyond simulations by introducing digital thread to produce real-time digital twins
- Only possible under the consensus of all the stakeholders.