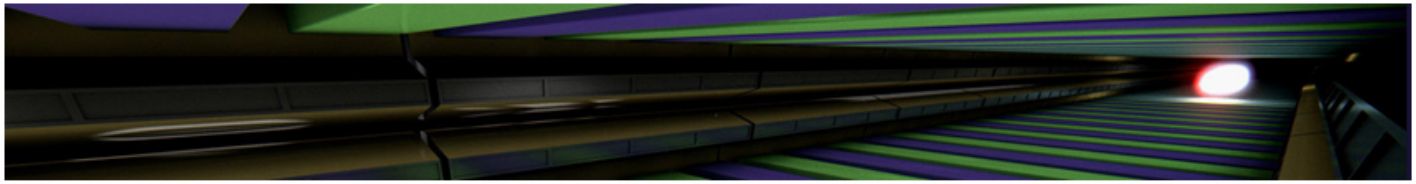


The European XFEL

a Management Challenge

What is management?

Management is the act of bringing together people and resources for accomplishing a desired goal

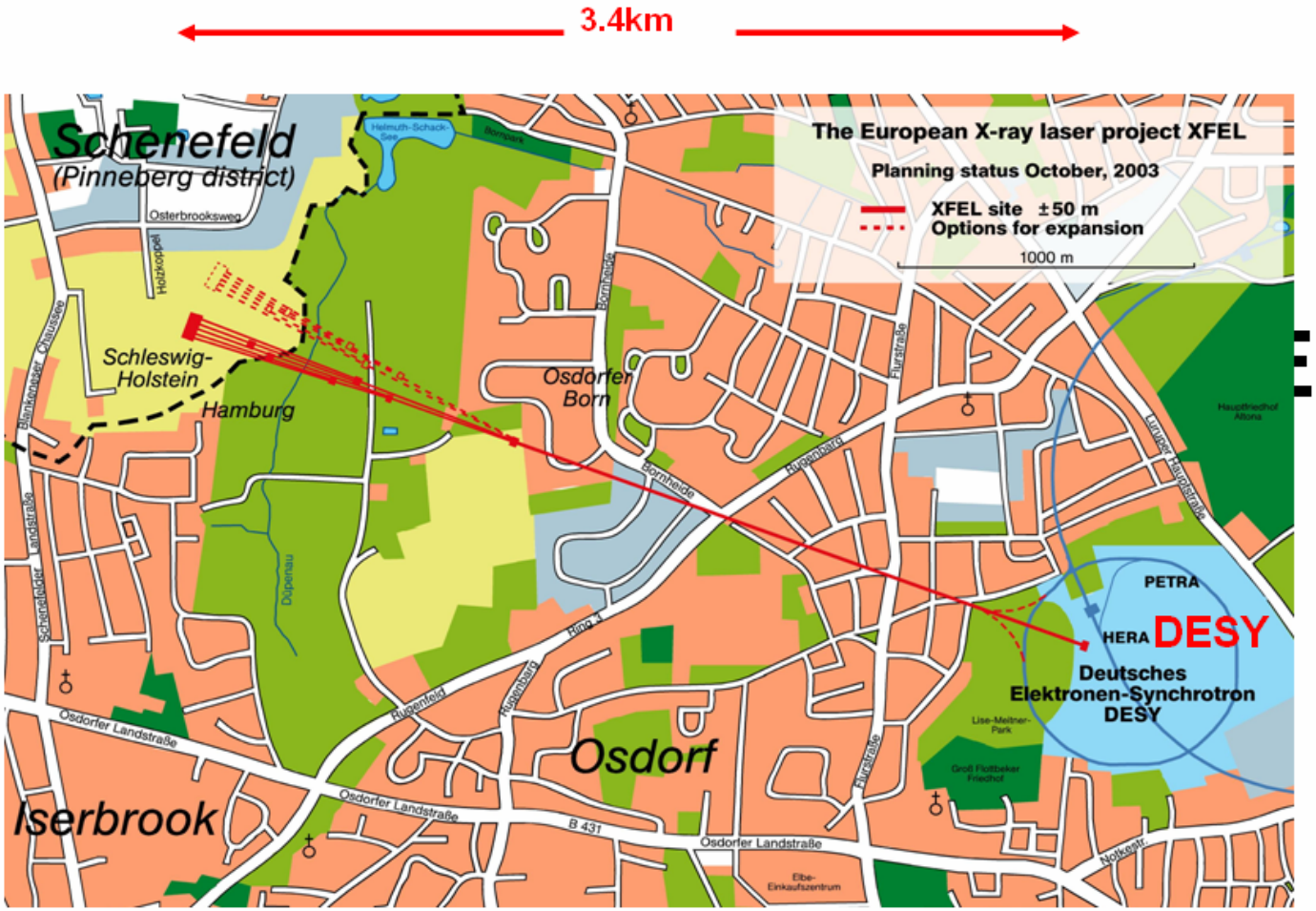
It comprises planning, organising, staffing, directing and controlling an organisation

What is the European XFEL?

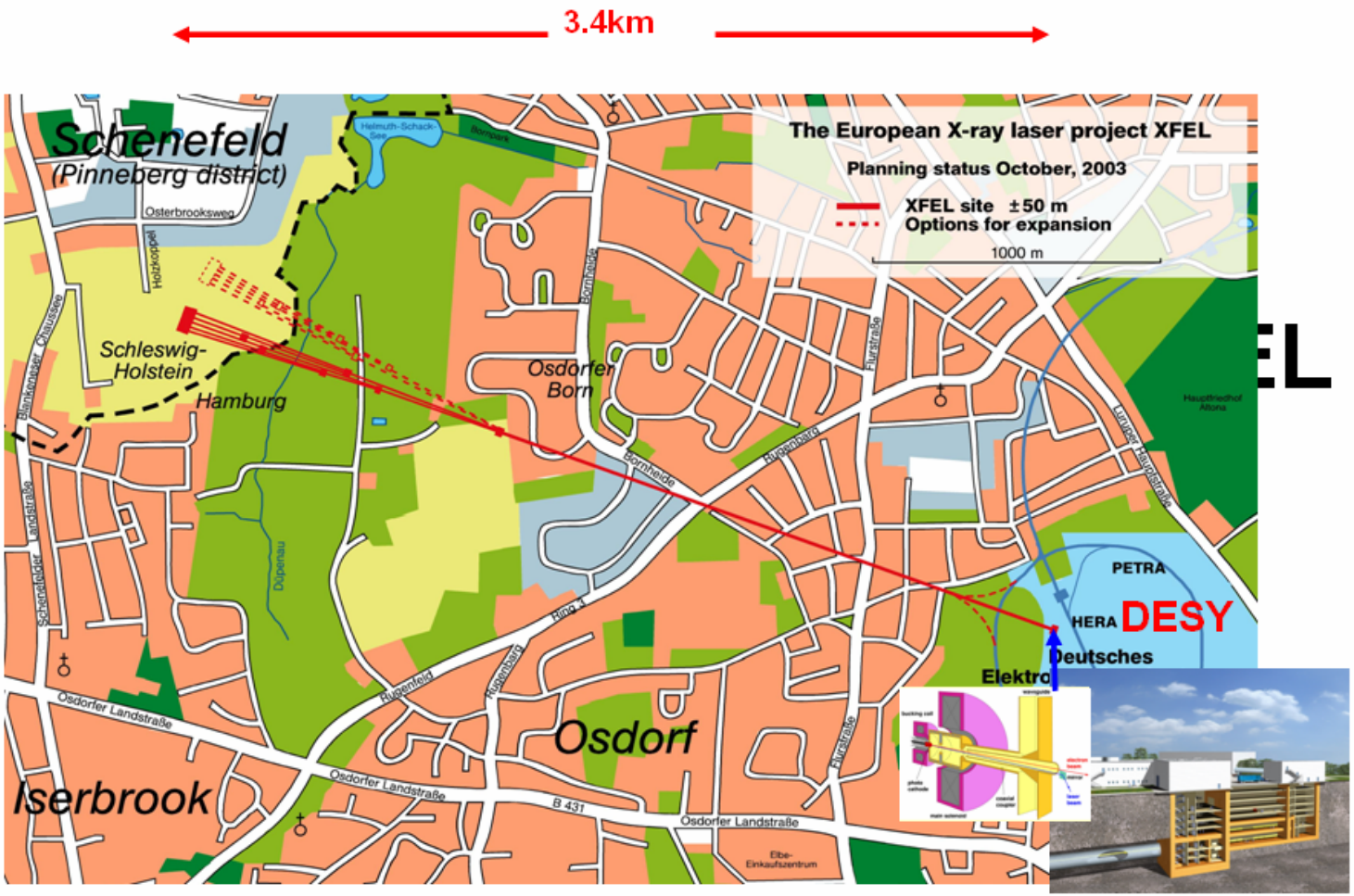
XFEL is a fascinating project

A scientific idea
A political idea
A prototype for decentralised projects
A management challenge

XFEL Facility (≈ 10^9 €)



XFEL Facility (≈ 10^9 €)



