The Pyramid.

Start of Works.

Quite unlike the preparations for any other building site.

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Information Management and Design Integration in In-Kind Collaboration

> Introduction
> Examples from the European XFEL
> Analysis: General Principles & Ideas
> Further Observations and Recommendations

INTRODUCTION
The presented work was conducted in the frame of **DESY, Information Management**

The group IPP helps to optimize business processes at DESY, with the objective of strengthening the processes by enterprise information systems. IPP offers consulting on collaborative engineering, information and project management, and operates and maintains DESY’s PLM, CAFM, BPM & 3D CAD systems.

**XFEL WP40, Information and Process Support**

WP40 provides central services to the project in the areas of collaborative engineering and information management, in particular Engineering Data Management, 3D collaborative engineering and CAD services, and project management system and training.

 XFEL Organization and In-Kind Contributions

- XFEL organized into WP groups and WPs
- In this presentation, WPs and IKCs are mostly interchangeable terms
- XFEL WPs receive in-kind contributions from various partners which may contribute to several WPs
Solution Examples from the European XFEL

- Design integration model and process
- Fabrication planning using MBOM
- Inspections and parts tracking during fabrication and installation
- Project management
- Ubiquitous visualization
Design Integration at European XFEL

**Objective**
Provide complete and consistent design description of entire facility

**Approach**
Central design office receives & integrates contributions from all partners and performs clash checks.

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Civil construction starts 3 years ahead of all other systems.
Design Integration at European XFEL

Geometry generated from lattice simulation files
Already 3D models from several different (CAD) sources
Transportation needs to block space for handling components.

Safety needs to block space for escape routes.
Survey needs to block space for laser beams of alignment system

Clash checks – detect collisions before fabrication, save cost!

Data owned and solely modified by responsible WP

Accept contributions from anyone, at any time, by any system
Once a week Cheops would visit the room in the palace that had been set aside for the main architects. Everyone had the impression that he was in a hurry for one thing only: to leave. On one occasion, however, on the day when the model was first exhibited, he did stay a little longer. His eyes filled with a cold gleam.

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**Design Integration: Model**

Placeholder model used to ensure that deliverables from different WPs integrate without collisions

- **Objective**
  - Provide complete and consistent design description of entire facility

- **Approach**
  - Decouple design coordination and detailed design

- **Placeholder**
  - Maximum part dimensions
  - Envelope + Space for Tolerances, Tools …

- Placeholders are (de-) coupling activities of WP and central integration office – enable design updates by WPs w/o further clash checks if detailed designs fit into placeholders

- Detailed design model used by WP for engineering and production
### Design Integration: Process

<table>
<thead>
<tr>
<th>Sub-System Designers</th>
<th>3D CAD Integrator</th>
<th>3D CAD QA</th>
<th>Technical Coordinator</th>
</tr>
</thead>
<tbody>
<tr>
<td>RF</td>
<td>integrate &amp; release building model</td>
<td>perform QA: collision checks</td>
<td>negotiate resolution strategy</td>
</tr>
<tr>
<td>create / update subsystem model</td>
<td>iterate from here every two weeks</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Sub-System Designers**
- RF
- Ventilation

**3D CAD Integrator**
- Integrate & release building model

**3D CAD QA**
- Perform QA: collision checks...

**Technical Coordinator**
- Negotiate resolution strategy

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**Objective**
Provide complete and consistent design description of entire facility

**Approach**
Decouple central and de-central activities

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What contributed above all to the mental torture was that everything hung together. A minor correction to the height or the base dimension led to an infinite number of other changes – the air vents, the false escape routes, the pressure on the funeral chamber, the gradient, the number of stones, not one of these things could be conceived in isolation.

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Fabrication Planning Using MBOM (Manufacturing Bill of Material)

**Objective**
Clarify responsibility and (fabrication) procedures for in-kind contributions.

**Approach**
Use extended MBOM including administrative and procedural information in line items.

PBS acc. to manufacturing
Part name and documentation

- Responsible party
- S/N format, location
- Tracking details
- Logistics requirements
- Tools, return parts
- Test, transport times
- Re-order conditions
- ...

