Upgrade, Commissioning, Operations & Maintenance Project Management Plan

N. Arnaud, A. Rocchi, M. Was

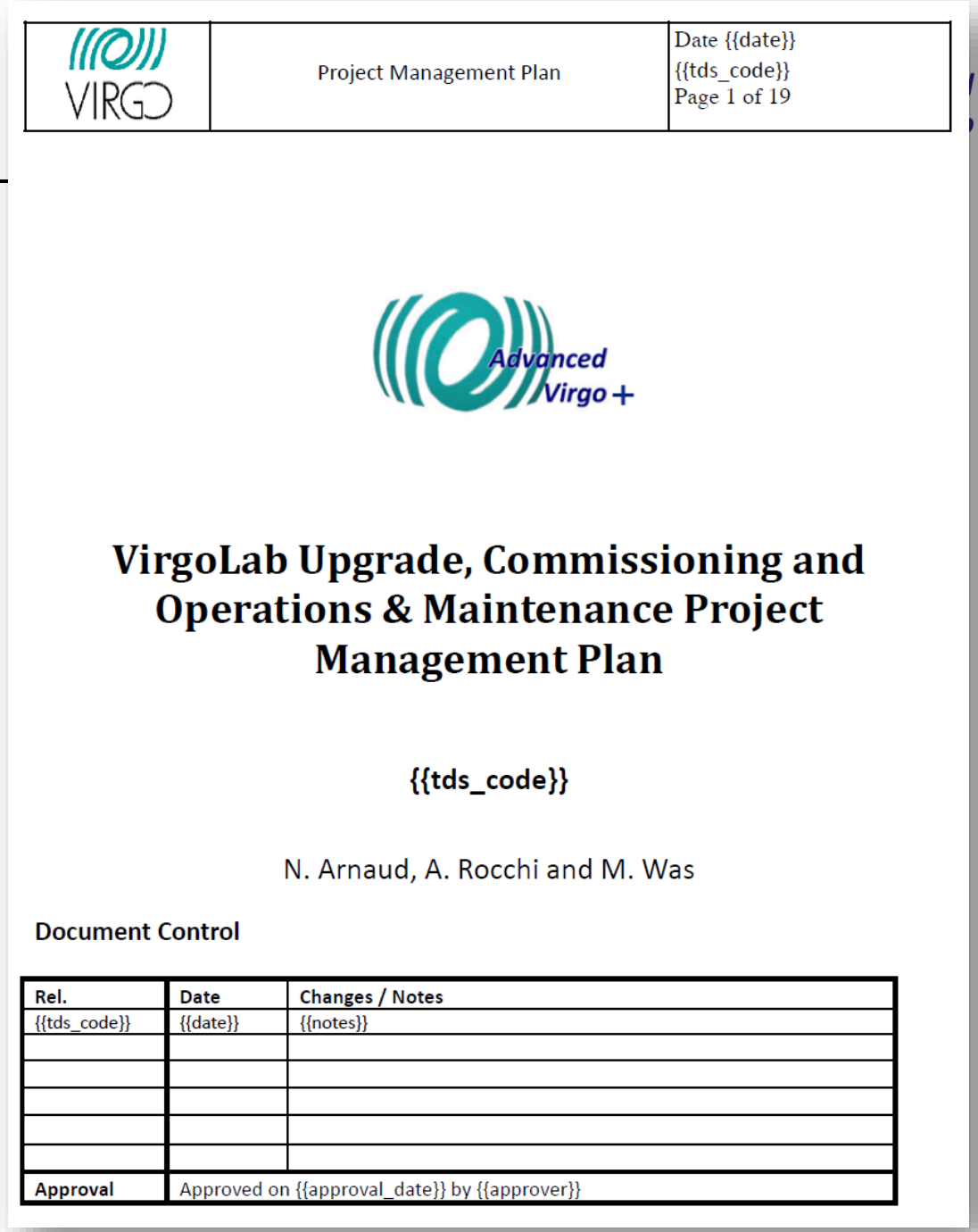
VIR-0952A-25

Outline

- Project Management
  - Organizational Breakdown Structure
  - Project management processes
  - Record Of Decision/Agreement (RODA)
- WBS and planning

Project Management Plan

- New single document for all three phases
  - Builds on AdV+ Project PMP (VIR-0912A-24)
  - Reviewed stakeholders and updated some processes to harmonize the three phases
- Document authored by the Coordinators:
  - Commissioning: M. Was
  - Science Run: N. Arnaud
  - Upgrade: A. Rocchi



