Integration of 3D models belonging to different WPs and services

Y. Muttoni EN-MEF-INT

with the contribution of P. Fessia

Summary

- Introduction : what is integration?
  - Mandate
  - Design office overview
  - Integration work process
- CAD data in project HL-LHC
  - Our strengths
  - Possible issues
  - Cad data and time life project
  - PLM working group
- Conclusions

Introduction : what is integration?

Mandate

- Provide the existent 3D CAD* data environment (using also reverse engineering) to realize new equipment studies.
- Centralize all the new 3D CAD data provided by <u>all the design offices involved</u> in a project (see slide integration work process)
- In order to guarantee the correct installation of each machine equipment and also to avoid the interferences during installation phases, handling and transport, the integration studies are an essential step in this project realization. In future also key to minimise radiation to personnel.
- Using our integration work feedback learnt during the previous following project
  - LEP Machine
  - LEP Machine to LHC Machine

correct and apply the methodologies to new project

  - LHC Machine to HL-LHC Machine**
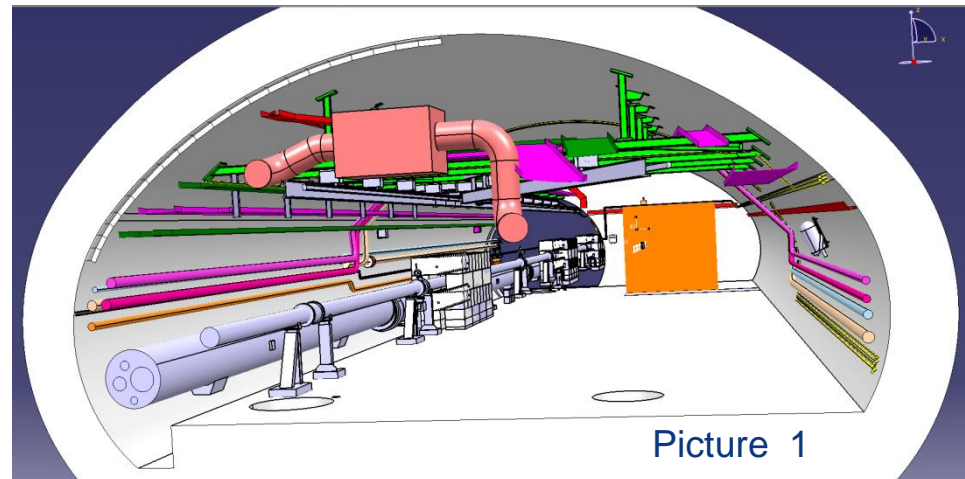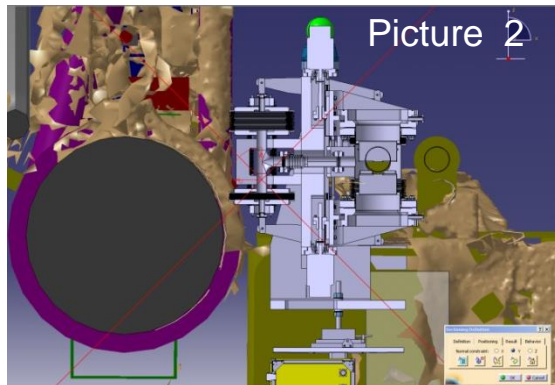
* CAD Computer Aided Design
** Also LIU Project, HieIsolde, Elena and more

