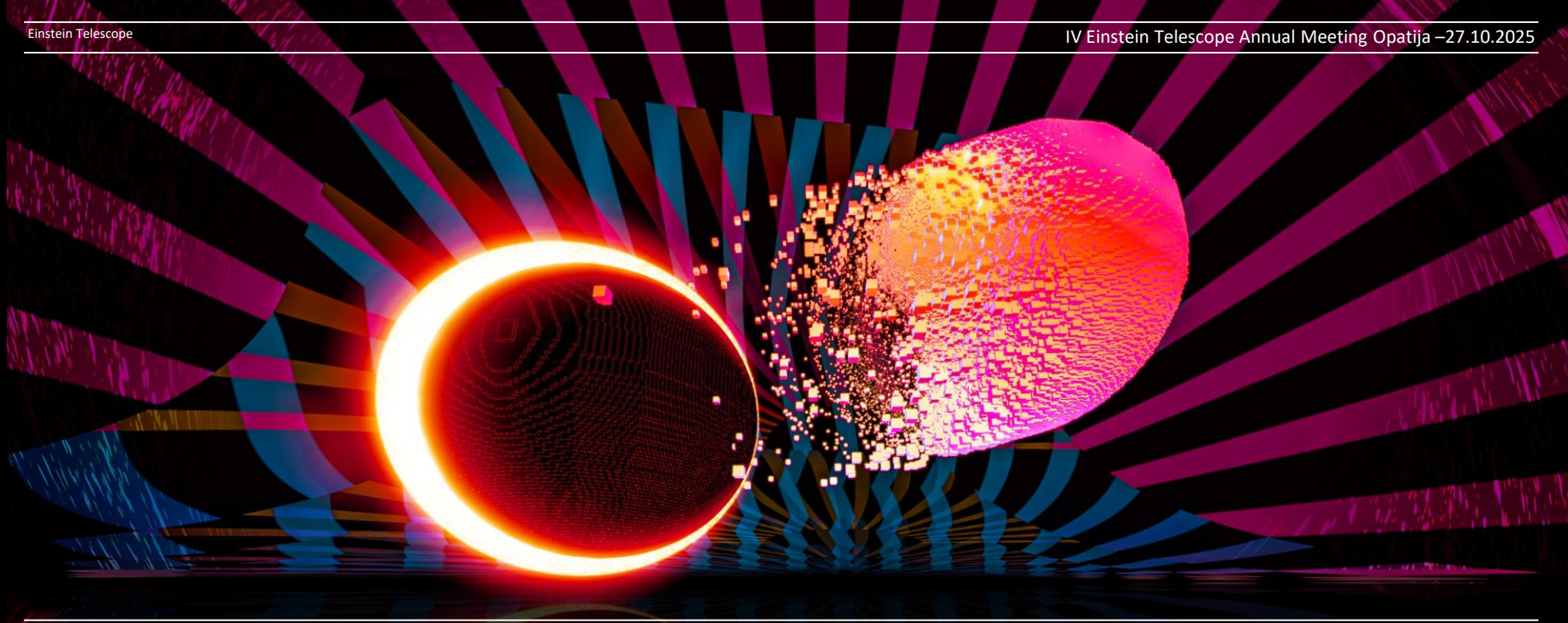


IV Einstein Telescope Annual Meeting Opatija –27.10.2025

EINSTEIN TELESCOPE

Systems Engineering and Configuration Management: towards PBS2.0

Romano Meijer - ETO-Project Office, Nikhef (r.meijer@nikhef.nl)

Recap – Context and purpose of a Product Breakdown Structure (PBS)

Work Breakdown Structure (WBS): "Decomposition of activities required to deliver the system"

- **Purpose:** link organization, technical system and planning through decomposition of the activities
- **Populated by:** tasks, deliverables, responsibilities

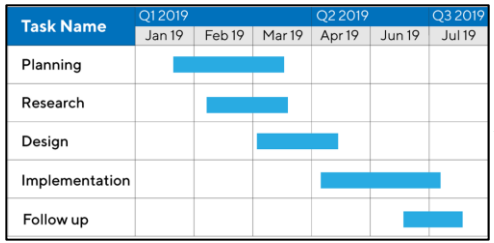
Product Breakdown Structure (PBS): "Decomposition of functional and physical subsystems and their elements, as derived from the system architecture"

- **Purpose:** mitigate system complexity in the technical configuration
- **Populated by:** (architectural) layouts and parameters, requirements, design specifications, validation plans

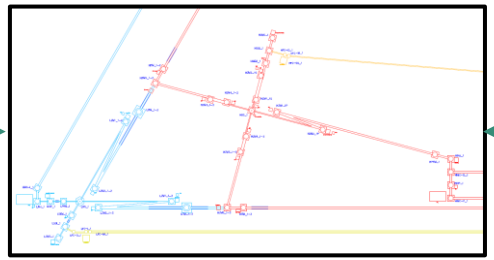
Bill of Materials (BOM): "Structured decomposition of all (reused) assemblies, subassemblies and parts needed to assemble and manufacture the product"

- **Purpose:** Outline component quantities, specifications and technical drawings
- **Populated by:** CAD 3D-models, component manufacturing and system assembly drawings

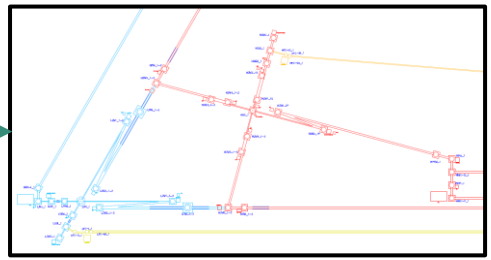
WBS



PBS



BOM



Recap – Starting point: 2023-2024 Project Office reviews (PBS1.0)

Level	PBS code	Level 1	Level 2	Level 3	Level 4
1	1	Einstein Telescope			
2	1.1		LF instrument		
3	1.1.1			Suspensions	
4	1.1.1.1				Suspension chain
5	1.1.1.2				Test-mass suspension
17	1.1.1.3				Seismic isolation platform
21	1.1.1.4				Cryogenic Payload (see also 1.1.4.4)
31	1.1.1.5				Other large optics payloads
46	1.1.1.6				Auxiliary suspensions
53	1.1.1.7				Production and assembling Tools for the
69	1.1.1.8				Front end analog and digital electronics
76	1.1.1.9				Cabling
82	1.1.1.10				Modeling and Simulations
87	1.1.2			Optics	
105	1.1.2.1				Core Optics
106	1.1.2.2				Lasers
131	1.1.2.3				Input and Output Optics
187	1.1.2.4				Quantum noise reduction
243	1.1.2.5				Wavefront sensing and control
510	1.1.2.6				Scattered Light
561	1.1.3			Interferometer	
590	1.1.3.1				Observatory Design and Noise Budget
591	1.1.3.2				Optical Layout Sensing and Control Schem
597	1.1.3.3				Data Acquisition and Real-Time Control
625	1.1.3.4				Calibration
642	1.1.3.6				Noise Characterization
665	1.1.3.7				Modelling and Design Tools
679	1.1.4			Vacuum&Cryogenics	
689	1.1.4.1				Tower Vacuum
690	1.1.4.2				Pipe Arm Vacuum
720	1.1.4.3				Cryostats and Cryopumps
787	1.1.4.4				Cryogenic Payload (see also 1.1.1.3)
809	1.1.5			Active Noise Mitigation	
838	1.1.5.1				Newtonian Noise
839	1.1.5.2				Environmental Sensors
898	1.1.5.3				Suspensions
956	1.1.5.4				Magnetic Noise Mitigation
963	1.1.5.5				Seismic Platform SPI
1011	1.1.5.6				Low-Frequency Control Noise
1033					

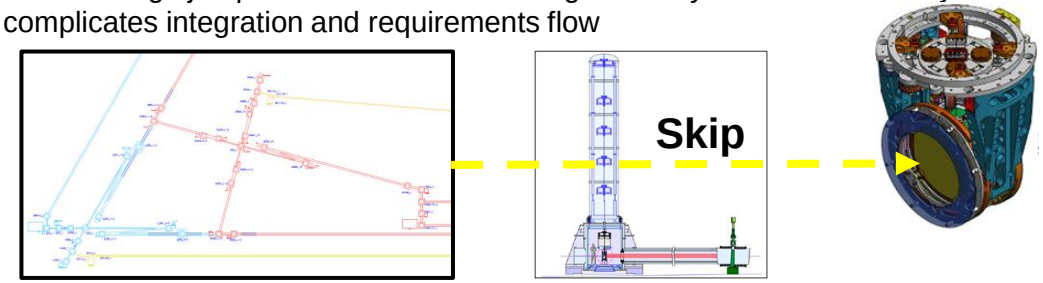
First system breakdown effort started with ET Collaboration

