Institut national de physique nucléaire
et de physique des particules

The EIB Product Breakdown Structure (PBS)

EIB Workshop - Aachen

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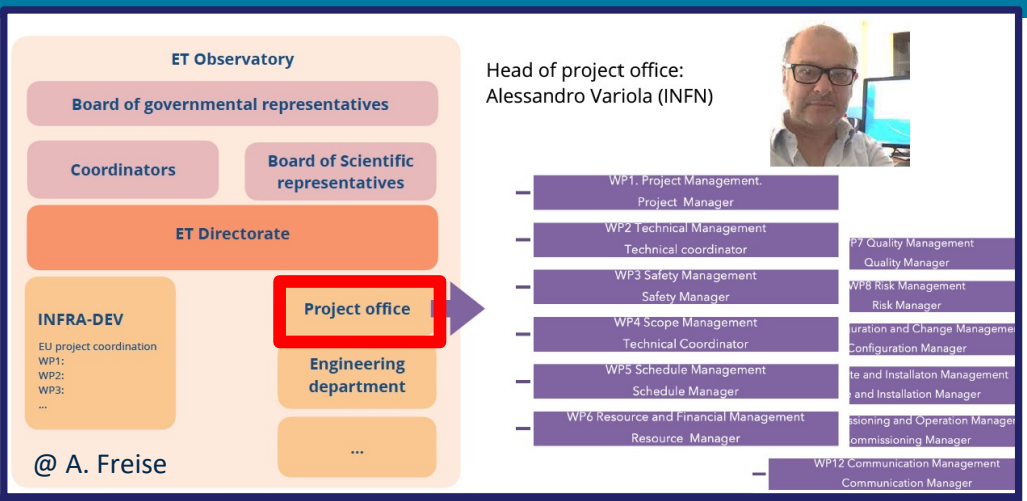
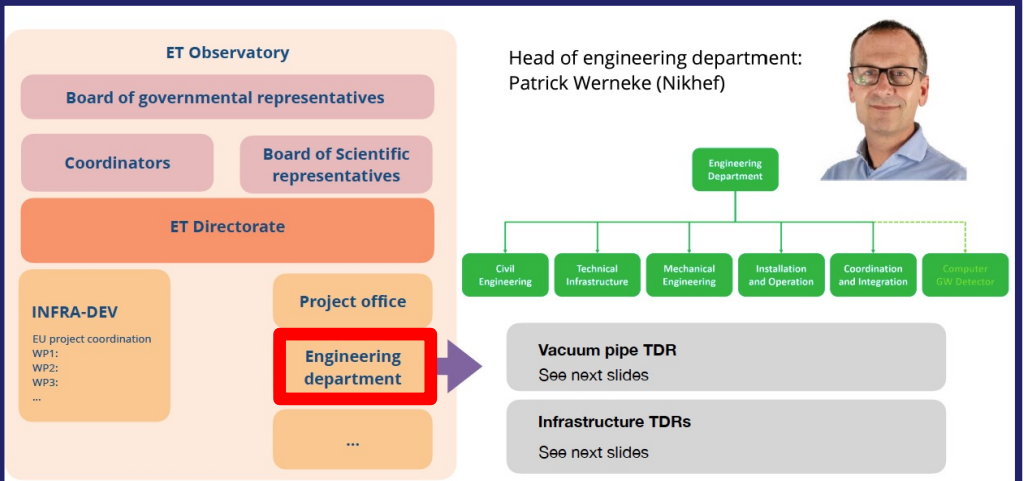
Project Office - Engineering Department - PBS WG





Tasks of the PBS Working group:

- provide input for the costing (not including FTE)
- provide the backbone for the WBS that will define the project schedule
- provide the backbone for requirements breakdown and hierarchy

Members: A.Variola (PO), A.Rocchi (PO), P.Verdier (EIB, PO), P.Werneke (ED), C.Olivetto (PO), G. Gemme (ISB), D.D'Urso (SCB), S. Hild (SPB), with observers L.Latronico (PO) and H. Lück (EB)

1) PBS WG Mandate

- Provide a strategy for the PBS decomposition and for its hierarchical structure. This should be summarized in a short document.
- Following this strategy, **carry out the breakdown of the baseline configuration in systems and subsystems.**
- **The subsystem decomposition will stop when the elements are fully described by their functionality, and it can be managed by a single expertise in the project at the engineering specification level.**
- Provide a first proposal for the coding of the PBS elements, to be harmonized in future with the Quality Manager.
- Provide the PBS documentation.
- Periodically present the PBS build up progress to the EB board and the Project Directorate.