Y. Muttoni EN-MEF-INT
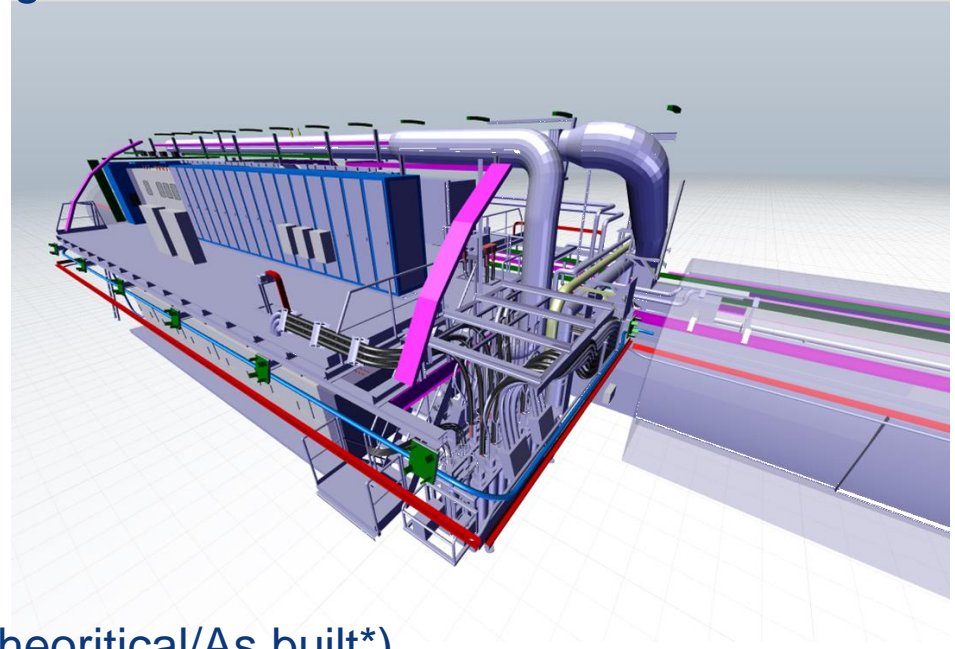
Design office overview Integration

Deliverables:

- 3D Integration assembly of the services for the machine (Picture 1)
- Simplified models of machine equipment (Magnet, collimator, vacuum pipe) (Picture 1)
- Layout machine in 3D and 2D layout drawing
- Meshing scan* to check installation services (Picture 2)
- Some mechanical drawing (Doors, shielding blocks, light metallic structure)

Picture 2

Picture 1

*treatment cloud of points provided by survey team in using a laser scanner

Y. Muttoni EN-MEF-INT

The design offices in the service groups

- Services and Infrastructure design offices
  - Electrical services EN/EL.
    - Cables trays, Racks layout.
  - Cooling and ventilation EN/CV.
    - Pipes, Water pump, Air duct.
  - Transport and handling EN/HE.
    - Transport volume, Handling equipment
  - Civil Engineering GS/SEM .
    - Building, underground cavern.
    - Metallic structure.
  - Cryogenic equipment TE/CRG.
    - Cryogenic pipes, cryogenic plants.

Deliverables:
  - <u>3D Model for integration (Theoritical/As built*)</u>
  - PID Piping Instrumentation Diagram
  - Specification drawing
  - Installation drawing
 - Mechanical drawing

* To be clarify by methodologies

Y. Muttoni EN-MEF-INT

Design office overview Mechanical

- Machine equipment EN/MME
  - Vacuum chamber, magnet, collimator ….
- Detector equipment inside the machine PH
  - Roman pot, detector scintillator ….

Deliverables:

- 3D Model detail assembly for manufacturing and as built
- 2D drawing detail assembly for manufacturing and as built
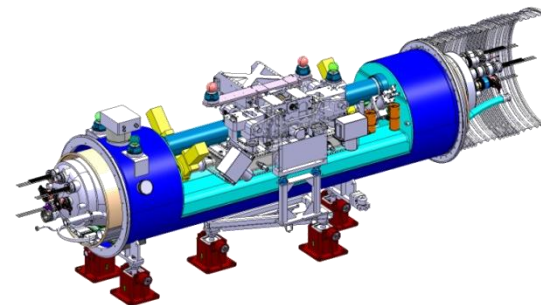
LHC Collimators in
DS plus QTLC