- Expert-division centered rather than system-centered; down to component level
- Approx. 1800 elements; 9200 parameters generated, 7 decomposition levels
- Captured in ET Database (see O. el Merchefi talk)

Points of improvement highlighted

Item 1: Activities and work-packages are in PBS; should be in WBS
(*F. Sorrentino talk)*

Item 2: Large jump in level of detail from High-level system to local subsystems complicates integration and requirements flow

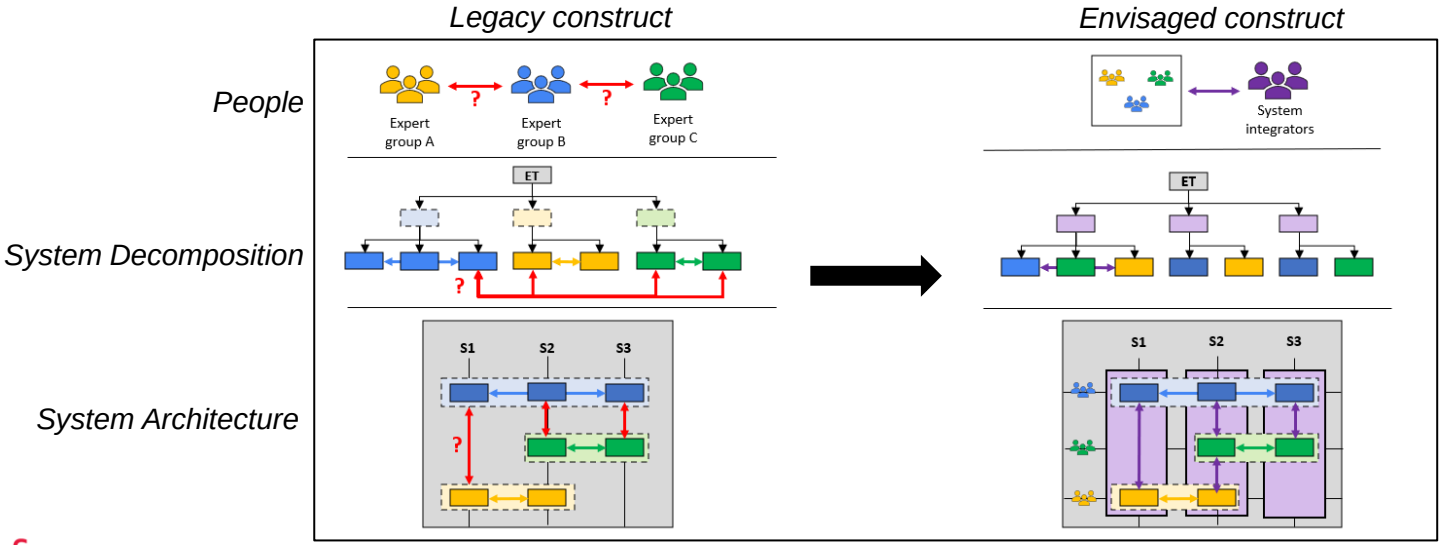


Item 3: System decomposition and requirements chain is interrupted because the high-level Interferometer group operates at the same level as Optics, Suspension etc.

Recap – ET Annual event 2024: proposed shift in decomposition and architecture strategy

Systems thinking shift from expert disciplines copy to integrated & distributed system architecture

- Stronger emphasis on high-level systems integration
- Set-up for improved requirements and interface traceability
- Set-up for improved engineering Bill-of Materials (BOM) overview
- Spreading the load: systems architecture, requirements and interface management to system integration professionals; detailed systems design remains with subject matter experts
- Moving in the direction of ‘Matrix-structure’ – well known in industry



Recap – The 2025 ETO Design Task Force applied Integrated Systems Decomposition

- ET baseline redesign during 6-month period
- Key opportunity for decomposition improvements
- Learn more at XV ET Symposium Indico: https://indico.ego-gw.it/event/819/timetable/#20250526.detailed

Scope of task force

Background
- 2020 ESFRI proposal
- 2024 optical layout update (ETC-ISB)
  - Triangle first, then 2L
- 2024 detector layout (ETO-ED)
  - Triangle first, then 2L
- **Informal** feedback by civil engineering experts from local teams:
  - infrastructure to host updated detector layout would be significantly more expensive than for the ESFRI proposal

Task force mandate (on ET Coordinators' proposal)
- adapt detector layouts of ET towards an **acceptable** preliminary **costing** for the civil **infrastructure**
  - for both triangle and 2L geometries **independently**
  - while **maintaining** ET's **scientific performance**

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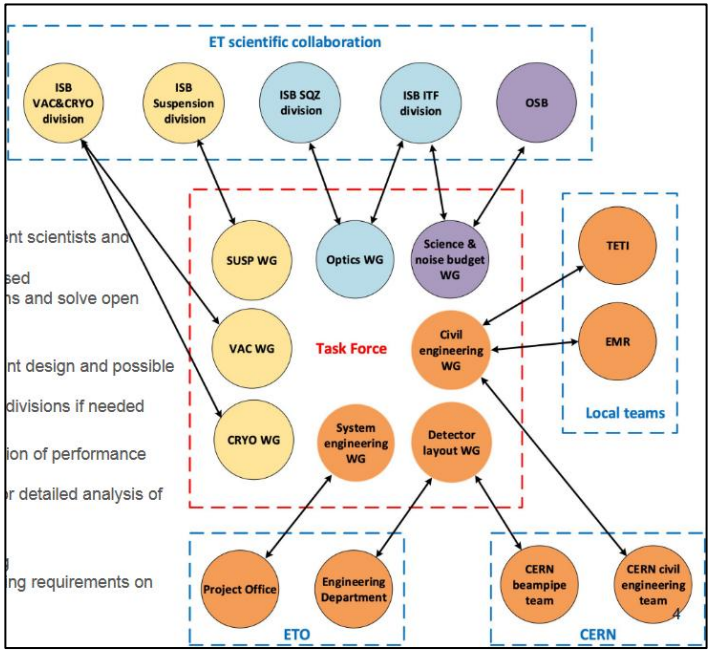