2) PBS Main goals

- PBS will define the structure of the Requirements Breakdown Hierarchy (not considering crosscutting systems or others)
- PBS shall represent the WBS (product oriented) backbone. **The first-Tier line of PBS and WBS should be identical.**
- PBS define what to do, WBS how to do.
- PBS is triggering the OBS (Organizational Breakdown Structure) via the definition of the WBS : Ease assignment of responsibilities.
- PBS shall produce the Project Object costing

3) PBS structure and rules

- PBS deliverable oriented is breakdown in systems, subsystems, and elements. It must have a logical and hierarchical structure.
- The breakdown process end is given by mainly two criteria: by knowledge (cognizant engineer or manager that can assure the specifications and the procurement of the element), by cost (critical spending unit criteria). Breaking down it has always to be considered that the element will constitute a unique body as far as the engineering and the contractual aspects are concerned
- Branching points respect the Tier integration to match the WBS, WBS shall be consistent with the PBS
- 100% rule. A PBS has to include ALL the physical deliverables of the project. All the sub systems must represent the 100% of the pertaining upper (sub)-system.
- The system and sub-systems levels are identified by performances or parameters more than specifications. The element level is defined by specifications. At this level, it refers to standards, whenever possible, instead of writing out the specification in detail.
- PBS can be decomposed starting from the systems or the families
- PBS process can be top down to proceed in serial way to the WBS decomposition or it can continuously align the WBS Tier to the single PBS Tier (step process)
- PBS should represent the Hierarchical backbone for the technical: functional, performances, interfaces, and constraints requirements

Example

Level 0	Level 1	Level 2
HF - Room temperature instrument	Optics system	Optical Design subsystem
		Core Optics subsystem
		Quantum noise reduction subsystem
		Stray light control subsystem
		Wave-front sensing & control subsystem
		Injection subsystem
		Detection and Pick-off subsystem
		Laser subsystem
	Vacuum system	Towers subsystem
		Cryotraps subsystem
	Environmental monitoring system	...
		...
	Suspensions system	Suspended benches subsystem
		Test mass suspensions subsystem
		Recycling cavity optics suspensions subsystem
		Payloads subsystem
	Sensing & Control system	Longitudinal DOFs subsystem
		Angular DOFs subsystem
	Data Acquisition & Real-Time control system	...

Each of these subsystems can be coordinated by a single person

Towards a PBS for EIB

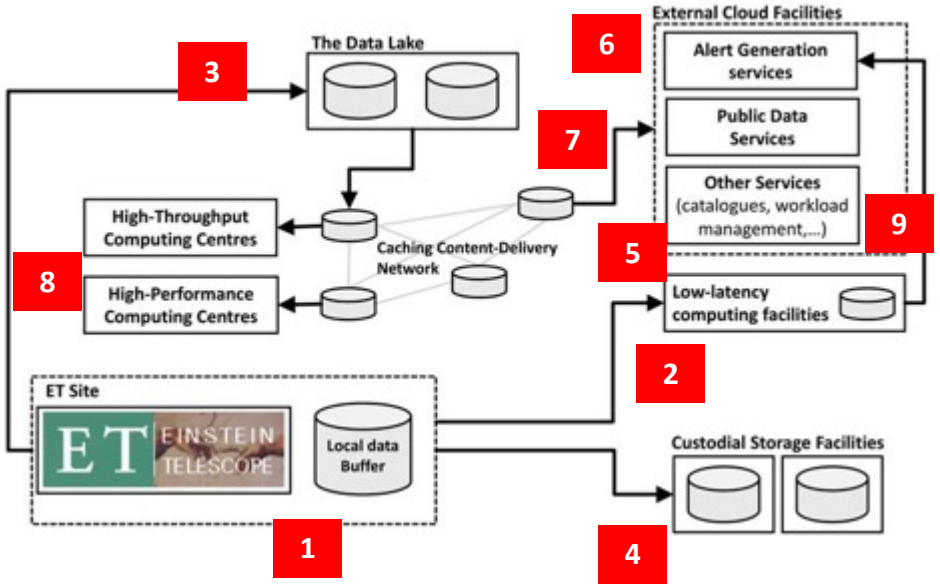
- **Particularities of EIB products:**
  - Include hardware for computing/storage/network but also a lot of software, database, services => translate all that into products
  - But, a lot of evolution are foreseen during the next 10 years
  - And there will be essential contributions from National Computing Centers (pledges)
  - Strong links with OSB, ISB, SCB
  - **Out of scope (?)**: actual science code, physics and engineering tools