Integration work Process

Integration meeting Ex: LS1 R2E Project

ICL Meeting	Number by year
28 - 2013	
39 - 2012	
37- 2011	
23 - 2010	
10 - 2009	

Integration Team   **+**   *Design offices*
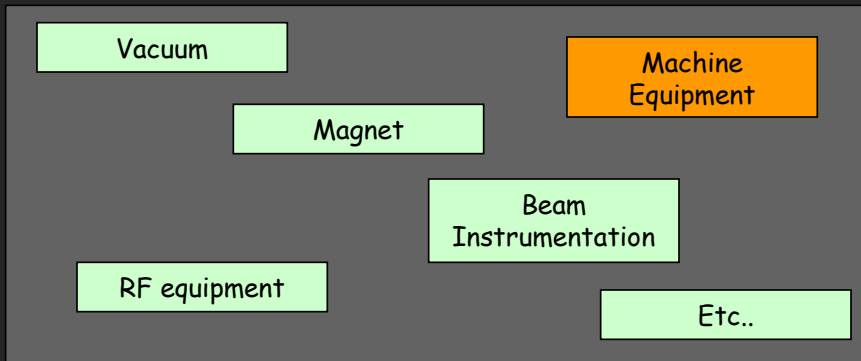
Mechanical design office

Vacuum

Magnet

Machine Equipment

Beam Instrumentation

RF equipment

Etc..

Services design office
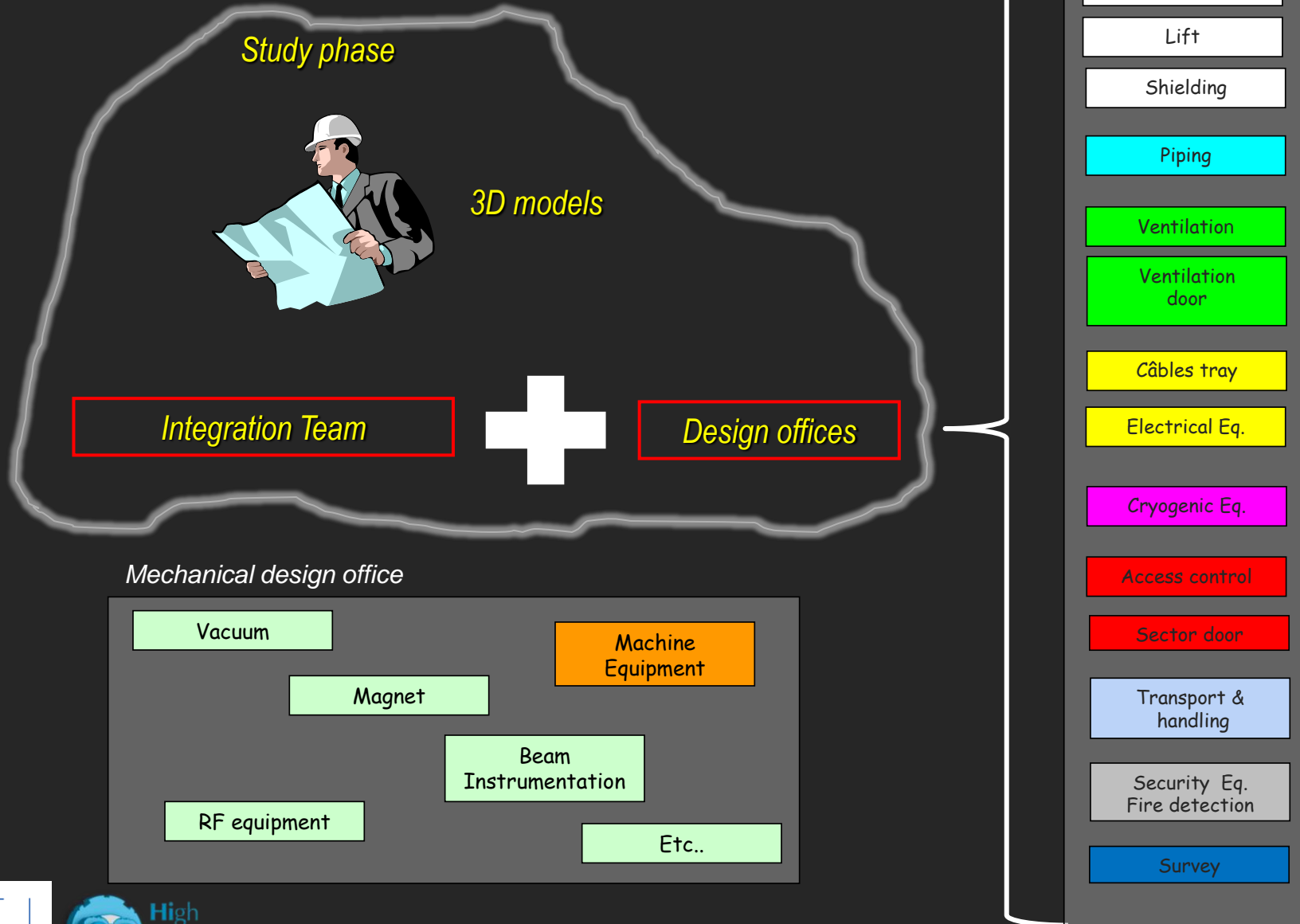
Civil engineering

Metallic structure

Lift

Shielding

Piping

Ventilation

Ventilation door

Câbles tray

Electrical Eq.