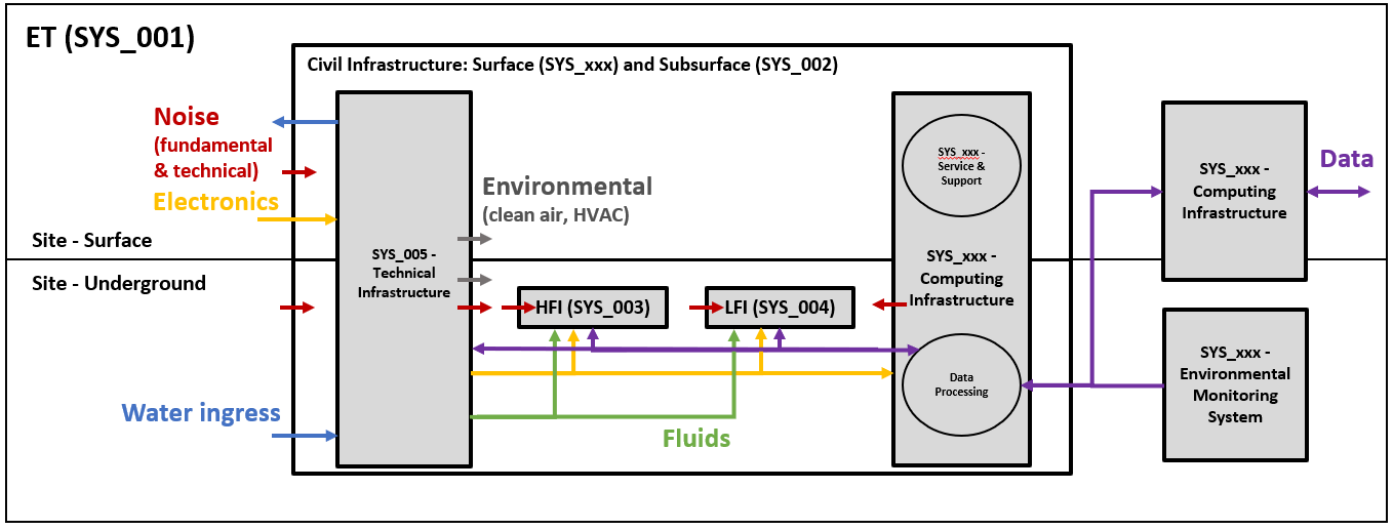
F. Sorrentino

Nikhef

Recap – Task Force: ET's high-level system architecture

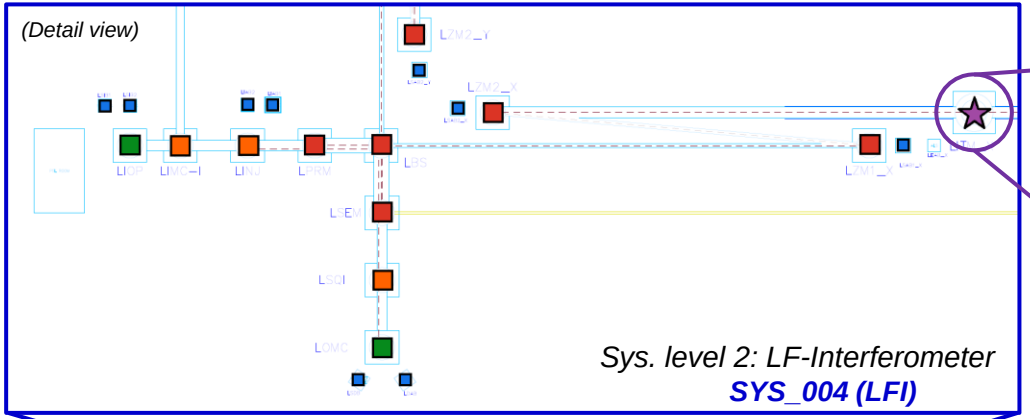
Functional partitioning yields small set of high-level subsystems

- Two instruments: High-Frequency and Low-Frequency Instrument (HFI and LFI)
- Civil Infrastructure: Surface (site) and Subsurface (tunnels/caverns/shafts)
- Technical Infrastructure: cleanrooms, logistics, cryogenic supply, building HVAC, …
- Computing Infrastructure: data processing, control platforms, …
- Environmental Monitoring: seismometers, accelerometers, temperature, magnetic field, Newtonian noise calibrators, …

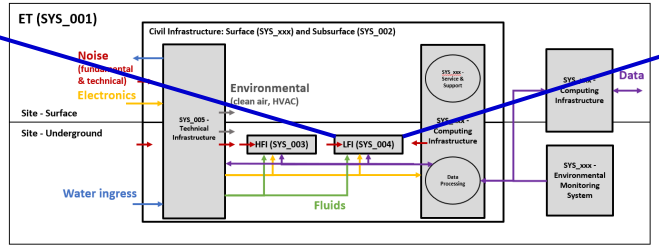


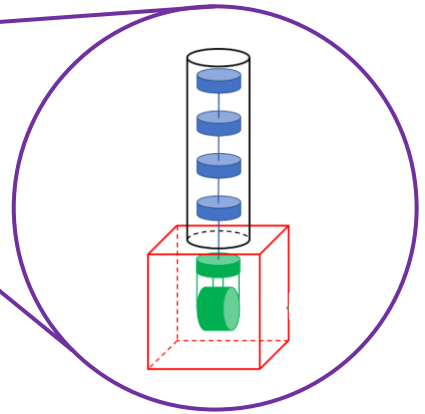
Repeat decomposition – ET's nodal representation of the high-level system architecture

- ~~Discipline-based~~ → **Integrated/distributed-systems** based decomposition
  - ✖ **Lv. 1:** ET → {Grouping of expert systems} → **Lv. 2:** All ET Suspensions → …
  - ✓ **Lv. 1:** ET → {**Functional & physical partitioning**} → **Lv. 2:** Low-Frequency Interferometer (LFI) → …



Sys. level 2: LF-Interferometer
SYS_004 (LFI)

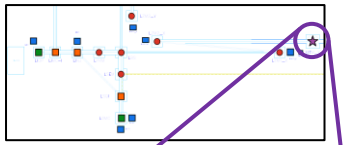




Sys. level 3: LF-Test Mass tower
SYS_129 (LITM_Y)
[Task Force temporary system ID]

ET's traceable Requirements Management framework

- **Numbered** requirements and specs are stored in Output Tables; connected to numbered systems
  - → Traceability from sensitivity curve to Civil Functional volumes
  - → Requirements and Specifications linked to unique System ID's

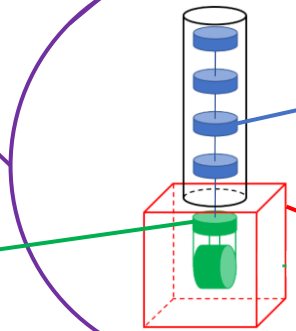


1. Specification line root

Associated Node				
Unique ID	Name	System ID	Unique tower type	Tower abbreviation
		auto-fills if name is found here		
INFORMATION SOURCES:				
(row for enabling filtered views - enable once number of rows is near final)				
SPC_6071	LITM_Y	SYS_129	T9	S6SO_mVACcryo

1c. Seismic Isolation subsystem requirements

Suspension system architecture											
Residual motion (category? to be filled by SUSP team, then checked by Optical Layout for compatibility	RM value estimate	RM frequency	Proposed SUS architecture	Alternative architecture(s)				Bench variant proposed	Bench area (m2)	SUS system name	SUS system estimated height (m)
	(m/sqrt(Hz))	(Hz)		SO	MO	TB	BB				
2024 SUS classification											Supporting doc, 2024 SUS classification
CAT6			Single Optic (SO)	☐	☐	☐	☐	N/A	N/A	S6SO	12



1. SYS_129 (LITM_Y)

[Task Force temporary system ID]

1a. Optical Payload subsystem requirements

OPT payload boundary conditions				
Type	Suspended	In-vacuum	OPT total area request (m2)	Special features - payload
TAB 3C	2024 docs	TAB 3C	TAB 3C	
single optic	yes	Yes - Main science beam	N/A	optical element, cryogenic

1b. Vacuum vessel subsystem requirements

Vacuum vessel architecture						
DET layout access constraints	Proposed access (2L, Triangle, Both)	Alternative access	Proposed air volume cleanliness ISO class	VAC vessel name	Vessel/Node estimated footprint (mxm)	Vessel estimated height (m)
-	Both: Bottom	Both: Lateral	ISO5	mVACc...	5.0x5.0	15

Lessons from PBS1.0 and Task Force system decomposition

PBS1.0

Strengths
- Revision process incorporated (but slow)
- Large body of work: baseline represents many details and non-physical systems

Weaknesses
- Entangled work, organization and ‘Reuse Products’ all in one structure next to ‘Unique Products’
- Low emphasis on systems integration
- Limited to no traceability of requirements and parameters

Task Force System Decomposition

Strengths
- Focused system breakdown; disentangled work and organization
- Increased emphasis on system integration; product of Systems Architecting process
- Enabled system and requirement traceability

Weaknesses
- No sustainable revision process incorporated – ‘one-off’
- Entangled ‘Unique Products’ with ‘Reuse Products’
- ‘Partial baseline’: only systems with spatial constraints considered

Lessons from PBS1.0 and Task Force system decomposition

Main improvements necessary for PBS2.0

P1) Advance Technical Baselining process maturity to enable continuous PBS development and support design activity