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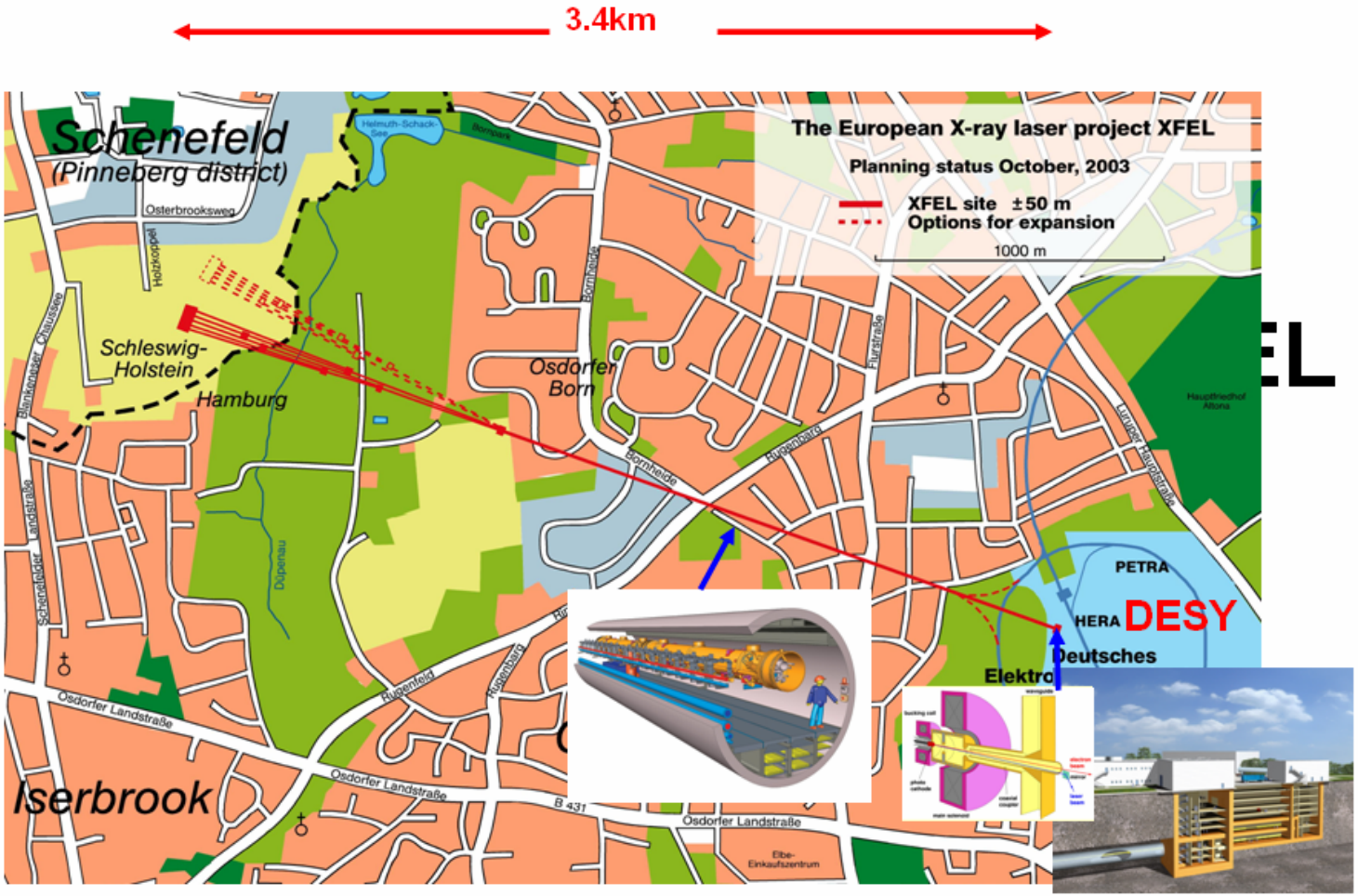

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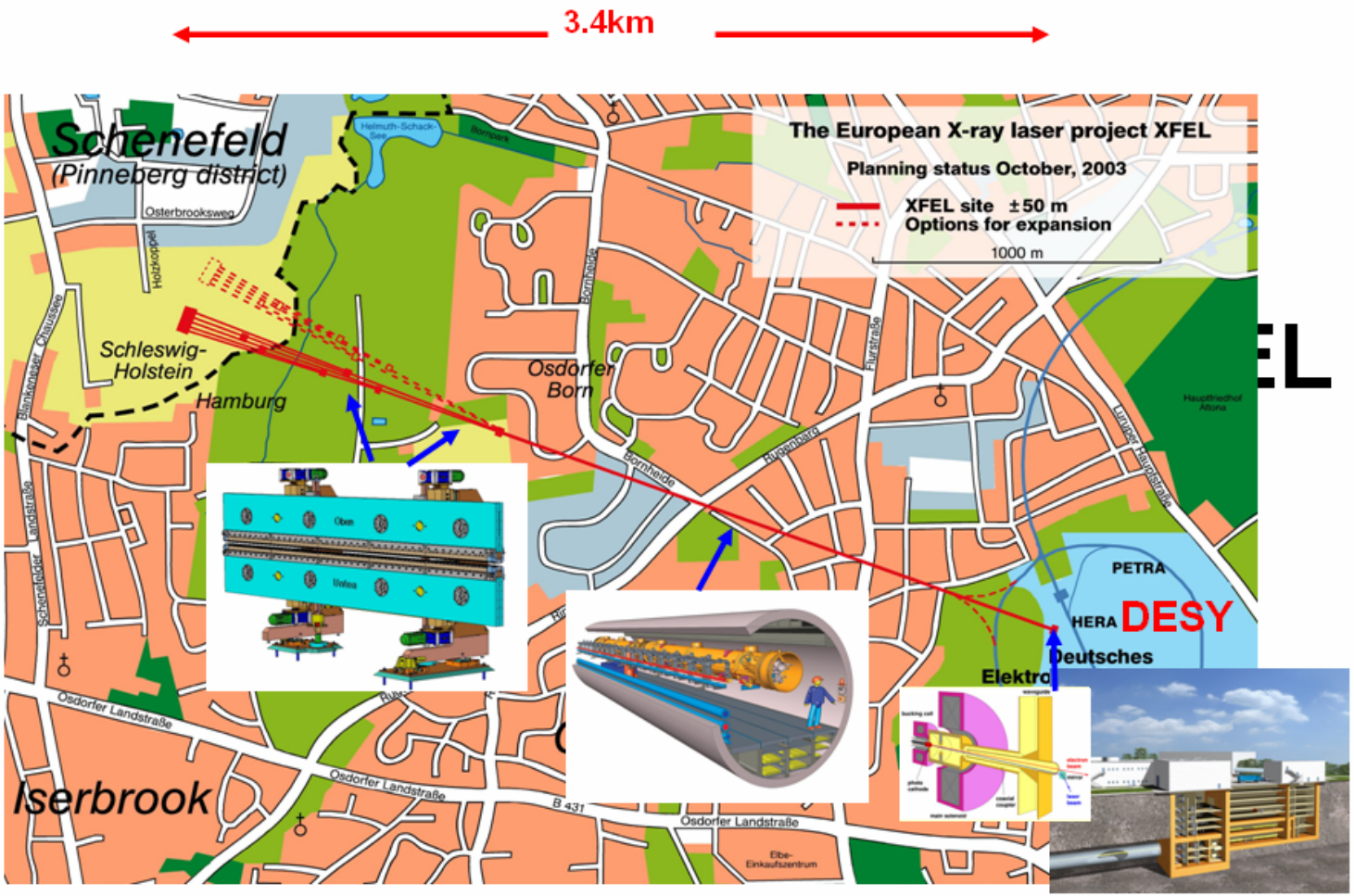