Cryogenic Eq.

Access control

Sector door

Transport & handling

Security Eq. Fire detection

Survey

Y. Muttoni EN-MEF-INT

Share the 3D data with external design office

Integration work Process

Study phase

3D models

Integration Team + Design offices

Mechanical design office

Vacuum

Machine Equipment

Magnet

Beam Instrumentation

RF equipment

Etc..

Civil engineering
Metallic structure
Lift
Shielding
Piping
Ventilation
Ventilation door
Câbles tray
Electrical Eq.
Cryogenic Eq.
Access control
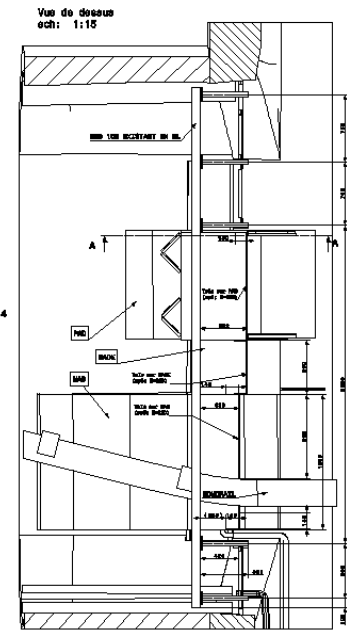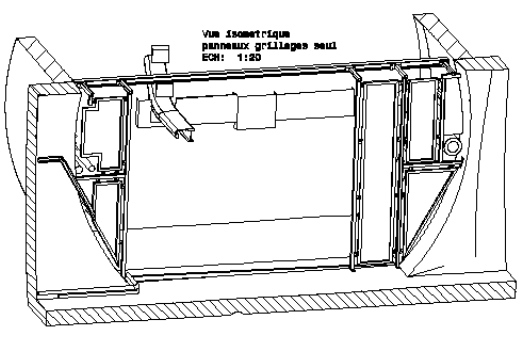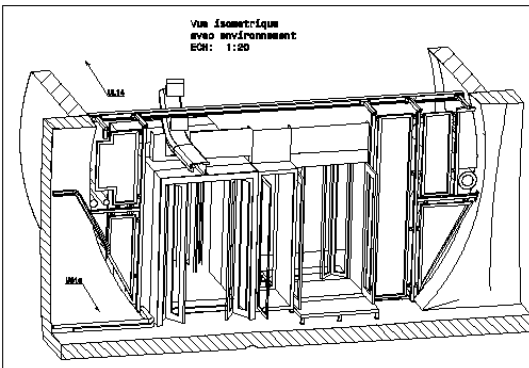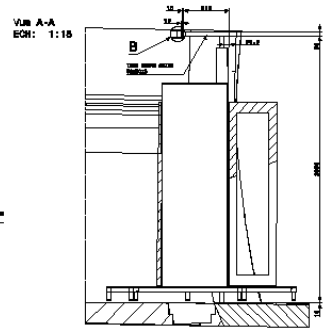Sector door
Transport & handling
Security Eq. Fire detection
Survey

Y. Muttoni EN-MEF-INT

Integration work Process

Study phase

Installation drawings or Installation presentation

3D models

Design offices Integration team

Civil engineering
Metallic structure
Lift
Shielding
Piping
Ventilation
Ventilation door
Câbles tray
Electrical Eq.
Cryogenic Eq.
Access control
Sector door
Transport & handling
Security Eq. Fire detection
Survey