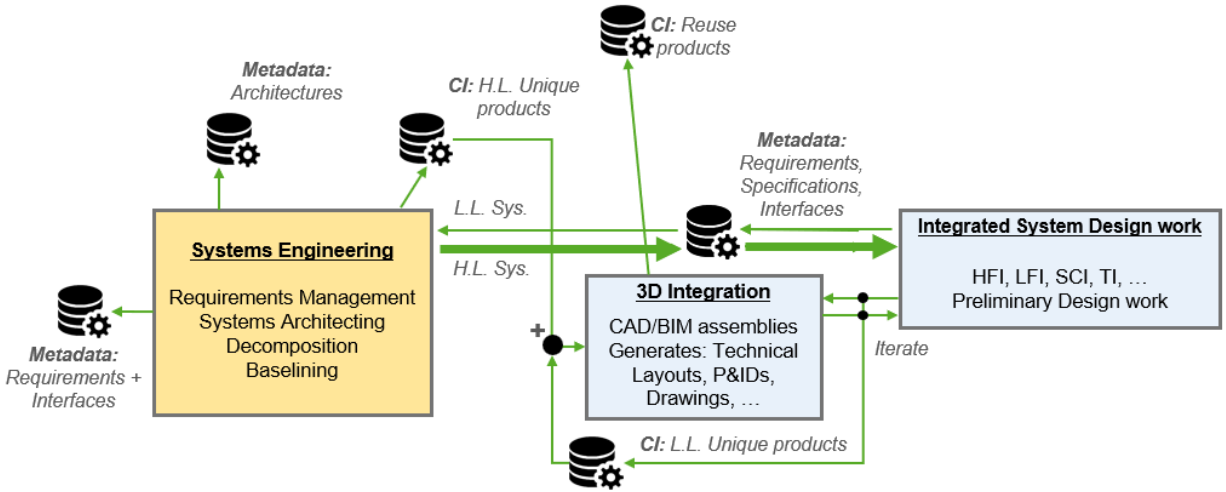
T1) Disentangling of ‘Reuse Products’ from unique systems (e.g. _X; _Y ‘systems’)

T2) Professional environment (toolchain) to make traceability less error-prone and scaleable
→ *See F. Moers and R. Meijer talk (MBSE)*

T3) Scope extension: Task Force work had limited scope – even at High-Level system → More system branches needed for preliminary design (especially non-physical systems)

PBS within broader Technical Baselining framework

P1) Advance maturity of Technical Baselining process to enable continuous PBS development and support design activity
→ Cooperation between design groups, systems engineering and 3D Integration to produce Configuration Items and attached Metadata

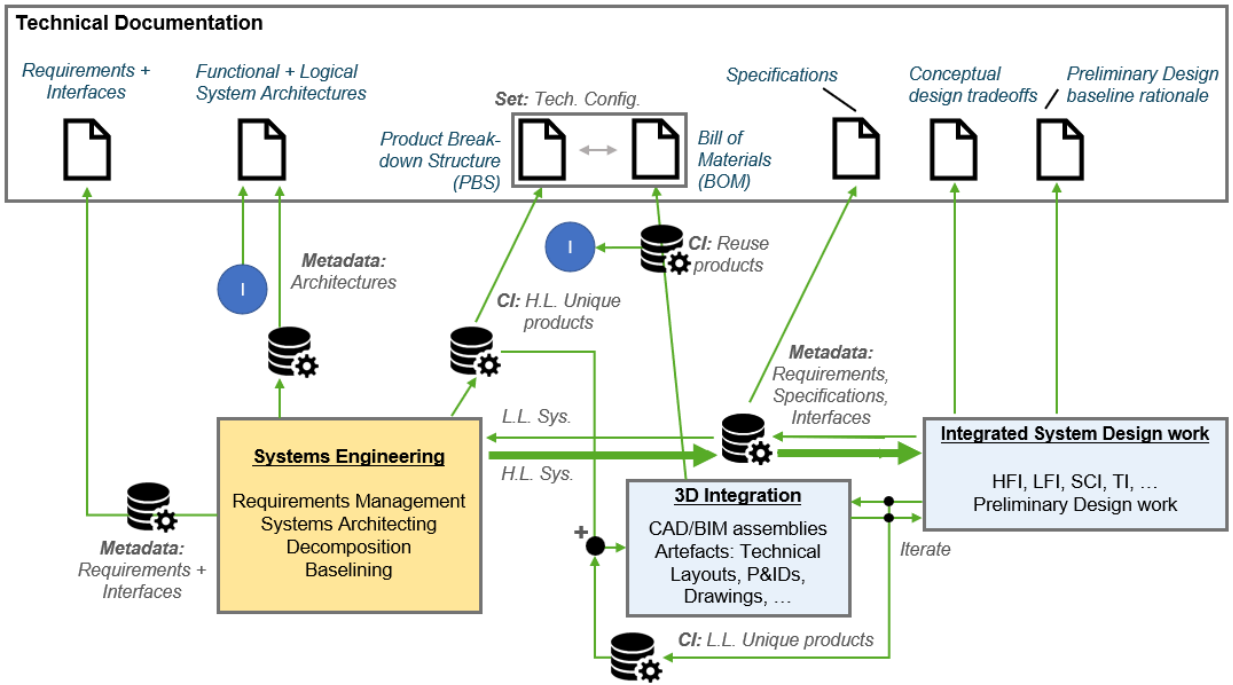


PBS within broader Technical Baselining framework

P1) Advance maturity of Technical Baselining process to enable continuous PBS development and support design activity

→ Cooperation between design groups, systems engineering and 3D modelling to produce Configuration Items and attached Metadata

→ Produced technical documentation should then be revision-controlled to yield periodic Technical Baselines



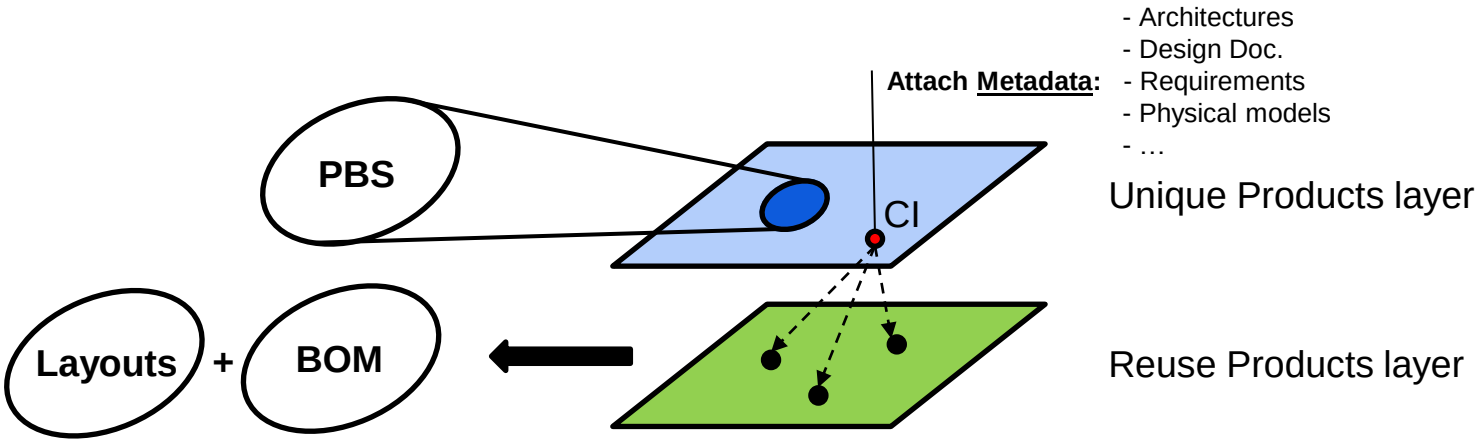
Technical improvement: Disentangling Unique Products, Reuse Products and Assets

T1) Task Force entangled unique systems with Reuse Products: the same exact product was reuse in another location (e.g. _X; _Y ‘systems’ not truly unique, but documented in Task Force decomposition as such)

→ **Two-layer approach proposed; in review**

Configuration Items: Unique Products → Reuse Products

Metadata attaches to CI’s: Requirements, test reports, risks, interfaces, drawings, 3D model, …



Technical improvement: scope extension of continuous SE and Tech. Baselining work

T3) Scope extension: Task Force work had limited scope – even at High-Level system → More system branches needed for preliminary design (especially non-physical systems)

→ **Application 1 (started):** Transferring usable PBS1.0 branches into PBS2.0
→ **Application 2 (started):** ETO-ED / CERN agreement on Technical Infrastructure systems development
→ **Application 3 (pending)**: Continuous Detector development work; supported by ETO-Systems Engineering

→ **Pictured in blue:** Examples from PBS 2.0 preparatory work considering ETO-ED / CERN collaborative work