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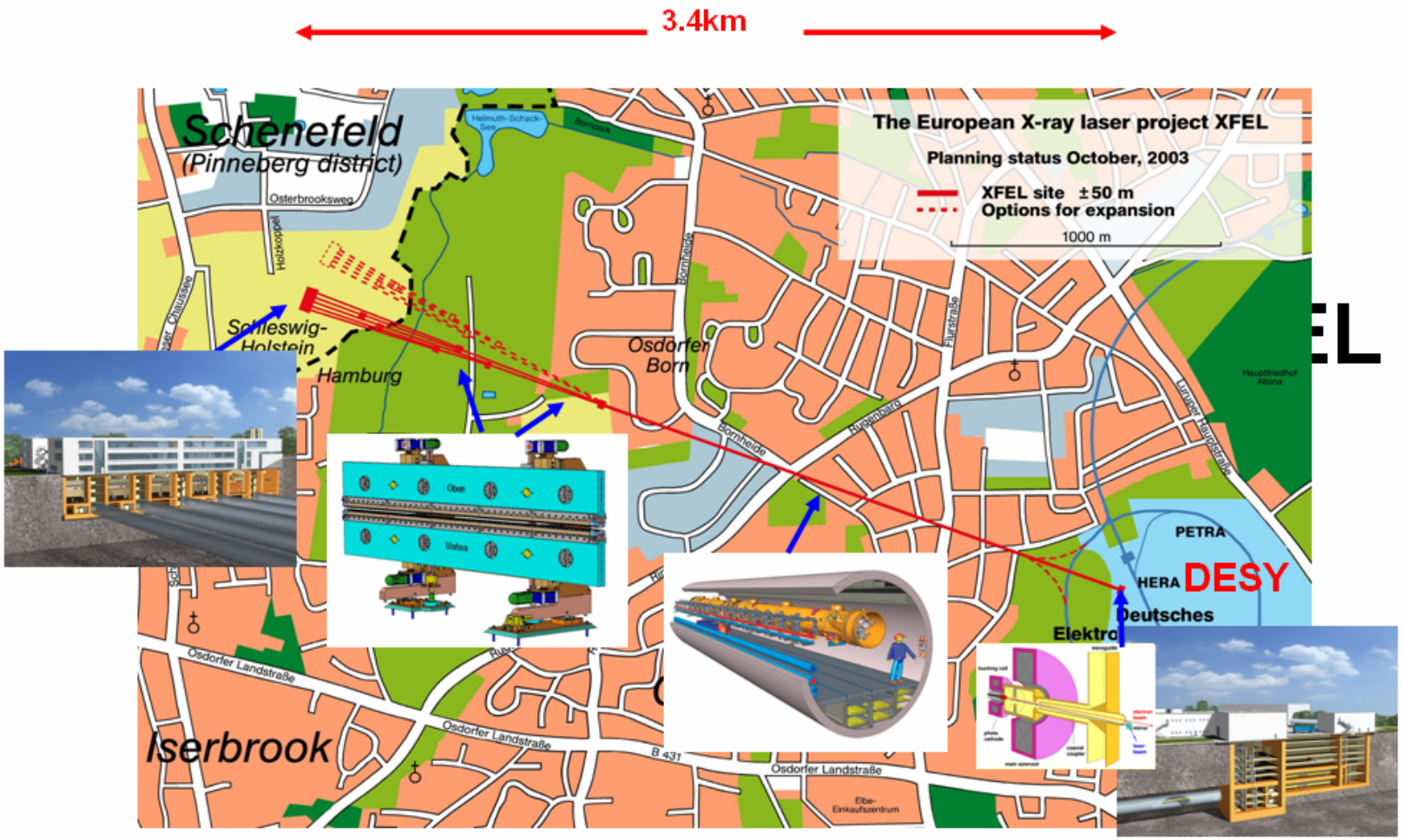
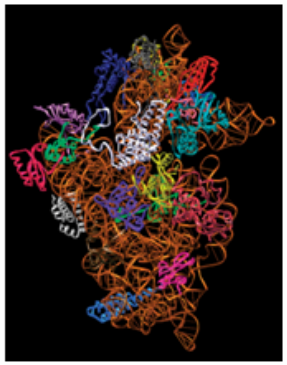


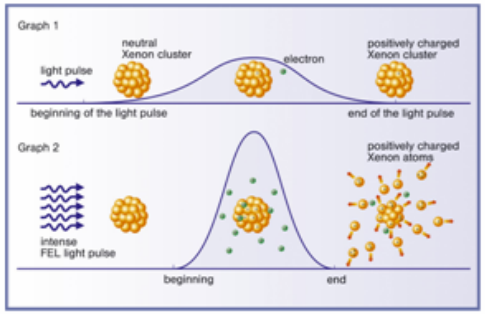
XFEL Facility (≈ 10^9 €)

The Scientific Case

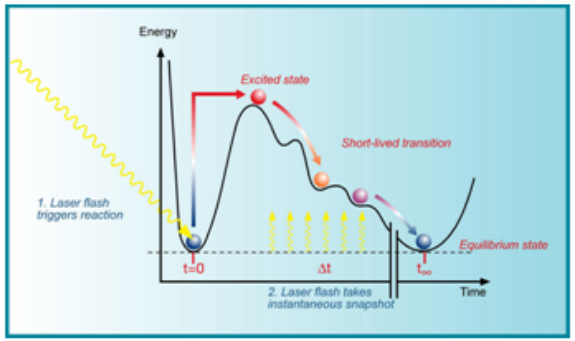
The ultra short (10-50 fs), highly coherent and brilliant XFEL light pulses allow:



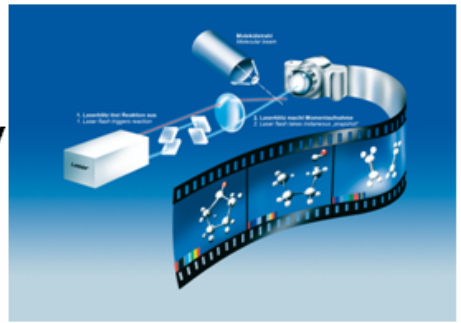
Structure determination



Studying exotic states of matter (like in stellar gases)



Femto-Chemistry
–> Movies



(The light pulses are about 1000 x shorter & 10^{10} x more brilliant than at latest synchrotrons)

The International Context

Currently there are worldwide 3 large X-ray FEL projects:

LCLS (Linac Coherent Light Source), SLAC, USA
-> 120 pulses/s

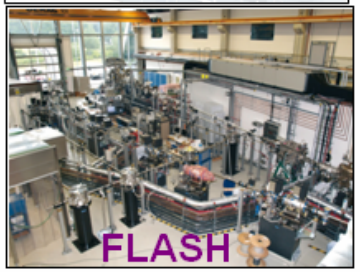
SCSS (Spring-8 Compact SASE Source), Spring-8, Japan
-> 60 pulses/s

LCLS and SCSS aim to be operational 2009/10

XFEL, DESY, Germany
-> 30.000 pulses/s (Superconducting Linac)

XFEL aims for 'first e$^-$-beam' in 2014 and 'ready for users' in 2015

FLASH (at DESY), already operating user-facility
–> Sets standards for generating VUV and soft X-ray laser light
–> Sets standards for the scientific exploitation of such radiation
—> ≈ 1/10 of XFEL



XFEL – The Political Idea

The primary political idea is to launch a new way in Europe for establishing large-scale science projects (ESFRI roadmap)

14 Countries have decided to build jointly a new international research facility in Europe

It shall be owned the contributing countries:

- **Limited Liability Company**
- **Countries will be shareholders**
- **Lasting rights & obligations**
- **Construction Cost ∑≈ 1G€**
- **In-kind & in-cash**

The primary political idea is not to build a XFEL facility as fast and as cheap as possible –> **Implications to be understood**

Analysis

What needs to be considered for setting up an efficient running project

Prehistory & Status – Technical Analysis

XFEL (like practically all large projects) has a long prehistory

- Originating from the TESLA linear collider proposal
- Original TESLA technologies now optimised for XFEL
- Accelerator layout is further developed than the photon part
- R&D has been basically stopped – **Technologies** cores regarded basically **"mature"**
- "Big" new ideas cannot be implemented anymore
- Mass production must be launched –> Industrialisation!
- Interfaces and lifecycle issues require now highest attention
- Implementing good QM and Logistics is crucial

Prehistory & Status – Social

- Prepared by many small working groups and individual people
- Grown structures
- Common and diverting ideas –> what and how to realise
- Hard tested emotions and beliefs over the years
- New entities get involved –> new ideas, responsibilities must be given away, other methods must be accepted
- "High-Energy Community" shall become a "Photon Science Community"
- Important secondary objectives of stakeholders

Management as Discipline

Science is highly individuals-related, which is mostly good:
–> The best 'science brains' have often the best science ideas

"Science Management" is also very individuals-related, which is often not so good:

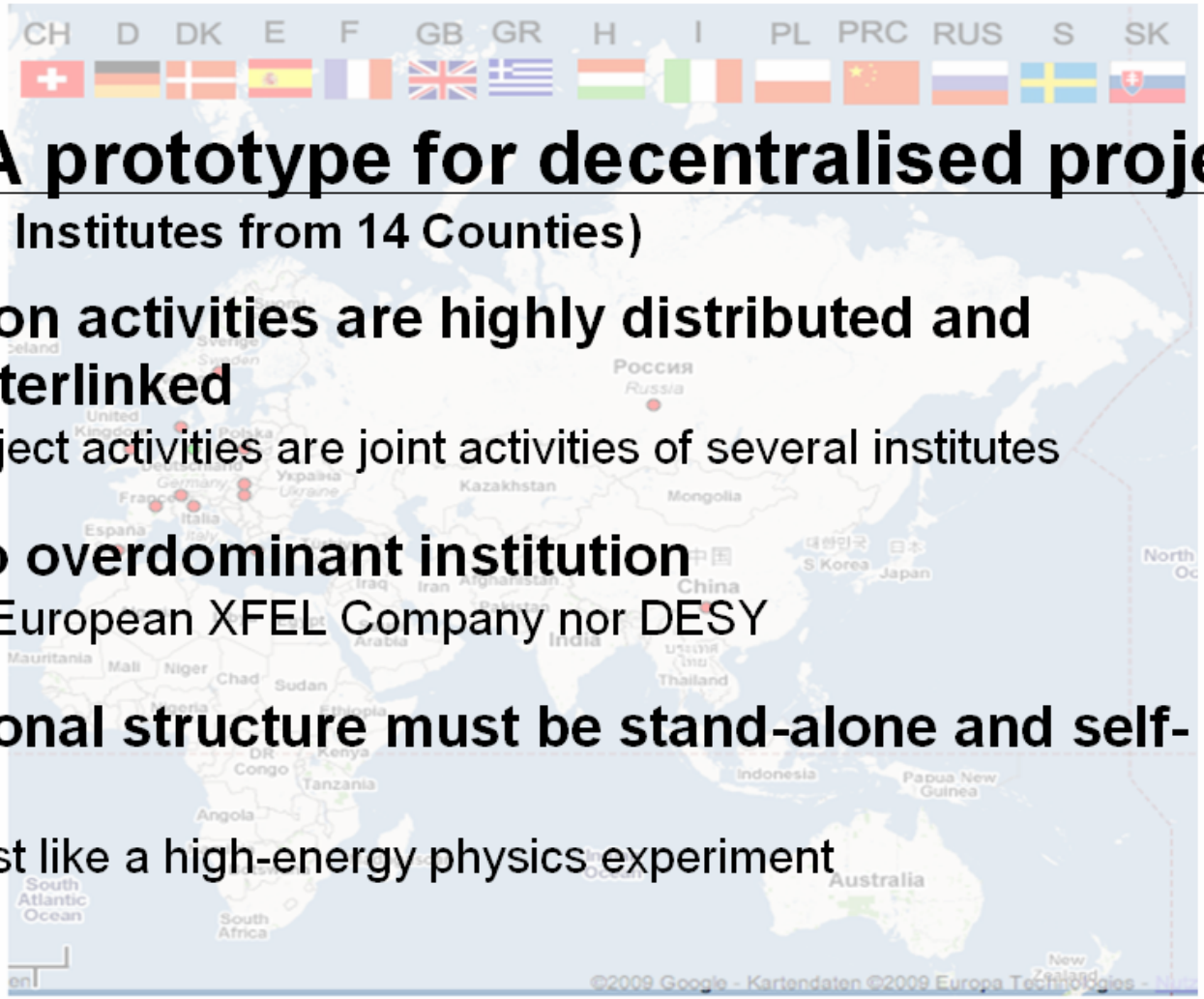
–> The best 'science brains' become loaded with other issues than doing science