Manufacturing Process and Acceptance Testing

**XM**
Module ready for shipping
Module received
Module ready for waveguide

**Final Inspections**
Owner: Module Owner
Possessor: IKC
Delegate: Industrial Sub-contractor
Location: IKC Shipping Area

**Prepare for Shipping**
O: Module Owner
P: Carrier
L: Transportation-to-DESY

**Transportation**
O: Module Owner
P: WP10
L: DESY-AMTF

**Incoming Inspection**
Transit Documents
Incoming Inspection Record

**Final Test Record**

Track XM lifecycle status by accompanying documents

Cryomodule lifecycle
Inspections Everywhere

**Objective**
Provide scalable and rapidly adaptable scheme for issuing and receiving work instructions and records

**Approach**
Excel everywhere – for task-specific checklists with auto-post processing

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Parts Tracking

**Objective**
Monitor supply chain to ensure timely availability of sufficient material

**Approach**
Integrate parts tracking with inspection procedures, also at IKCs

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**Submitted Assembly Record implies part at this time located at IKC assembly area**

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**Good coverage, and on-the-fly technical documentation**

**Easily and intuitively include partners and suppliers**

**Adapt to specifics of WPs by the WPs**
Especially a study of the quarry’s delivery notes, of the stone’s bills of lading, of the first and second control certificates established the fact that beyond any possibility of error the fatal stone was the two hundred and four thousand and ninety-third piece in the south slope, or, in the recording system used in the general inventory, stone n° 92 308 130393.

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**Project Management**

- Coordinate and consolidate project planning in > 50 WPs
- Follow well-defined PM process, obtain automated reports
- Maintain project plans within WPs & global plan in Project Office

**Vision Sharing: Ubiquitous Visualization and Access**

**Objective**
Reduce frictions in communication and collaboration

**Approach**
Offer ubiquitous visualization and information access

**Better communication among teams & better decision making**

**Better collaboration with contributions optimized to context**

**Improved design validation**
ANALYSIS
GENERAL PRINCIPLES AND IDEAS

Analysis: Selected Principles and Ideas

> Lifecycle and deliverables
> Collaborative engineering
> Documents for workflow automation
> Non-invasive tools
“I want to be in the middle”, Cheops declared.

“I understand, Majesty”, replied the architect-in-chief.

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Collaborative Engineering Process Pattern

Keep details in authoring systems inside WPs

Use high-level representations for integration in PO

Note: Some detailed work may have to be started before reasonable high-level information becomes available.

Process Automation Based on Spreadsheet Documents

> Documents can be used for organizing, controlling and tracking processes (Order → Deliverable)

> Approach: Documents to initiate and follow-up on activities are issued and captured by the central PLM system, next actors may be determined by workflows
Non-Invasive Tools

Tools shall impose as few IT requirements as possible on partners, be “non-invasive” on their computers.

Web-based download and upload tools running on any web browser issue and retrieve files to/from WPs, suppliers, ...

Spreadsheet with only very few rules regarding reserved fields allows WPs to create checklists and work instructions according to their needs.

FURTHER OBSERVATIONS AND RECOMMENDATIONS
Selected Observations and Recommendations

- **The responsible party may not always be the best party to perform a task.** Partner may not be in possession of component at a given time, or may have lost resources.
  - Component develops leak during transportation – Who will fix it? Who is responsible?
  - Delayed delivery → downstream contributor may have lost staff on temporary contracts

- **Lemma: Replicate the entire engineering infrastructure and expertise of your IKCs on-site.** Be prepared for receiving IKC engineers and provide them with adequate infrastructure – or risk losing time in case fixes needed at installation & commissioning.

- **Provide central services, not central offices.** If you establish a common standard, provide a dedicated service helping IKCs to comply
  - Applies to requirements, design models, inspections, etc., but also technical standards

- **Find the right balance of standards vs flexibility.** IKCs may have individual best practices worth accepting -- include IKCs in defining processes and standards

- **Work on basis of consensus.** Many issues resolve by common effort of process improvement.

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It had to be a project that could in principle be completed, without ever reaching completion. In a nutshell, a permanently self-renewing project. And one that would be really visible.

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