0268	SYS_006	TI	SYS_268	CSU-HETM_X	Cryogenic Supply Unit - High-Frequency Input Test Mass - X
0269	SYS_006	TI	SYS_269	CSU-HITM_Y	Cryogenic Supply Unit - High-Frequency End Test Mass - X
0270	SYS_006	TI	SYS_270	CSU-HETM_Y	Cryogenic Supply Unit - High-Frequency Input Test Mass - Y
0271	SYS_002	SCI	SYS_271	CAV-HVAC	Cavern HVAC system
0272	SYS_002	SCI	SYS_272	TUN-HVAC	Tunnel HVAC SYSTEM
0273	SYS_002	SCI	SYS_273	SCI-SAF	Subsurface Infrastructure Safety System
0274	SYS_002	SCI	SYS_274	SCI-PDS	Subsurface Power Distribution System
0275	SYS_002	SCI	SYS_275	SCI-DEW	Subsurface Dewatering System
0276	SYS_002	SCI	SYS_276	SCI-CIR	Subsurface Logistics and People Circulation System
0277	SYS_002	SCI	SYS_277	SCI-COOL	Subsurface Distributed Cooling System
0278	SYS_008	COM	SYS_278	SCADA	Supervisory Control and Data Acquisition system
0279	SYS_008	COM	SYS_279	ODSS	On-site Data Storage System
0280	SYS_008	COM	SYS_280	ITFOS	Interferometer Operating Software
0281	SYS_008	COM	SYS_281	LLCI	Low-latency Computing Infrastructure
0282	SYS_008	COM	SYS_282	OSDA	Off-Site Data Analysis system
0283	SYS_008	COM	SYS_283	CHW-OTHER	Other computing hardware
0284	SYS_008	COM	SYS_284	SW-OTHER	Other software systems

To summarize

The 2023-2024 Project Office PBS reviews were the first effort to take inventory of ET's systems from Expert point-of-view

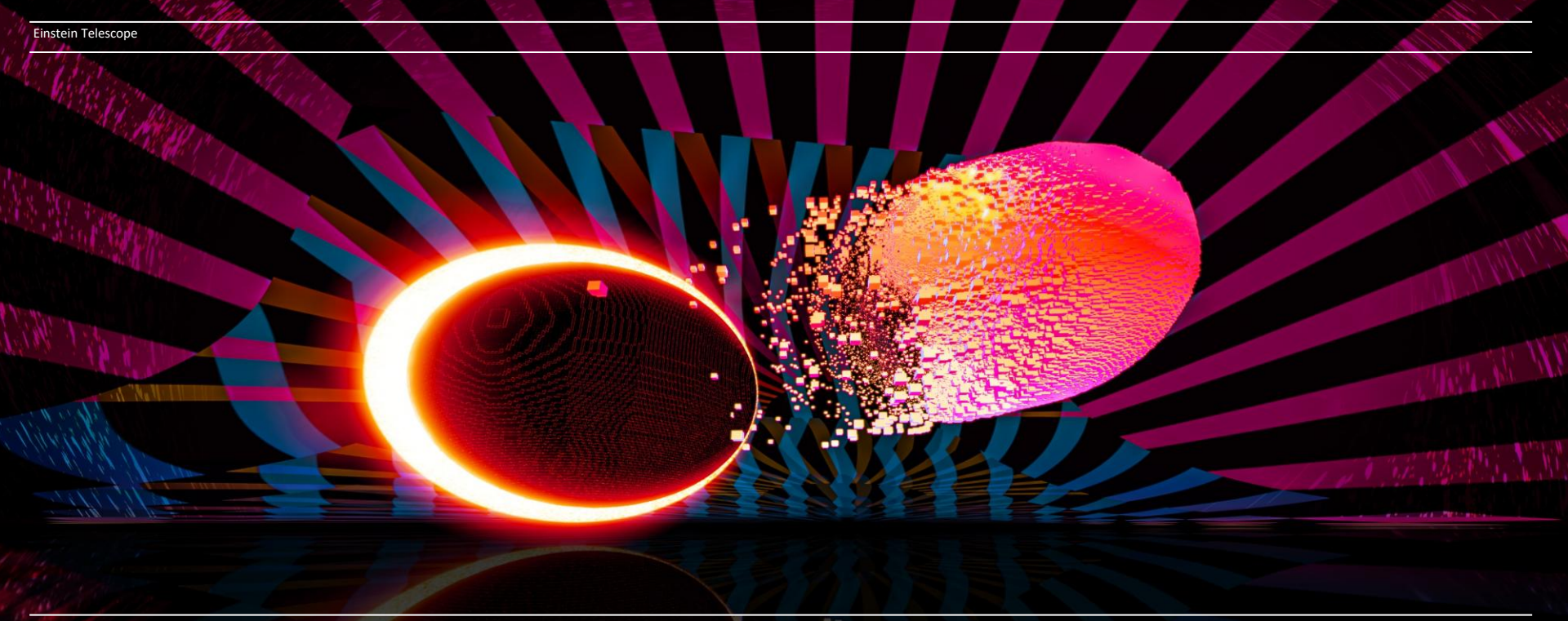
The 2025 Task Force work implemented the Warsaw-proposed SE principles within ET's active development work

"PBS 2.0" should take the best from both PBS1.0 and the Task Force system decomposition. F. Sorrentino and R. Meijer developing first systematic proposal; but the future decomposition should be developed continuously between ETO and ETC

Current challenge: translate the one-off exercises into continuous, revision-controlled and scalable processes supporting ET's active design work

Looking forward, fundamental process (P) and technical (T) improvements are necessary to enable this

- [P1]: Introducing and formalizing the Technical Baselining framework process
- [T1]: Disentangling the Task Force PBS into Unique Product PBS and Reuse Product BOM/Layouts structure
- [T2]: Developing advanced (Model-Based) Systems Engineering processes and Toolchain in PoC branch and prepare for use in active development branch
- [T3]: Expanding again beyond Task Force scope and incorporate PBS1.0 findings



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Thank you for your attention

WBS update
&
how to move for its implementation

F. Sorrentino

RECAP ON MAIN CONCEPTS

Work Breakdown Structure – scope & main features

- ET will require a **unique WBS**
  - Define global configuration by integrating instruments and infrastructures
  - Possibly similar structure across different project phases
- Define hierarchical structure of activities to design, build, and operate ET
- Identify high-level work-packages as main systems
  - integrated systems
  - distributed functions
- Decompose main work packages into tasks
  - following systems -> subsystems decomposition
- Decomposition should be suited for
  - proper **matching with PBS** elements
  - **scheduling**: identification of **causal dependencies** between **tasks** and **deliverables**
- For each system and for each subsystem identify:
  - required expertise
  - **one** coordinator (OBS)
  - a working team
    - people **in charge** for individual **tasks**

Work Breakdown Structure – project phases

- Specific activities will depend on project phase, but structure should be possibly kept throughout the project - **already needed to properly build TDR**
  - E.g. in wavefront sensing and control, task on ETM ring heaters
    - During preliminary design -> conceptual design & requirements definition of ring heaters
    - During technical design -> technical design of ring heaters
    - During construction –> RH parts procurement, RH assembly, RH installation
    - During commissioning –> RH tuning
    - During operations -> RH tuning, support for RH repair/replacement
    - During upgrades -> repeat cycle