–> Only few really love it and specialise in it

–> Management is handled rather as a practice then as a discipline

–> Steering and follow-up styles vary strongly

Decentralised Project



XFEL - A prototype for decentralised projects

(presently 22 Institutes from 14 Counties)

Construction activities are highly distributed and strongly interlinked

Almost all project activities are joint activities of several institutes

There is no overdominant institution

Not even the European XFEL Company nor DESY

Organisational structure must be stand-alone and self-contained

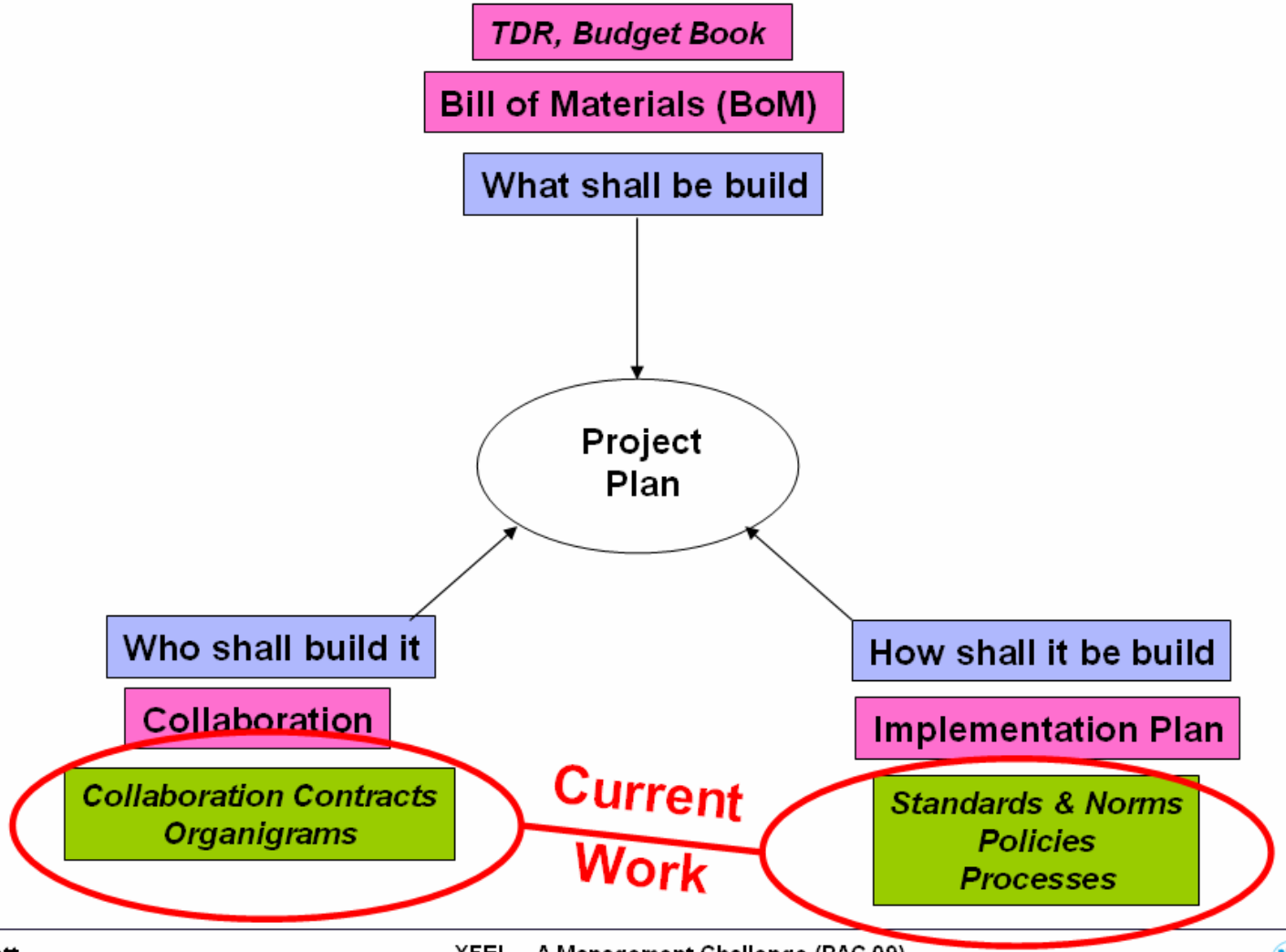
XFEL is almost like a high-energy physics experiment

Wrap-Up

- Demanding technologies must be integrated into a functioning facility
- A complex social situation must be converted into an enthusiastic & focused collaboration
- Individual steering and follow-up must become homogenous
  –> Based on roles and institutionalised processes
- A decentralised project must be made manageable

How does XFEL tackle its challenges?

Project Definition



Understand Complexity

Two stonecutters are working in a quarry.

Asked what they are doing one said:

The other said:

Hidden Complexity

Is XFEL more complex – compared to earlier projects?

Number of components is not really higher, BUT:

- Technologies are higher integrated (software & hardware)
- More design optimisation –> 3D Modelling, Simulations, 3D Master Models, UML Models …
- More legal regulations, more reporting
- More information is exchanged and parallel processed
- More decentralisation –> Increased organisational efforts
- More planning in the early project phases – for the benefit of cost efficiency, less change management with the grinding machine and enhanced reliability

'Things' have advanced & perform more

–> but also demand more

XFEL applies "Systems Engineering" for the demanding cases

1. Organisational ones : "Moderated Process Analysis"
   so far WP31-"Civil Construction", WP34-"Utilities"

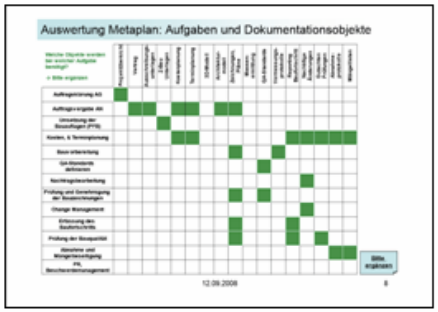
Reveal Complexity

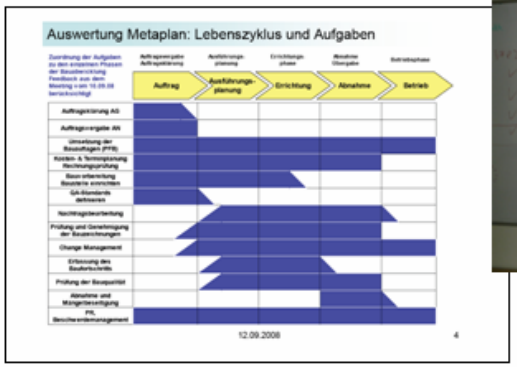
XFEL applies "Systems Engi… g cases

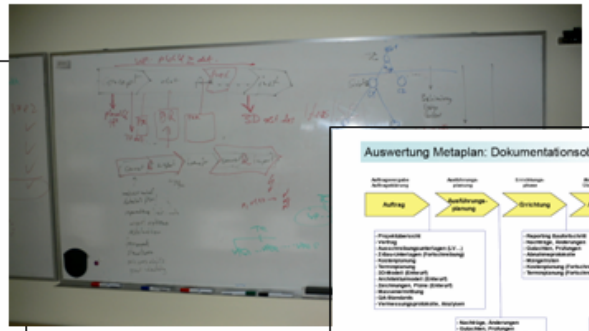
1. Organisational ones : "… sis"
   so far WP31-"Civil Constructio…