Y. Muttoni EN-MEF-INT
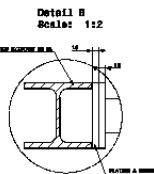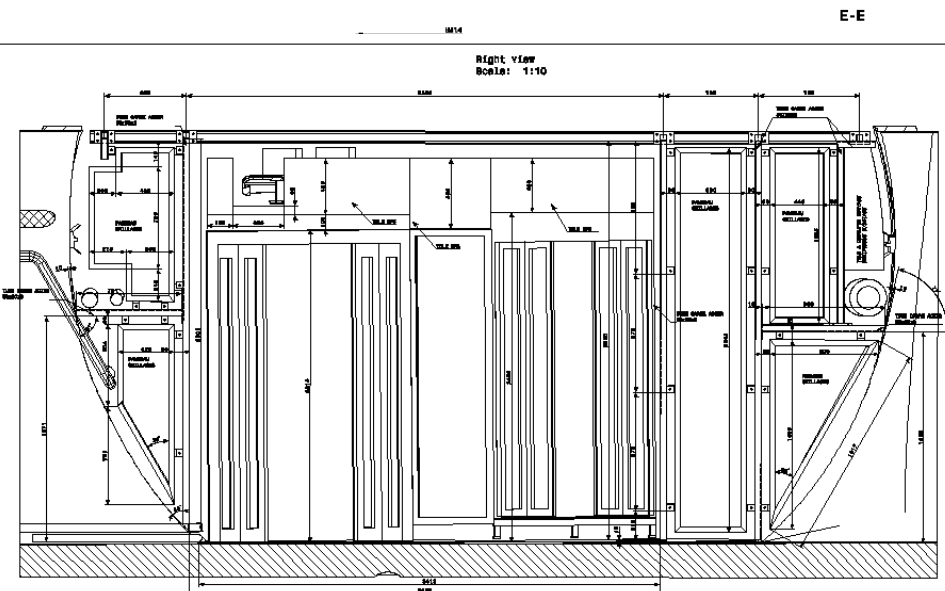
EN-MEF
Access control installation drawing

Y. Muttoni EN-MEF-INT

CAD data in project HL-LHC

Our strengths

- Excellent relationship among design offices and designers.
- General effort to keep the designer knowledge to guarantee the quality of the 3D models provided by all design office.
- Management support to keep the number of designer in the integration section to realize the work (Integration studies and installation follow up).
- Dedicated integration meeting with designers (mechanical and services) and project engineer. ICL meeting link

- Using at CERN the same CAD software 3D.
- Using scanning* method to realize reverse engineering.
- Using scanning* method to check the new installation.
- To provide better tailored integration information and continually updated environment we do not provide integration drawing but we validate and approve 3D model and simplified PPT documents in EDMS.

*See slide 5

Possible issues to watch and to improve

Integration design office

- A better follow up by integration designer to update integration approbation.

External design offices

- Necessary to stabilize the number of designer in each design office to be able provide CAD data.
- CAD data exist without design owner (ex: waves guide RF)

All design offices

- Some CAD data should be used by the project with a migration cycle did not yet complete (ex. Many 3D model to an unique equipment necessary to clean data). See next slide.
- Not clear status indicator available to give the maturity of the 3D model. (PLMWG : Specification, Support : implementation)

Cad data and time life project

- Time life CAD software vs time life project.
- Using the feedback CAD software Euclid vs machine LHC
  - Data migration
  - Completely different CAD software
- During all the exploitation of the machine the CAD data should be available to visualization and modification.