WBS elements

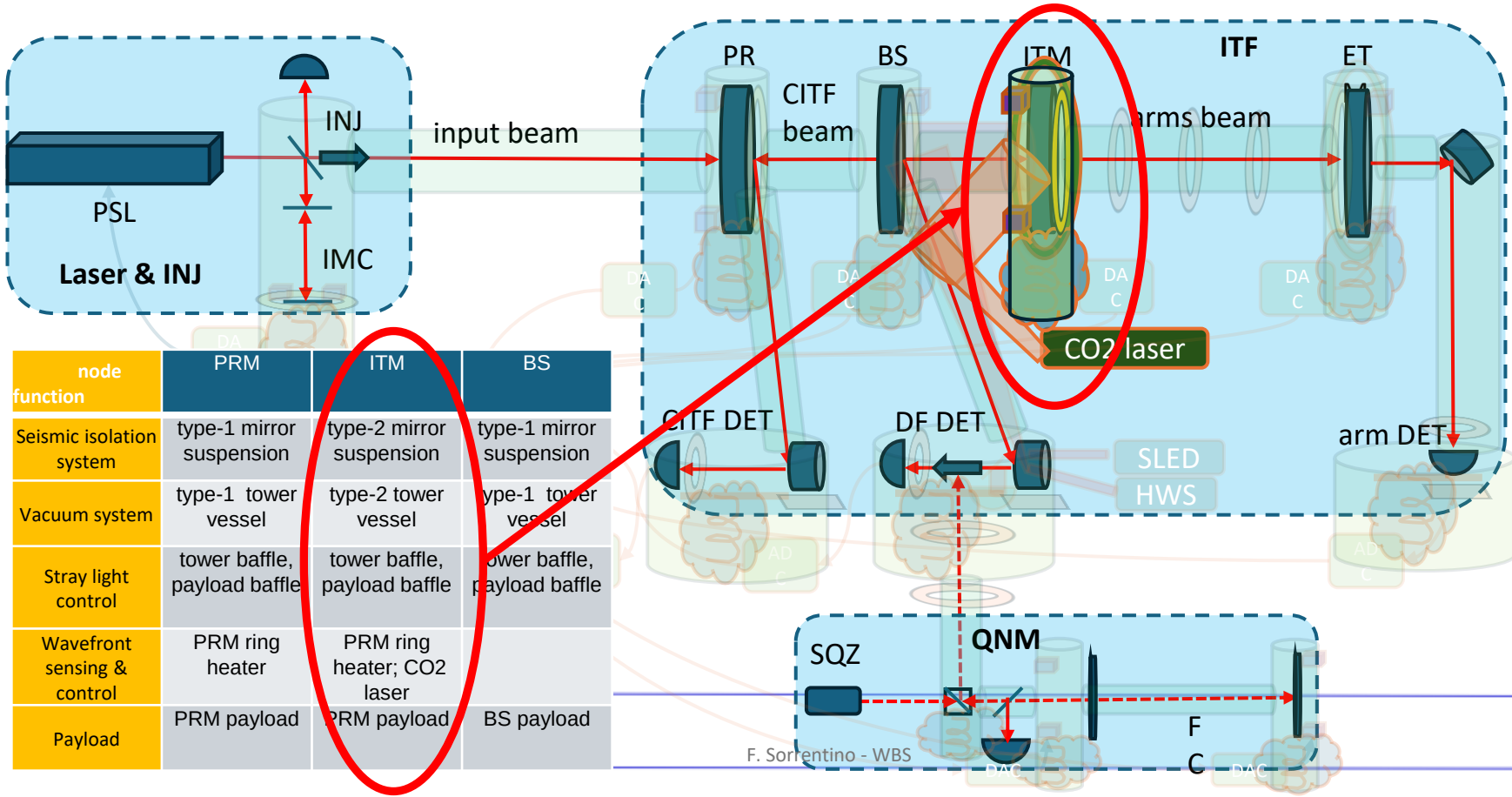
- WBS elements represent **activities**, e.g.
  - Global system integration (interferometer, civil infrastructure, …)
    - coordination by high level scientific expert
  - Local system integration (core optics tower, suspended bench tower)
    - coordination by system engineer
  - Global function (stray light control, seismic isolation, wavefront sensing & control…)
    - coordination by technology expert
  - Design and requirements definition (optical design, optical simulation, sensing and control, noise budget)
    - coordination by scientist

WBS & PBS

WBS & PBS: configuration nodes

- Instrument nodes
  - integrated systems where several global functions of the instrument are crossing
    - mirror towers, suspended bench towers, pipes
  - GW detectors require suspending critical elements in vacuum
  - -> most hardware is conveniently grouped into optical nodes with a seismic isolation inside vacuum vessel
- Underground infrastructure nodes
  - integrated systems where several instrument nodes and technical infrastructure functions are crossing
    - caverns, tunnels
- All nodes (instrument & infrastructure) show up at layer 4 in PBS.2

Global functions to node mapping



node function	PRM	ITM	BS
Seismic isolation system	type-1 mirror suspension	type-2 mirror suspension	type-1 mirror suspension
Vacuum system	type-1 tower vessel	type-2 tower vessel	type-1 tower vessel
Stray light control	tower baffle, payload baffle	tower baffle, payload baffle	tower baffle, payload baffle
Wavefront sensing & control	PRM ring heater	PRM ring heater; CO2 laser	
Payload	PRM payload	PRM payload	BS payload

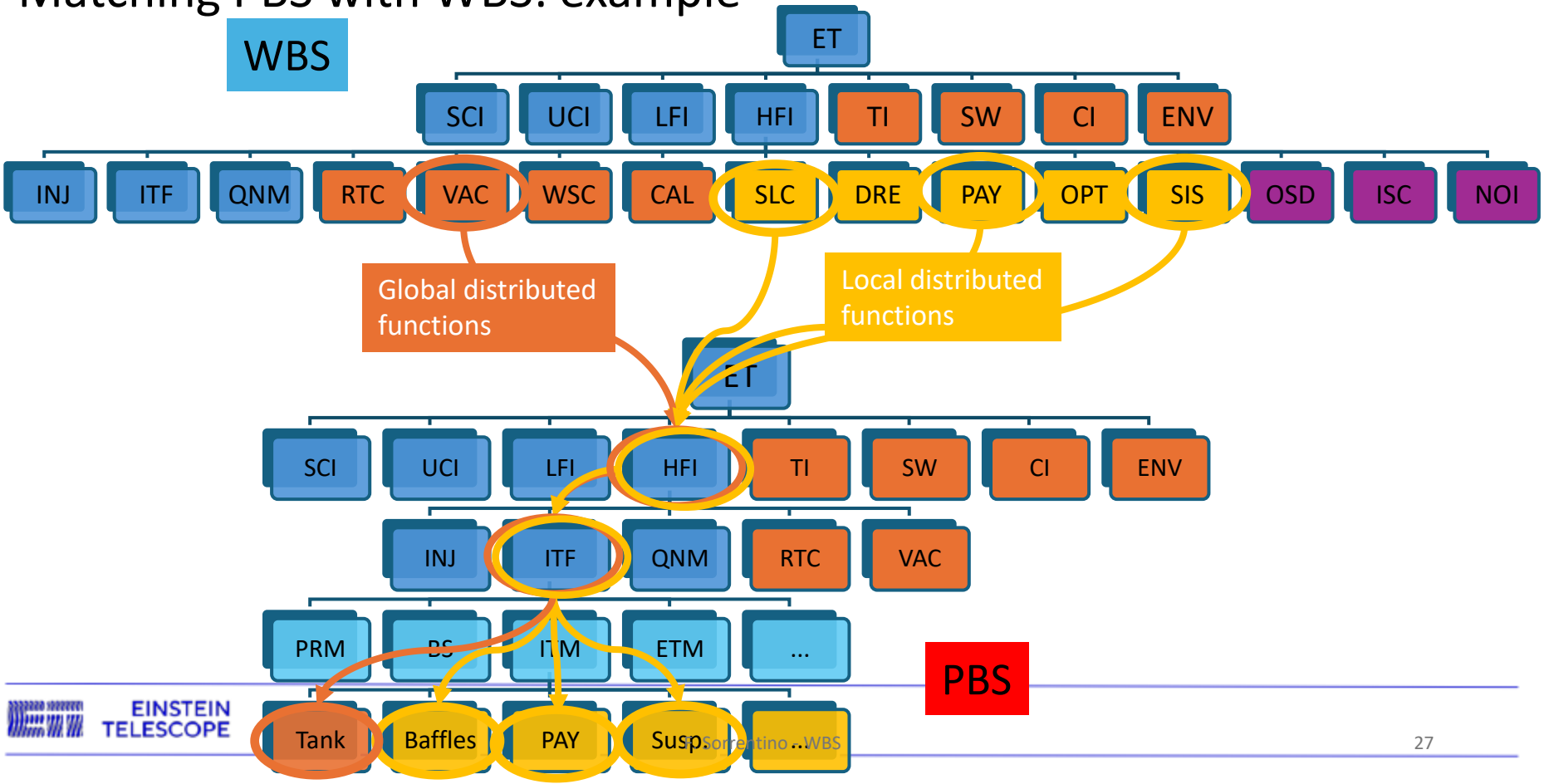
Mapping global functions into PBS nodes - instruments

node function	PSL	INJ optics	IOP	IMC-I	IMC-E	PRM	BS	SEM	ZM1	ZM2
Seismic isolation system		susp. bench	susp. bench	type-1 mirror suspension	type-1 mirror suspension	type-1 mirror suspension	type-1 mirror suspension	type-1 mirror suspension	type-1 mirror suspension	type-1 mirror suspension
Vacuum system		bench vessel	bench vessel	type-1 tower vessel	type-1 tower vessel	type-1 tower vessel	type-1 tower vessel	type-1 tower vessel	type-1 tower vessel	type-1 tower vessel
Stray light control		bench diaphragms	bench diaphragms	tower baffle, payload baffle	tower baffle, payload baffle	tower baffle, payload baffle	tower baffle, payload baffle	tower baffle, payload baffle	tower baffle, payload baffle	tower baffle, payload baffle
Wavefront sensing & control		HWS source and detector	HWS optics	IMC-I ring heater	IMC-E ring heater	PRM ringh heater		SEM ring heater		
Real-time control system	PSL DAQ	INJ DAQ			IMC-E DAQ					
Payload				IMC-I payload	IMC-E payload	PRM payload	BS payload	SEM payload	ZM1 payload	ZM2 payload
Optics	PSL optics	INJ optics	IOP optics	IMC-I mirror	IMC-E mirror					
Detectors & readout electronics	PLS photodiodes	IMC linear PD; IMC align. QPDs	Pstab PD		IMC-E linear PD					
Calibration										