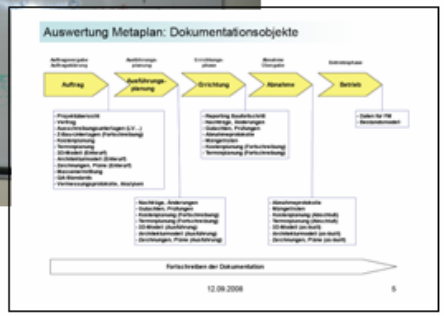
Moderated by: WP40
"Information & Process Support"
(Project internal consultant)

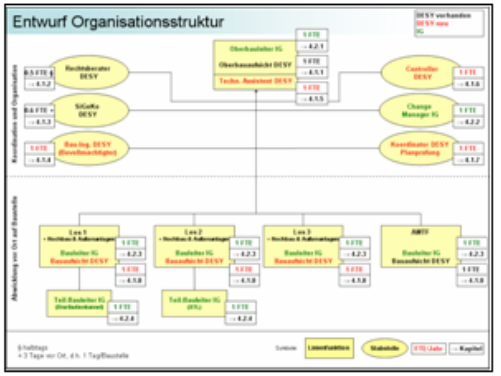
Poster: TURFP057











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1. Organisational ones : "... sis"
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Moderated by: WP40
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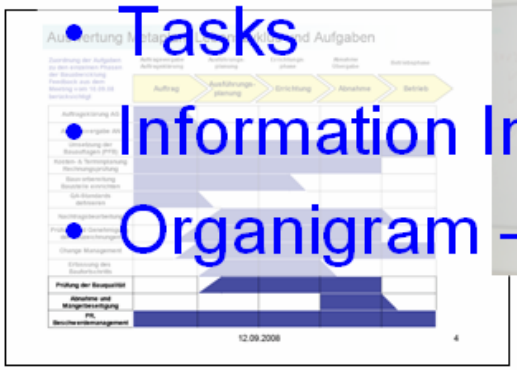
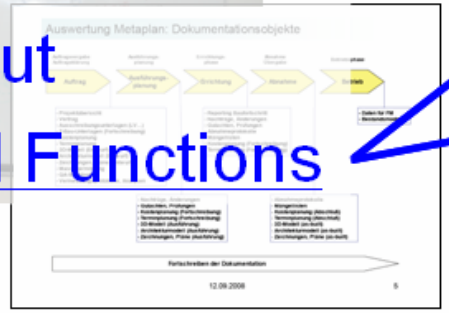
Poster: TURFP057

How to structure:

- Lifecycle Phases
- Tasks
- Information Input/Output
- Organigram –> Lateral Functions



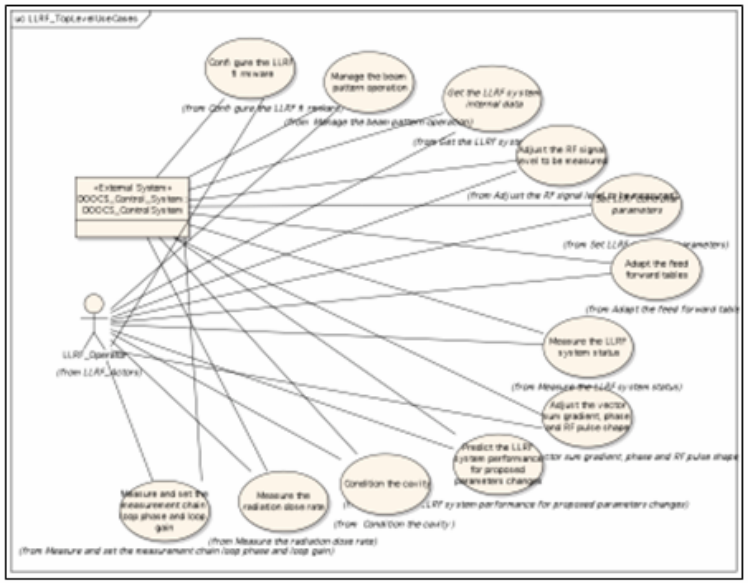


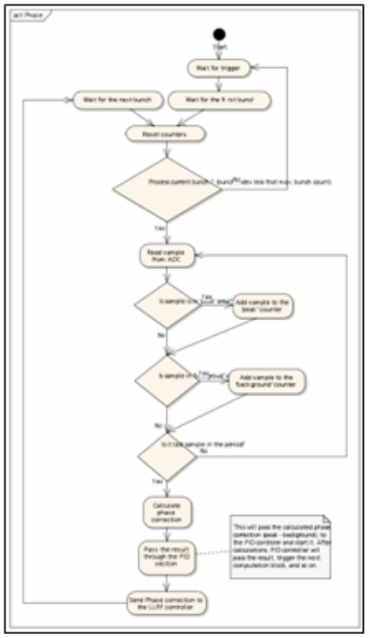
Reveal Complexity

XFEL applies "Systems Engineering" for the demanding cases

2. Technical ones: "System Modelling"

so far WP02-"LLRF" with external consultant:
"Fraunhofer Institute for Experimental Software/Systems Engineering" (IESE)





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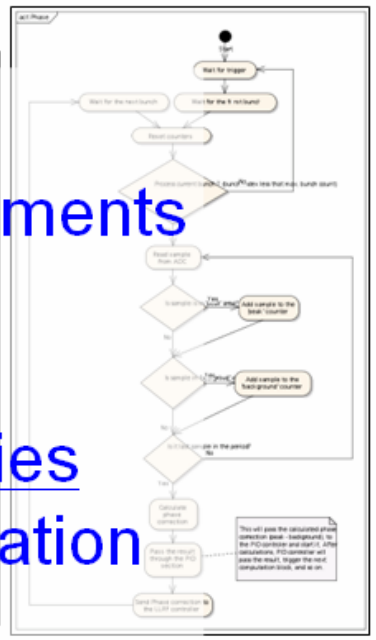
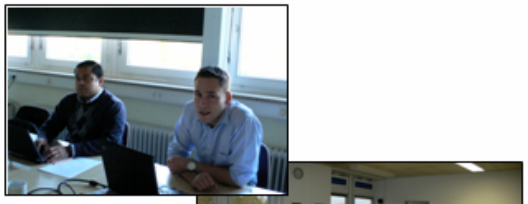


Delivers:

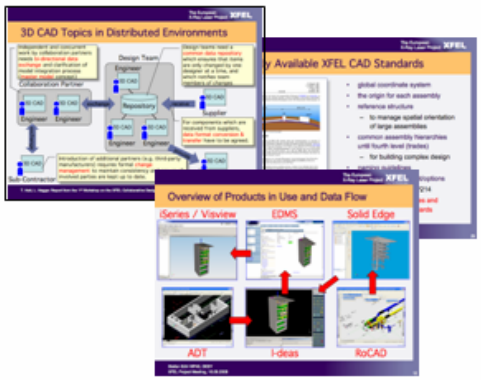
- Consolidated Requirements
- Specified Layout
- Specified Interfaces
- Specified Functionalities
- Consistent Documentation



XFEL applies "Systems Engineering" for the demanding cases

3. Collaboration wide issues: CDE-Workshops (Collaborative Design Effort)

(1st CDE-WS on 23 & 24 Sep. 2008 – Collaborative Design Processes)
(2nd CDE-WS on 12 & 13 May 2009 – Technical Reviews Procedures)

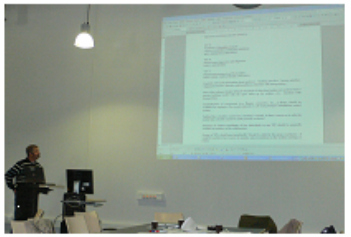


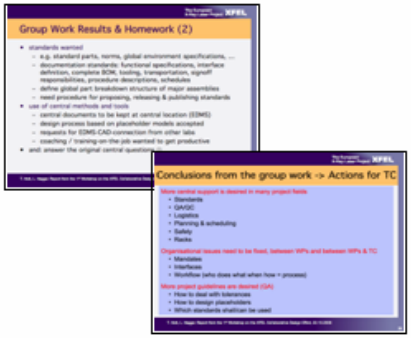
Photon Systems

Warm e-Beamlines

Cryogenics

Cold Linac





Concepts
Presentations

→ **Group Work** →

Adaptations
Action Steps

Poster: TU5RFP058

Manage Complexity

XFEL is on its way to merge 2 concepts

- Principle of Subsidiarity
- Institutionalised Follow-Up

Principle of Subsidiarity

"Matters ought to be handled by the smallest, lowest or least centralized competent authority!"