PLM working group
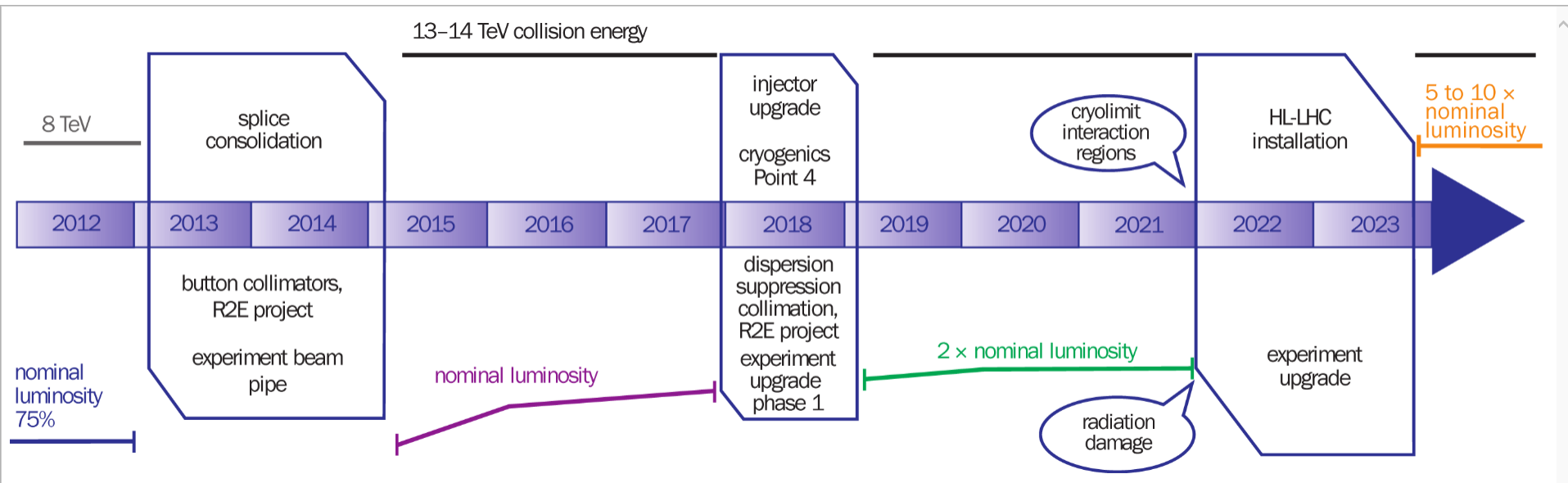
On courtesy of S. Bally

European Organization for Nuclear Research

PLM WG - Background

2010 Q1

- The **PLM WG** is launched as a sub-activity of **CAEC** *(Computer Aided Engineering Committee)* and **complements** the work currently done by the **GUCS** *(Groupe d'Utilisateurs Catia-SmarTeam)*

- Whereas the GUCS focuses on the needs of **designers** using the native **Catia-SmarTeam** at the CERN site, the PLM WG includes as well the needs of other **users** of **CAE data**
    - Project managers, engineers, physicists
    - <u>Outside</u> collaborators and institutes
    - Workshops and sub-contracting companies

PLM Working Group,
SmarTeam Requirements

2-day SmarTeam Workshop, 29-30 August 2012

4

Y. Muttoni EN-MEF-INT

PLM working group

On courtesy of S. Bally

PLM WG - Mandate

- Define **processes** needed for efficient **lifecycle management** of **CAE data** at CERN and **coordinate** the **adoption**, **use** and **evolution** of these processes throughout the **organization**

- **Ensures** at CERN level the **coherence** and the **consistency** in matters related to **PLM**

- *Mandated by, and reports to **CAEC***

- *Works in close **collaboration** with **GUCS** in PLM issues attaining to **CAD tools** (Catia and SmarTeam) as well as with people in charge of the **Quality Assurance** matters at CERN*

PLM Working Group,
SmarTeam Requirements

2-day SmarTeam Workshop, 29-30 August 2012

5

Y. Muttoni EN-MEF-INT

Conclusions

- All design offices at CERN should continue to work with the same CAD Software the same PDM* and the same methodologies.

- The high level of radiation increases the need to have the better visualization of the virtual machine.

- Put in place at CERN the correct process to produce CAD data to exchange the correct CAD data with external firm or collaboration. (Input PLMWG)

- Quality assurance plan should be involved in the process. (Cycle approbation integration part of QA plan)