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Advanced Virgo+

VirgoLab Upgrade, Commissioning and Operations & Maintenance Project Management Plan

{{tds_code}}

N. Arnaud, A. Rocchi and M. Was

Document Control

Rel.	Date	Changes / Notes
{{tds_code}}	{{date}}	{{notes}}
Approval	Approved on {{approval_date}} by {{approver}}	

Project within VirgoLab

- Project approval from EGO Council
- Reporting to:
  - VirgoLab Executive Board
  - EGO STAC/Council
- Independent decision making on technical matters
  - Support/advice from Technical Teams
  - when decision implies relevant change in cost or performance → approval from Executive Board
- Board of PIs endorsement needed on OBS changes (TBC)
  - As for Technical Team Leaders
  - Appointment of System Unit Managers

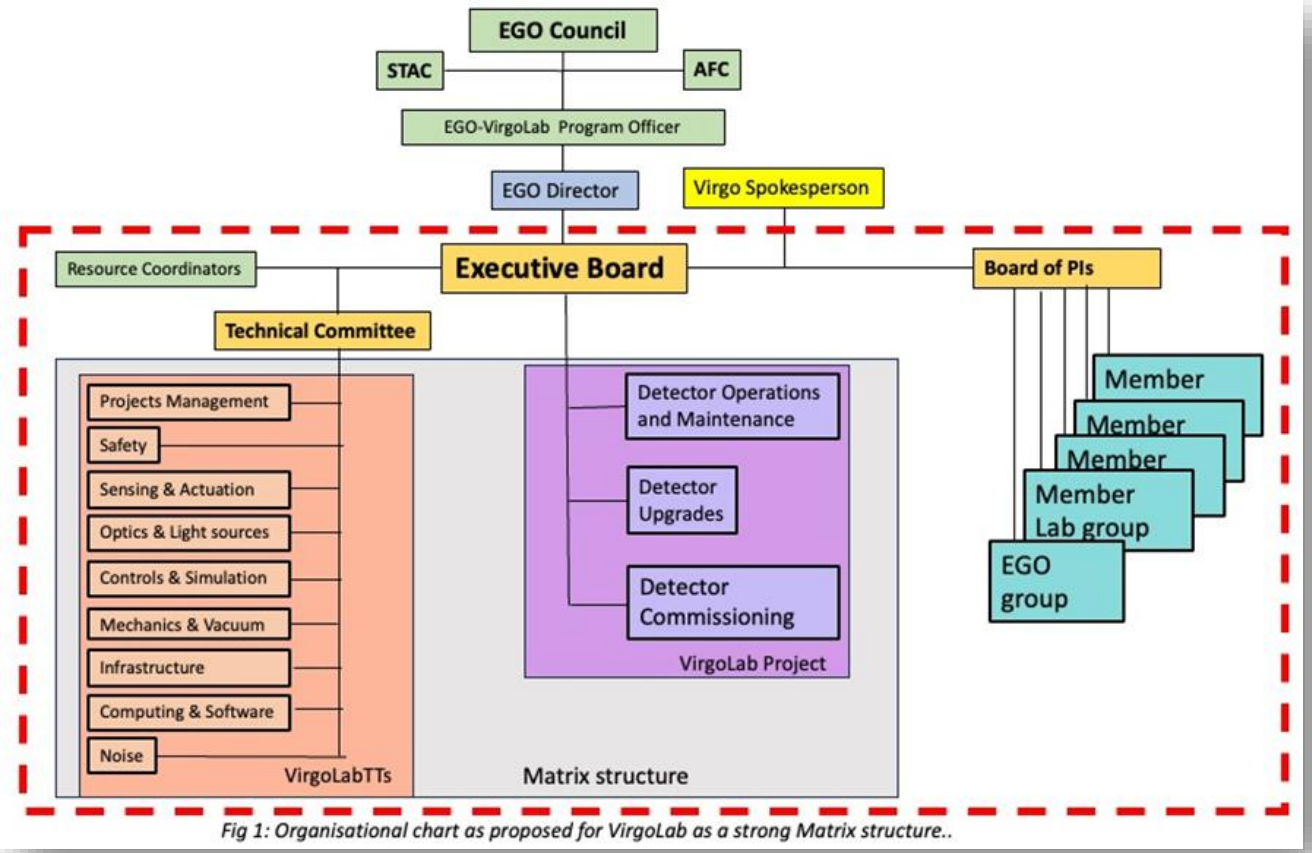
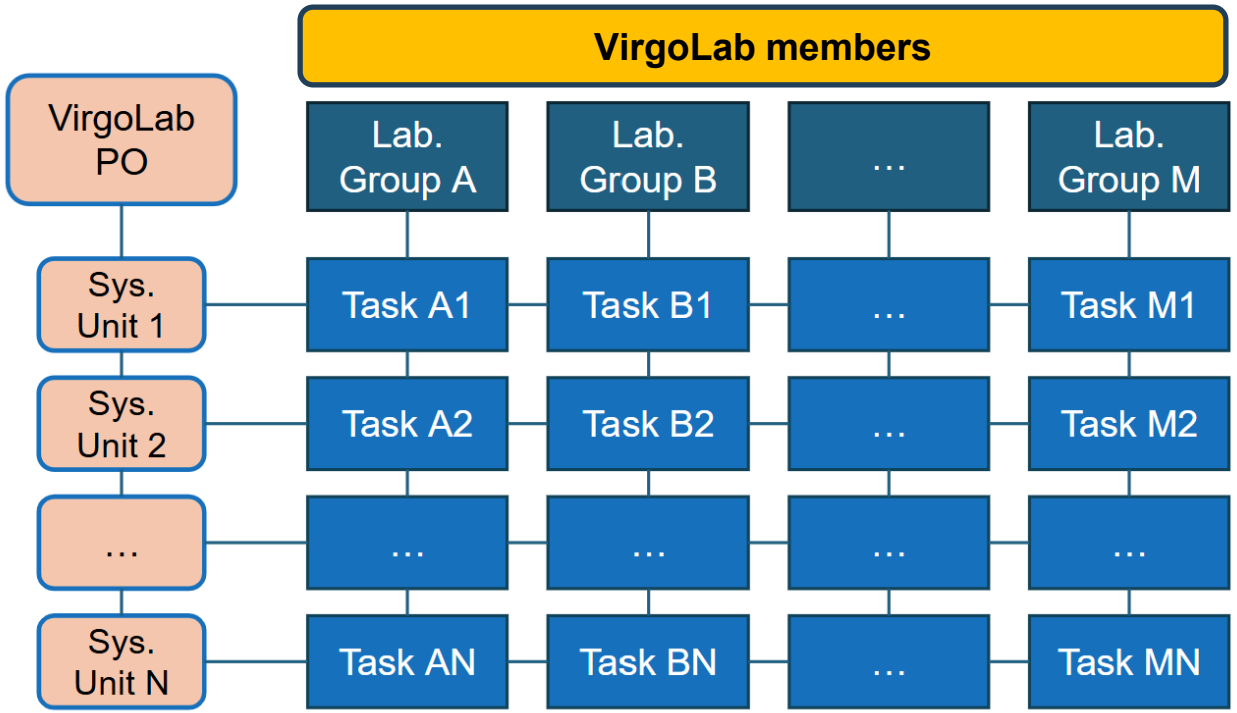