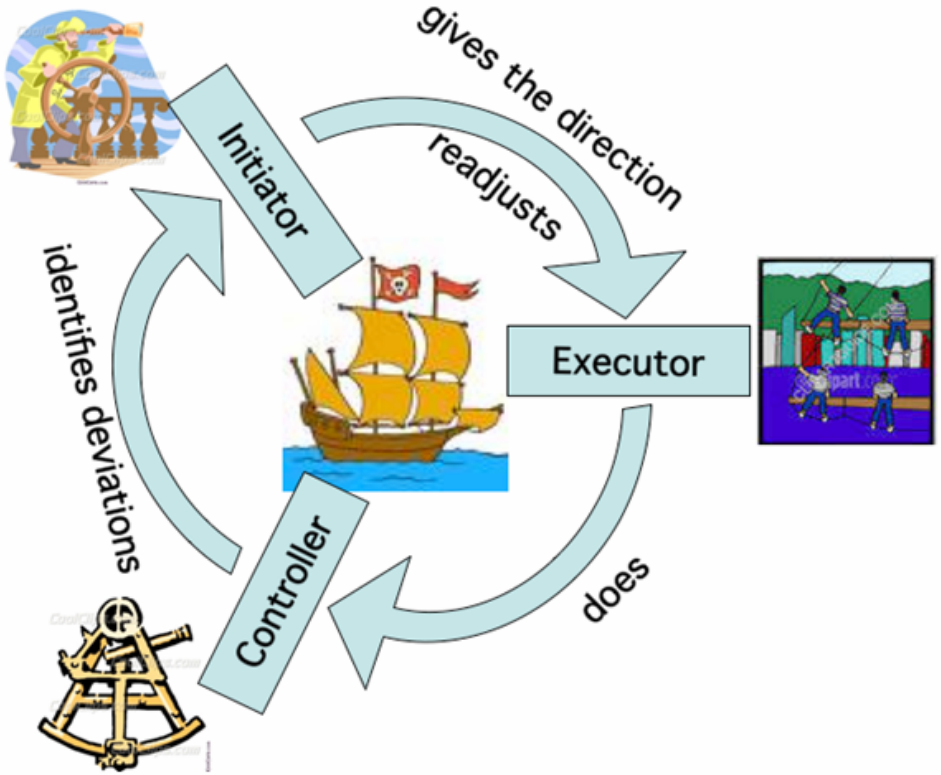
Only relevant issues shall be brought to the attention of the Project Management – Less relevant issues shall be handled by 'lower' entities.
–> Applying the PoS offers best usage of capabilities and resources

BUT it requires pre-defined areas of responsibility, which are based on a comprehensive roles model – WITH established roles, interfaces and processes (–> escalation criteria)

–> And then the respective decision empowerments must be granted and lived (–> roles & process compliance)

Institutionalised Follow-Up

Project Follow-Up – A Feedback Circuit – Understand the 'Roles'



Institutionalised Follow-Up

Important issues that need follow-up (among others)

- Technical advancement
- Pending issues
- Risks
- Requirements compliance
- Standards compliance
- Schedule compliance
- Resources usage
- Process compliance

Institutionalised Follow-Up

Institutionalised Controlling Means (basically)

Quality Management:	Structures and provides necessary decision criteria (defines how things shall be done)
Reports:	Examine and monitor the general progress at regular intervals
Reviews:	Examine readiness for/at crucial project phase transitions
Audits:	Verify (on-site) compliance and effectiveness of quality management or other processes (target/actual comparison)
Change Management:	Handles the exceptional issues
Issues Tracking	Handles pending issues & brings them up at regular intervals
Risk Management	Identifies, monitors and helps to limit risks

To be understood as main steering instruments

Institutionalised Follow-Up

Non-Institutionalised Controlling Means

Personal Interactions: Feel the pulse within the collaboration, give personal acknowledgement and are a /the 'lubricant'.

Personal interactions are essential. They complement but do not substitute institutionalised means.

The bulk of problems/deviations is to be handled via institutionalised paths/processes!

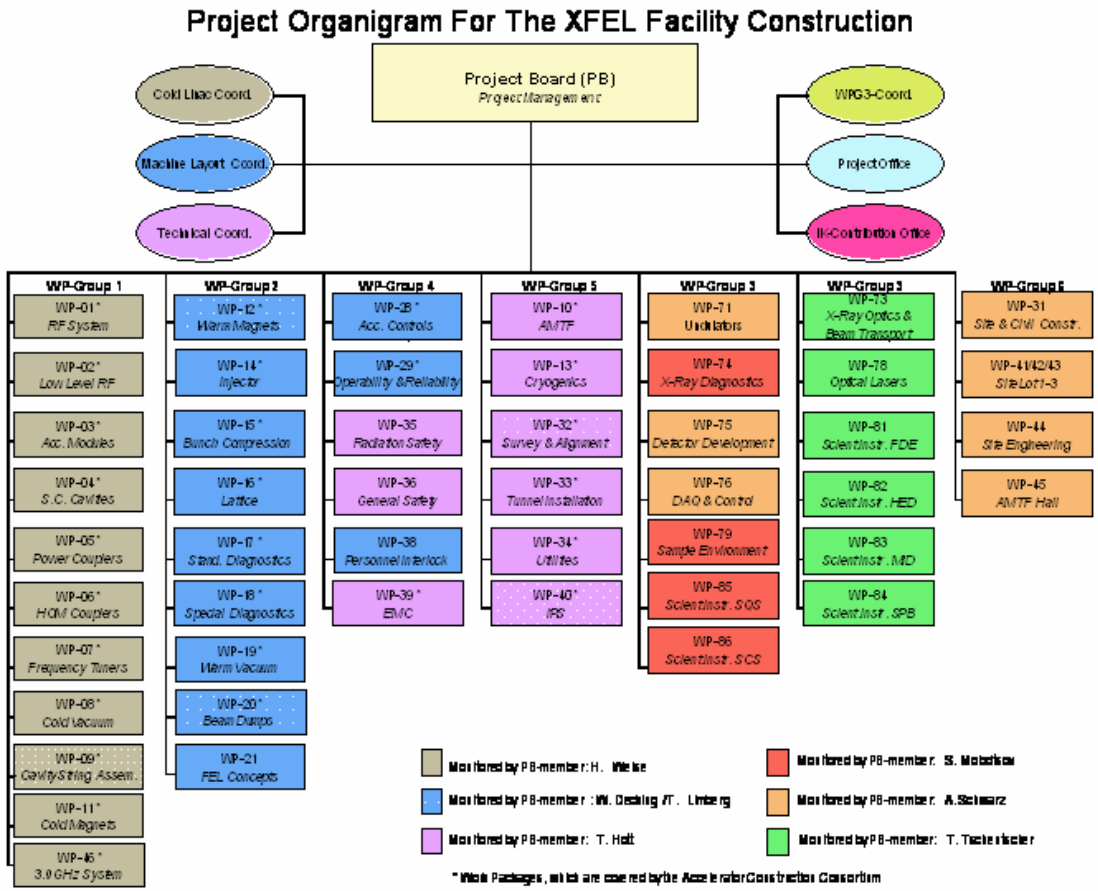
Example 1: Project Structure

TDR (2006): List of Work Packages – but not a real/complete WBS

WPG-1: LINAC	WPG-2: Accelerator Sub-Systems	WPG-3: Photon Beam Systems	WPG-4: Control and Operation	WPG-5: Infrastructure	WPG-6: Sites and Buildings
WP-01* RF System	WP-12* Warm Magnets	WP-71 Undulators	WP-28 Acc. Control System	WP-10* AMTF	WP-31 Site & Civil Constr.
WP-02* Low Level RF	WP-14* Injector	WP-74 X-Ray Diagnostics	WP-29* Operability & Reliability	WP-13* Cryogenics	WP-41/42/43 Site Lot 1-3
WP-03* Acc. Modules	WP-15* Bunch Compression	WP-75 Detector Development	WP-35 Radiation Safety	WP-32* Survey & Alignment	WP-44 Site Engineering
WP-04* S.C. Cavities	WP-16* Lattice	WP-76 DAQ & Control	WP-36 General Safety	WP-33* Tunnel Installation	WP-45 AMTF Hall
WP-05* Power Couplers	WP-17* Stand.Diagnostics	WP-79 Sample Environment	WP-38 Personnel Interlock	WP-34* Utilities	
WP-06* HOM Couplers	WP-18* Special Diagnostics	WP-85 ScientInstr. SQS	WP-39* EMC	WP-40* IPS	
WP-07* Frequency Tuners	WP-19* Warm Vacuum	WP-86 ScientInstr. SCS			
WP-08* Cold Vacuum	WP-20* Beam Dumps	WP-73 X-Ray Optics & Beam Transport			
WP-09* Cavity StringAssem.	WP-21 FEL Concepts	WP-78 Optical Lasers			
WP-11* Cold Magnets		WP-81 ScientInstr. FDE			
WP-46* 3.9 GHz System		WP-82 ScientInstr. HED			
		WP-83 Scient Instr MID			
		WP-84 ScientInstr. SPB			

Example 1: Project Structure

Now (Apr. 09): High Level WBS – which includes all lateral functions and serves also as project organigram