- **This will have to be defined and described in the ET Computing Model**

- **All this work is just starting within EIB and WP8**

Global Computing Infrastructure for ET

ET will use a distributed computing infrastructure largely based on existing infrastructures: most of the computing (data processing and services) might run off-site



1. Data collection in a local circular data buffer. A local computing infrastructure is used to pre-process and reduce the data to the format used for low-latency and offline analyses

2. Data are transferred to the low-latency search facilities, where search pipelines are automatically run

3. Data are also shipped to the Data Lake for subsequent offline analyses
[It may be possible for the low-latency processing sites to exploit the data lake, reducing the complexity of the computing infrastructure]

4. A reduced version of raw data are transferred to archival sites for safekeeping

5. All data (raw, processed, public) is registered in a general catalogue database that functions as a single front-end both for data discovery and access

6. Low-latency processing facilities run search pipelines and send triggers and candidate information to the low-latency alert generation and distribution services

7. Candidate event alerts are generated and distributed by the relevant services. Data segments to be distributed with the alert are not copied again but tagged in the database as "public"

8. Offline analyses (parameter estimation, deep searches etc.) and all scientific computing (numerical relativity simulation, Machine Learning model training, etc.) are run on available HTC, HPC or even "Big Data" facilities optimised for Machine Learning, depending upon the optimal type of technology

9. Publicly released data are not copied again, but tagged in the database and made available through public discovery and access services.

Functionalities to be provided by ET EIB (written 1 year ago)

- **Computing power:** provide and manage computing resources (HTC and HPC) for the processing of data, in all computing domains
- **Data transfer and storage:** safely and efficiently transfer all data to custodial storage and processing centres, including low-latency transfers
- **Data distribution:** make data available to worker nodes in computing centres anywhere, and possibly also to single workstations, including support to public releases of data
- **Authentication, Authorisation and Identity management:** provide consistent AAI across all domains and activities
- **Data cataloguing and bookkeeping:** organise all data and metadata and provide querying and discovering capabilities
- **Software packaging and distribution:** manage software lifecycle, and make packages available ubiquitously
- **High-availability service management:** provide a platform for running the collaboration's services (e.g. alert generation services, event databases,...)
- **Job lifecycle management:** provide a uniform job submission and runtime environment to research groups;
- **High-level workload management:** keep a database of all jobs and allow the enforcement of priorities and scheduling strategies; provide support for organized large-scale data processing campaigns
- **Monitoring and accounting:** monitor local and distributed computing, checking performance and looking for issues, and provide reliable accounting both at the user/job and site level

=> Decline that list in terms of products as required by the Project Office ?

Towards a PBS for EIB

Aiming for a PBS matching our organization

On-site computing facility	Computing/counting room Local data buffer Network to low latency facility Network to Custodial storage facility Network to the Data Lake ...
Low-Latency/alert facility	Low-latency computing facility Alert Generation Service
Custodial Storage Facility	[resource pledges (tapes) to T1 CCs]
The Data Lake	[resource pledges (tapes, disks) in the data lake]
Offline analysis facility	[resource pledges to HTC centers] [resource pledges to HPC centers] Network between "The data lake" and HTC/HPC centres ...

Software frameworks & packaging distribution	Software framework (including management framework) Software repository Software distribution system
Job lifecycle management	Job submission tool DB for job submission Job scheduling and priority system Job Monitoring and Accounting
Data Managing System	DB for Data cataloguing and bookeeping Data distribution system

Collaboration Services & Support	Authentication and Authorization Infrastructure
	ET Members Database
	ET Wiki
	ET Gitlab
	ET Mattermost
	ET Agenda servce (indico)
	ET website
	User support infrastructure
	...

... further breakdown until reaching « elements »

Conclusion

- **PBS WG: We learn to work together by sharing common language, practices, tools…**
- **A lot of work ahead to break down further the EIB project tree…**
- **For preliminary estimation, we may have to start with a scenario based on current technologies**
- **100% rule:**
  - ISB and SCB will also have software/DB products (Ex: calibration, monitoring, …)
  - "One" could want to also include analysis code (online & offline), simulation code, ...
    It needs to be clarified because it is clearly beyond EIB mandate: OSB must be involved

- **Next PBS meeting: March 17th in Paris**
- **Preliminary PBS for beginning of May**