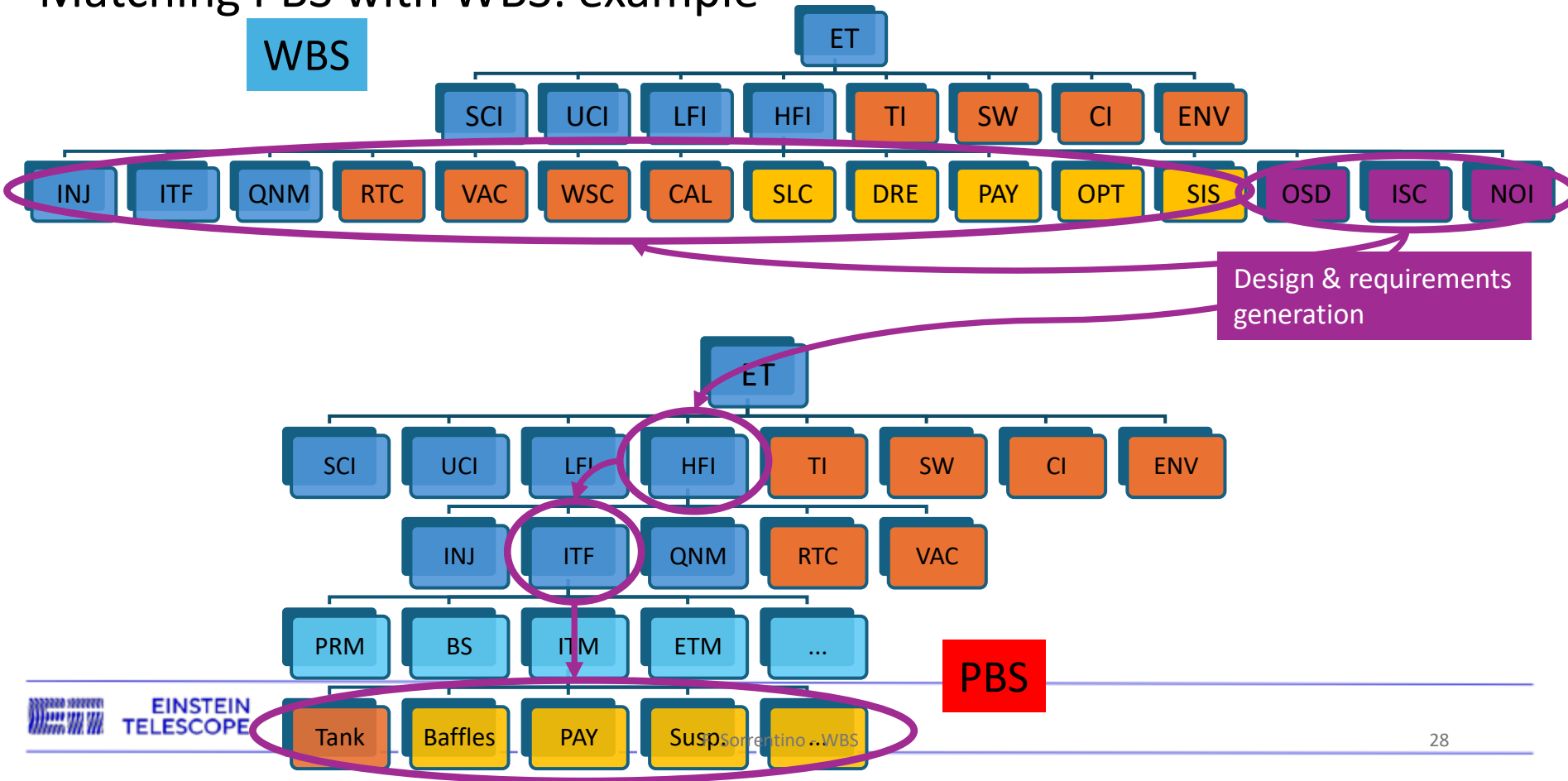
Mapping global functions into PBS nodes - infrastructure

node function	Cavern A	Cavern B	Cavern C	Cavern D	Cavern E	Cavern F1	Cavern F2	Tunnel A	Tunnel B	Arm Tunnel
HFI		PSL, INJ, IOP, BS, PRM, SEM towers			ETM tower			ZRM-PRM pipe	HFI arm pipe	HFI arm pipe
LFI	PSL, INJ, IOP, BS, PRM, SEM towers		CAL towers	ETM tower		FC tower	IMC towers		LFI arm pipe	LFI arm pipe
HVAC	Cavern A HVAC	Cavern B HVAC	Cavern C HVAC	Cavern D HVAC	Cavern E HVAC	Cavern F1 HVAC	Cavern F2 HVAC	Tunnel A HVAC	Tunnel B HVAC	Arm tunnel HVAC
Electrical	supply LF vertex towers complex	supply HF vertex towers complex	supply LFI CAL	Supply LFI ETM	Supply HFI ETM	Supply LFI FC	Supply LFI IMC			
Lighting	Cavern A Lighting	Cavern B Lighting	Cavern C Lighting	Cavern D Lighting	Cavern E Lighting	Cavern F1 Lighting	Cavern F2 Lighting	Tunnel A HVAC Lighting	Tunnel B Lighting	Arm tunnel Lighting
Circulation	Cavern A stairs/elevators	Cavern B stairs/elevators	Cavern C stairs/elevators	Cavern D stairs/elevators	Cavern E stairs/elevators	Cavern F1 stairs/elevators	Cavern F2 stairs/elevators	Tunnel A stairs/elevators	Tunnel B stairs/elevators	Arm tunnel stairs/elevators
Dewatering	Cavern A dewatering	Cavern B dewatering	Cavern C dewatering	Cavern D dewatering	Cavern E dewatering	Cavern F1 dewatering	Cavern F2 dewatering	Tunnel A dewatering	Tunnel B dewatering	Arm tunnel dewatering
Plumbing										
Cryogenics	LF PRM and SEM cryopump	LF PRM and SEM cryopump		LF ETM cryopump	HF ETM cryopum					