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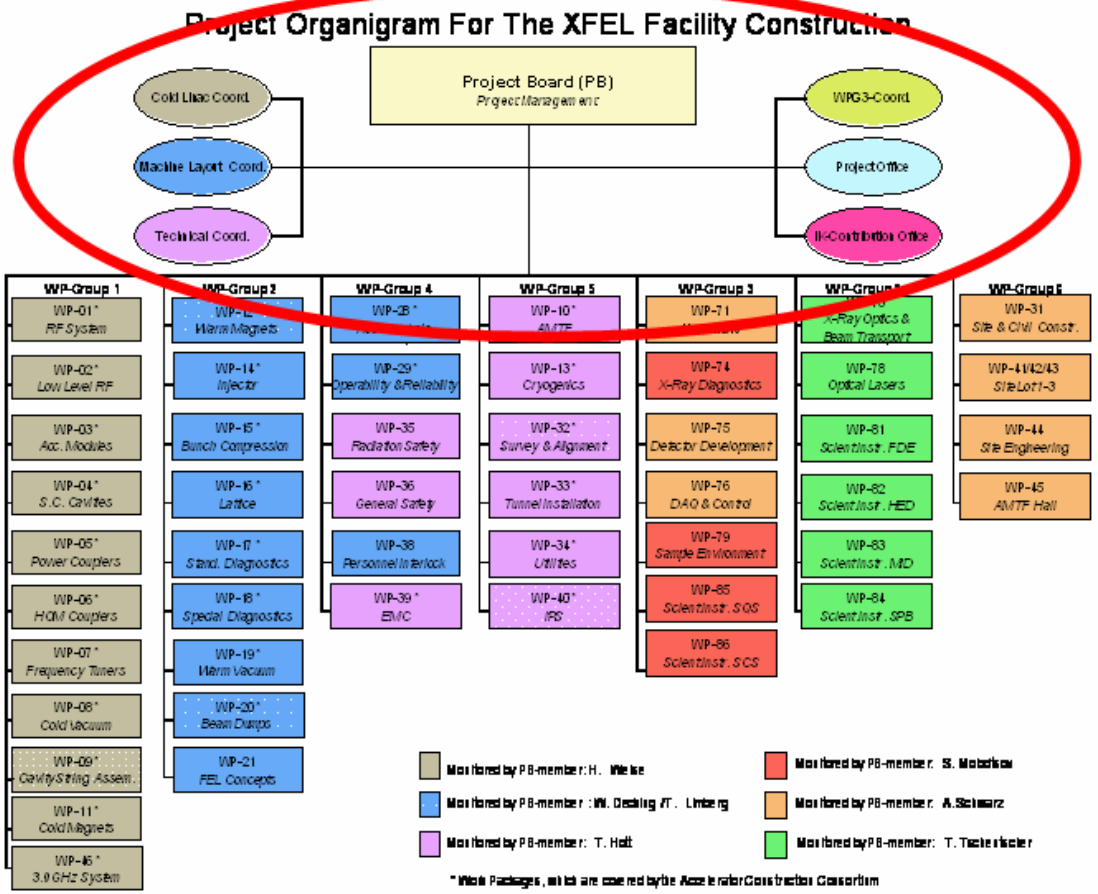


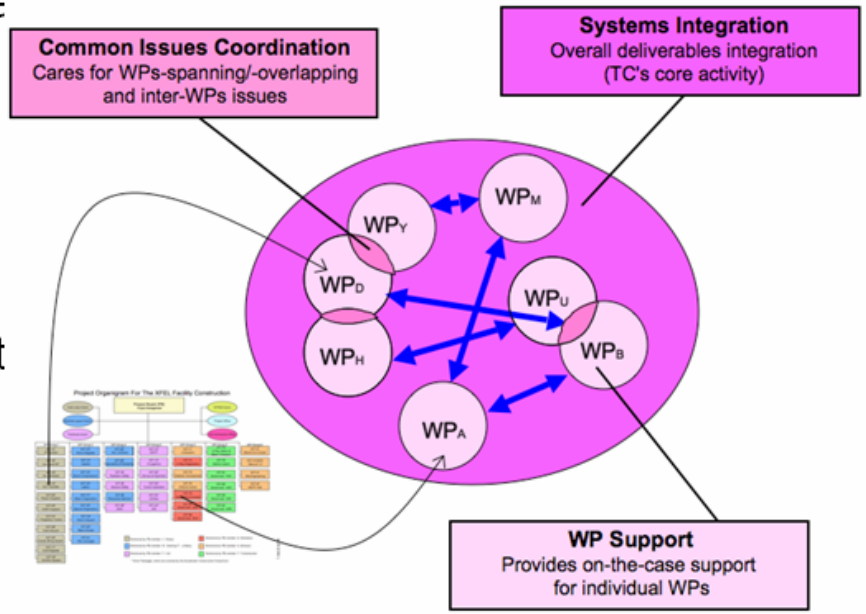
Example 2: Technical Coordination

Synthesis

Tasks mandate:

1. 'Systems Integration' – coordinates the global installation planning and supervision, i.e. the integration of WP deliverables, resp. of subsystems into a working XFEL facility
2. 'Common Issues Coordination' – coordinates those technical issues that are strongly connected to WPs' core responsibilities but do concern more than one WP likewise
3. 'Work Package Support' – help WPs resolving particular technical or organisational problems that can't be resolved WP internally

A Cross-Structural Function



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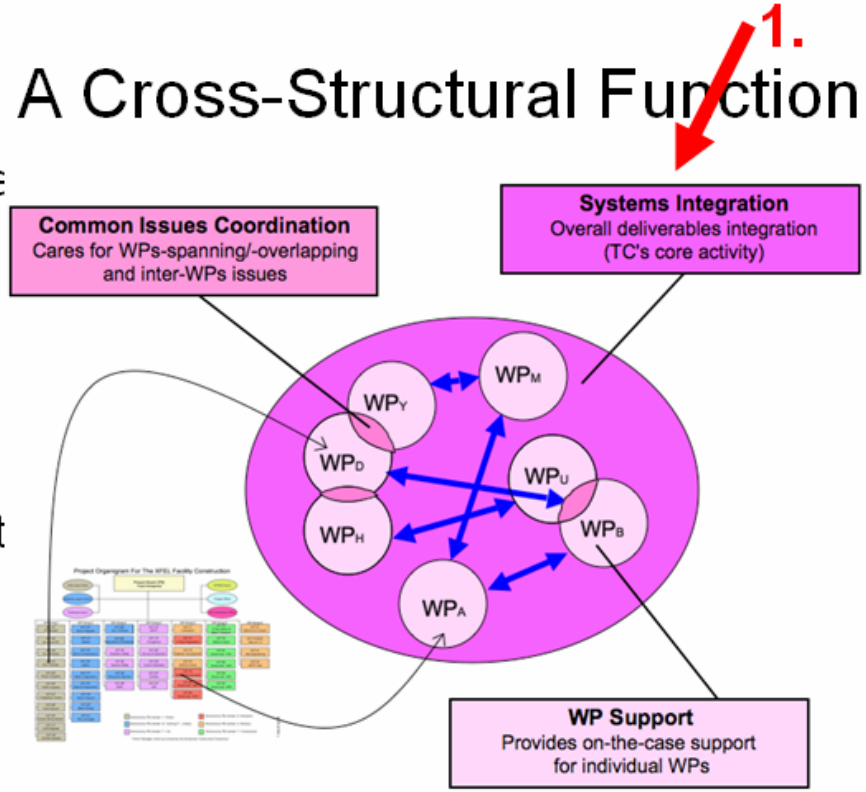

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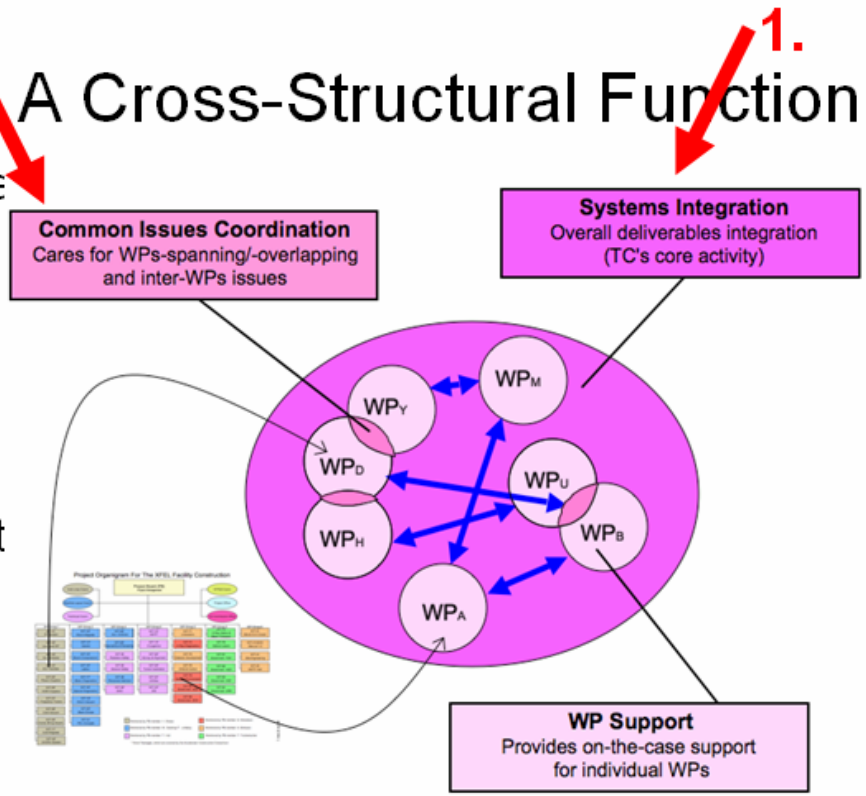