- Now design offices already are producing new data to HiLumi project data management and data structure shall follow.
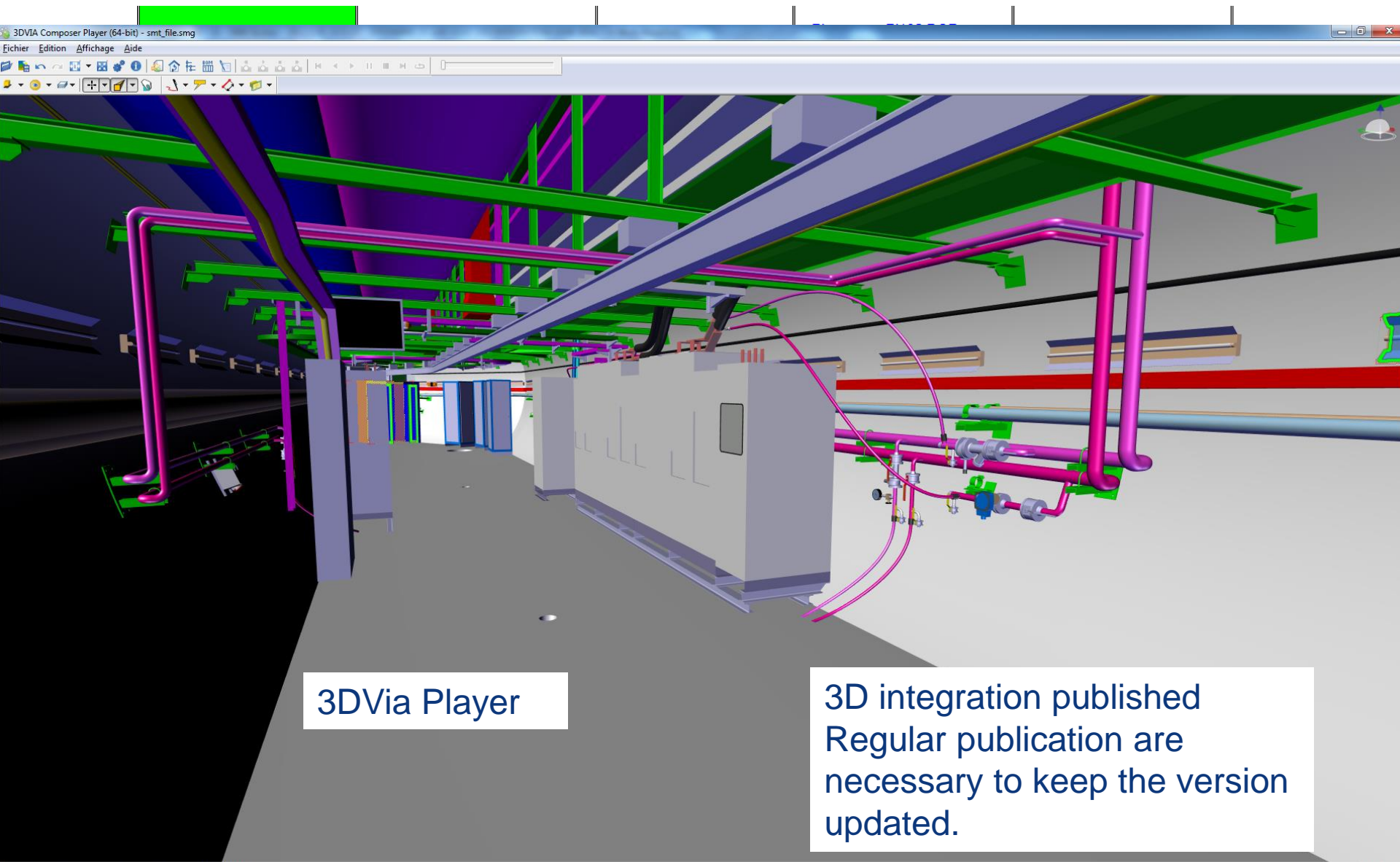
- Future CAD software Which? When? How? Migration data?

* PDM Product Data Management

Thanks for your attention
Questions?

Annexe

3DVia Player

3D integration published
Regular publication are
necessary to keep the version
updated.

The 3D publication provided 3D view to
non CATIA/Smarteam users.

Y. Muttoni EN-MEF-INT

CAD Data in project HL-LHC

Software used at CERN

- Using CATIA V5 software to create 3D model and 2D drawing.
- Using SMARTEAM software to store the CAD data .
- Memo CAEC * Requirements on user access to CERN CATIA and SMARTEAM (Edms 1276911)
- EDMS to exchange data with external firm.
- Rules and process should be written to produce to share and to protect the data (See slides on PLMWG)

* Computer Aided Engineering Committee

Y. Muttoni EN-MEF-INT