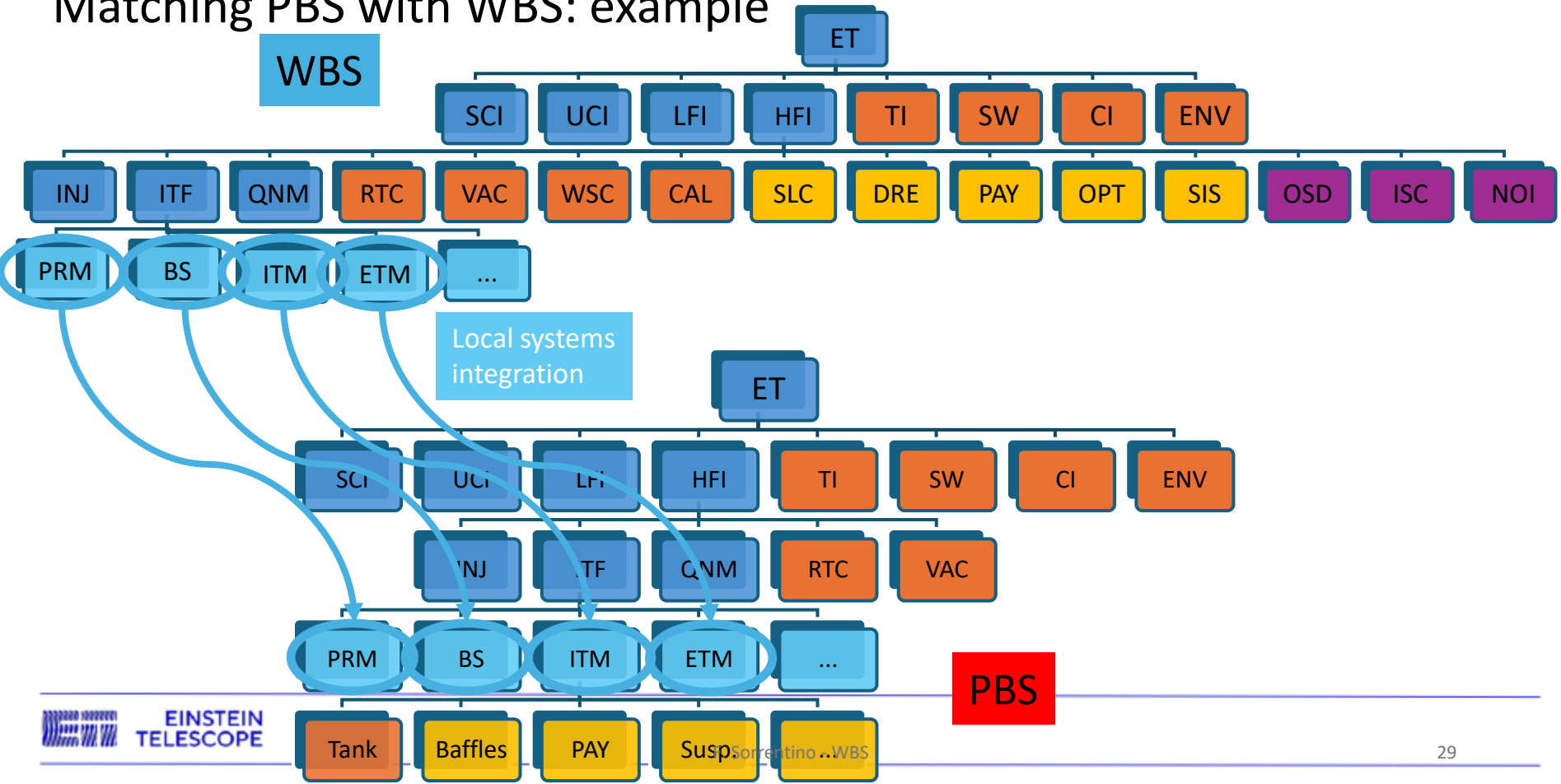
Matching PBS with WBS: example



Matching PBS with WBS: example



Matching PBS with WBS: example



STATUS & NEXT STEPS

Evolution after presentation @ 2024 ET annual meeting

- WBS.1 and PBS.2 tables available in shared spreasheet format
  - including integrated subsystems (i.e. arms)
    - more suitable for interface integration with underground civil infrastructure

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1		Layer1 name	L1_type	L1_description	L2_ID	Layer2 name	L2_type	L2_description	L3_ID	Layer3 name	L3_type	L3_description	L4_ID	Layer4 name	L4_type
2	1	Einstein Telescope (ET)	GSI	Generation of top level requirements; integration of level 2 systems	11	Underground civil Infrastructure	GSI	Caverns and tunnels hosting instruments and technical infrastructure; functional and integration interfaces; design, construction and maintenance.	1101	Access	GLF		110101	Access Shaft	LSI
3													110102	Safety Shaft	LSI
4													110103	Access Tunnel	LSI
5													110104	Boreholes	LSI
6									1102	Caverns	GLF		110201	Cavern A	LSI
7													110202	Cavern A	LSI
8													110203	Cavern A	LSI
9													110204	Cavern A	LSI
10													110205	Cavern A	LSI
11													110206	Cavern A	LSI
12													110207	Cavern A	LSI
13													110208	Cavern A	LSI
14													110209	Cavern A	LSI
15													110210	Cavern B	LSI
16													110211	Cavern C	LSI
17													110212	Cavern D	LSI
18													110213	Cavern E	LSI
19													110214	Cavern F1	LSI
20													110215	Cavern F2	LSI
21													110216	Cavern F3	LSI
22													110217	Cavern G1	LSI
23													110218	Cavern G2	LSI
24													110219	Cavern G3	LSI

WBS_breakdown_1a | WBS_breakdown_1b | PBS_breakdown_2a | PBS_breakdown_2b | WBS level 4 dependency matrix | +

Evolution after presentation @ 2024 ET annual meeting

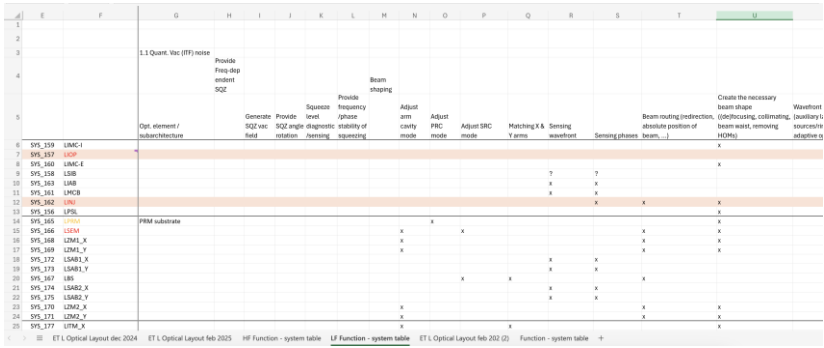
- WBS.1 and PBS.2 tables available in shared spreasheet format
  - including integrated subsystems (i.e. arms)
    - more suitable for interface integration with underground civil infrastructure
- Finalising integrated document on the structure of PBS.2 & WBS.1
  - Introduction
  - Product Breakdown structure: logic, decomposition, examples
  - Work Breakdown structure: logic, decomposition, examples
  - Mapping WBS functions into PBS nodes: logic and examples
  - Requirements flow: general logic, examples
  - WBS to OBS
  - WBS to scheduling: logic and examples
  - Conclusions

Evolution after presentation @ ET annual meeting

- WBS.1 and PBS.2 tables available in shared spreasheet format
  - including integrated subsystems (i.e. arms)
    - more suitable for interface integration with underground civil infrastructure
- Finalising integrated document on the structure of PBS.2 & WBS.1
- PBS.2 structure mapped to pre-TDR under preparation by ISB for ET-PP

Evolution after presentation @ ET annual meeting

- WBS.1 and PBS.2 tables available in shared spreasheet format
  - including integrated subsystems (i.e. arms)
    - more suitable for interface integration with underground civil infrastructure
- Finalising integrated document on the structure of PBS.2 & WBS.1
- PBS.2 structure mapped to pre-TDR under preparation by ISB for ET-PP
- Examples of simplified structure from Task Force
  - system decomposition
  - functions -> node mapping
  - highlighting HFI/LFI-UCI integration functions



Evolution after presentation @ ET annual meeting

- The 2025 ET baseline detector layout from ETO task force provided, for the first time, a coherent picture of the ET detector based on the relevant interfaces between instruments and infrastructures, though in the absence of an interfaces database.
- Such a very preliminary design was limited to the instrument subsystems with direct impact on civil infrastructure.
- A more complete, though still preliminary description of the instrument extending to all subsystems will be provided by the pre-TDR under preparation by ETC ISB as an ET-PP deliverable
- Next step should be providing a detector baseline configuration based on system engineering.
- This work, based on the implementation of WBS.1 and PBS.2, would provide some essential input to project feasibility assessment
  - tools supporting the requirements traceability and preliminary costing estimate (the integrated-systems PBS)
  - tools supporting possible scheduling estimate in the future (WBS)
  - an interfaces management plan
  - an update of existing risk assessment tools (risk register
  - a basic set of requirements to civil and technical infrastructures

Next steps

- Distribute integrated document describing the logic and structure PBS.2 and WBS.1
  - finalise structure in spreadsheets
  - include tables to map functions into configuration nodes
- Set up a new structure to follow up from Task Force experience in agreement with stakeholders
  - including people from ISB, PO, ED, end others (e.g. CERN)
  - implement & manage PBS.2 structure (involving ISB, ED, CERN, …)
  - develop an OBS from the WBS.1
- test advanced management tools (involving relevant stakeholders to make use of such tools in the future: ISB, ED, CERN, …)
    - WBS: scheduling tool
    - PBS: PLM/MBSE
    - configuration: database & requirements management tool