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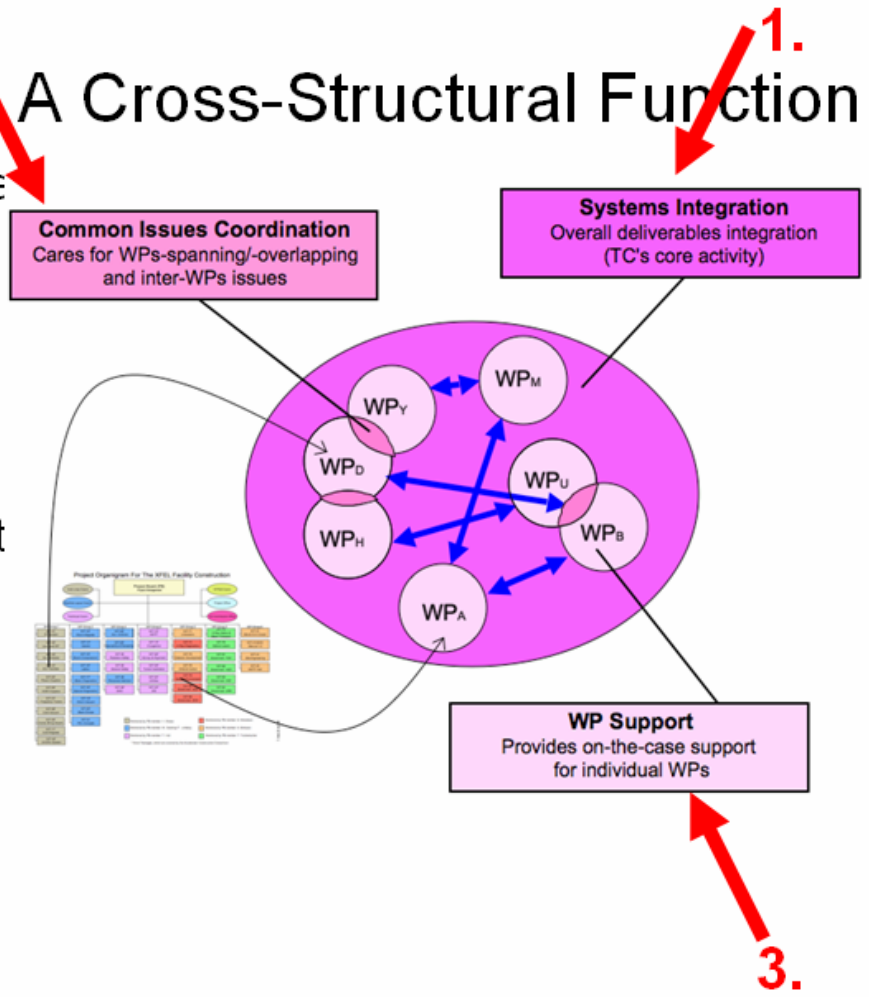
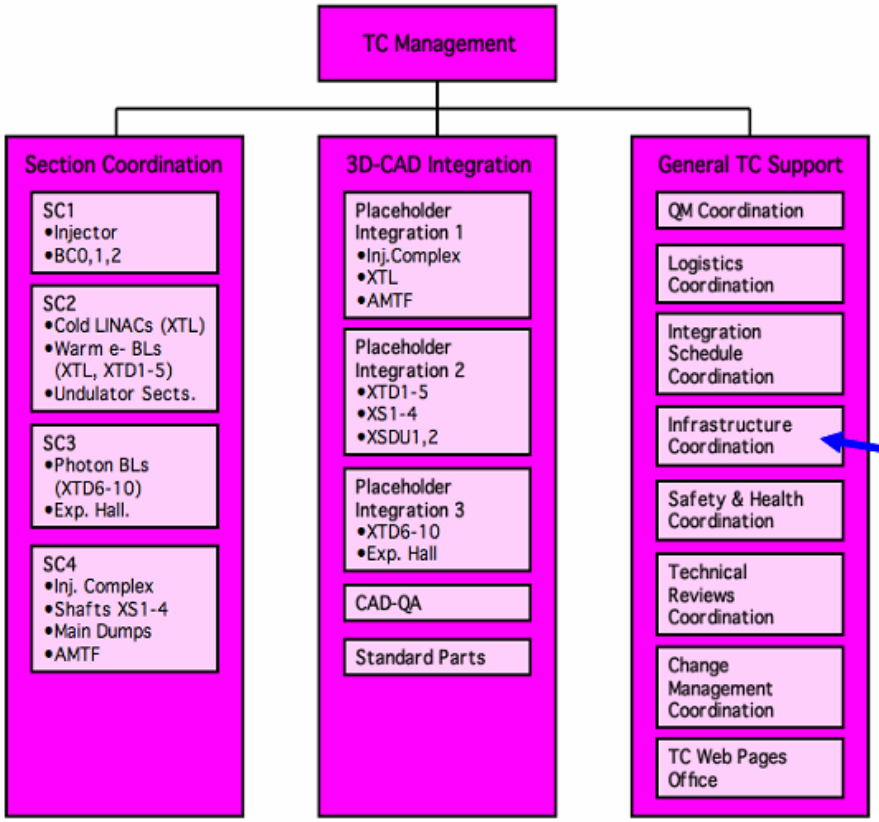


Example 2: Technical Coordination

Synthesis

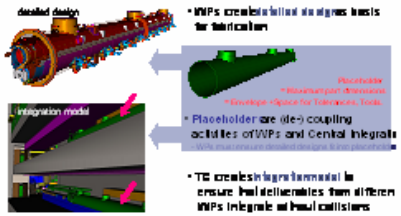
- Conceptual Systems Integration
- Section-QAResponsibility
- Change Management Leadership
- Installation Workflow Development
- Installation Supervision



with WP40 - "IPS"

Poster: WE6RFP046

with WP40 - "IPS"



Example 2: Technical Coordination

TC Management

Section Coordination

- SC1
  - •Injector
  - •BC0,1,2
- SC2
  - •Cold LINACs (XTL)
  - •Warm e- BLs (XTL, XTD1-5)
  - •Undulator Sects.
- SC3
  - •Photon BLs (XTD6-10)
  - •Exp. Hall
- SC4
  - •Inj. Complex
  - •Shafts XS1-4
  - •Main Dumps
  - •AMTF

3D-CAD Integration

- Placeholder Integration 1
  - •Inj.Complex
  - •XTL
  - •AMTF
- Placeholder Integration 2
  - •XTD1-5
  - •XS1-4
  - •XSDU1,2
- Placeholder Integration 3
  - •XTD6-10
  - •Exp. Hall
- CAD-QA
- Standard Parts

Logistics Coordination

Integration Schedule Coordination

Infrastructure Coordination

Safety & Health Coordination

Technical Reviews Coordination

Change Management Coordination

TC Web Pages Office

pre-defined verifiable "Results"

with WP40 - "IPS"

4.1. TC Management: Results & Benefits

Results	Benefits
Regular written and oral status reports:	PM is always and formally informed about the integrated assessed progress.
Regular TC activity papers and strategy papers:	PM is regularly informed about the TC performance as well as about changing needs -> PM receives proposals for corrective actions. TC can be steered and developed further.
Organized regular TC events (Technical Coordination Meetings, Workshops etc.):	The project receives coordinated platform for the established exchange of relevant technical information and to express needs and concerns.
Established TC internal cross-sectional functions:	TC can work effectively and efficiently.

4.2. Section Coordination: Results & Benefits

Results	Benefits
Documented and regularly updated comprehensive section descriptions:	All project entities are always informed about the relevant underlying ideas, purposes, requirements and decisions – and can take account on it with a designing or installing deliverables. The information is concerned, valid and up-to date – will be the reference for the installation, resp. the installation supervision.
Documented and regularly updated section-QM reports:	All project entities are always informed about QM requirements and policies – and can take account on it with a designing or installing their deliverables – will be very important for the installation planning and installation itself. The PM receives an assess the quality needs are understood, all the resulting section quality (e.g. in terms of performance) will be high.

4.3. 3D-CAD Integration: Results & Benefits

Results	Benefits
Regular/optimally bi-weekly coordination meetings:	WPs and TC interact regularly. Communication and information exchange are intensified and the entire process moderated – provide process continuity and enhance the overall efficiency and effectiveness.
Regularly updated valid 3D assembly models:	All project entities are aware of their deliverables will fit eventually in the XFEL facility. - Planning reliably is provided/conflicting components (WP boundaries) early and quickly identified, collision-estimation is facilitated. Will can work efficient! The present integration and planning status is always fully available for all project entities, also for off-site CAD users.

4.4. General TC Support: Results & Benefits

Results	Benefits
Documented QM requirements & policies:	All project entities receive comprehensive information about the general QM needs and strategies and can account for them in their activities / planning – enhances the WPs and overall efficiency, as well as deliverables and facility quality. Problems get identified at the earliest possible stages and corrective actions can be launched early.
Documented QM activity and status reports:	PM is aware all QM needs are identified and measures are implemented properly by all project entities, resp. future needs are identified. Feedback is given to all concerned parties; follow-up or corrective actions can be initiated. WPs know which standards and policies are important for their contributions.

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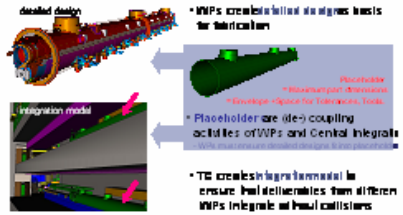

Summary: Key Messages

- Understand & reveal complexity
- Identify/define the Work Breakdown Structure (WBS)
- Establish an organisational structure based on roles & 'Principle of Subsidiarity'
- Institutionalise communication & project follow-Up
- Establish 'Total Quality Management'
- Develop methods and skills (i.e. people)
- Pre-define verifiable results for each activity

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Plan the implementation, implement the plan!