Fig 1: Organisational chart as proposed for VirgoLab as a strong Matrix structure..

Project OBS

- The Project is organized as a standard line-managed project, with a Work Breakdown Structure.
- WBS System Unit Managers assigned to an appropriate level.
- SUMs are drawn from the members of VirgoLab and are chosen based on technical and management expertise.
- SUMs comprise current Upgrade/Commissioning Subsystems and Operations Working Groups



Project Management Structure

VirgoLab Projects Office

Upgrade Coordinator: A. Rocchi
Operations & Maintenance Coordinator: N. Arnaud
Commissioning Coordinator: M. Was
Technical & Configuration Manager: H. Heitmann
System Engineer: F. Carbognani
Interface Manager: M. Galimberti
Risk Manager: F. Sorrentino
QA/QC Manager: TBD
On-site Integration Manager: TBD

OSD S. Steinlechner	**SBE** H. Bulten	**CRD** M. Bazzan	**NNC** J. Harms	**IME** I. Fiori	**JRPC** N. Arnaud
PSL W. Chaibi	**MIR** L. Pinard	**ISC** J. Casanueva	**INF** A. Paoli	**MPO** A. Gennai	**Low Latency** R. De Pietri
INJ M. Gosselin	**TCS** I. Nardecchia	**ALS** C. De Rossi	**VAC** A. Pasqualetti	**RCS** A. Bertolini & M. Razzano	
SLC L-M. Mir	**PAY** E. Majorana	**DAQ** S. Viret	**EMS** R. De Rosa	**Computing** S. Bagnasco & F. Carbognani	
DET R. Gouaty	**SAT** V. Boschi	**CAL** L. Rolland	**FDS** J.-P. Zendri & M. Vardaro	**DetChar** F. Di Renzo	

Project management processes

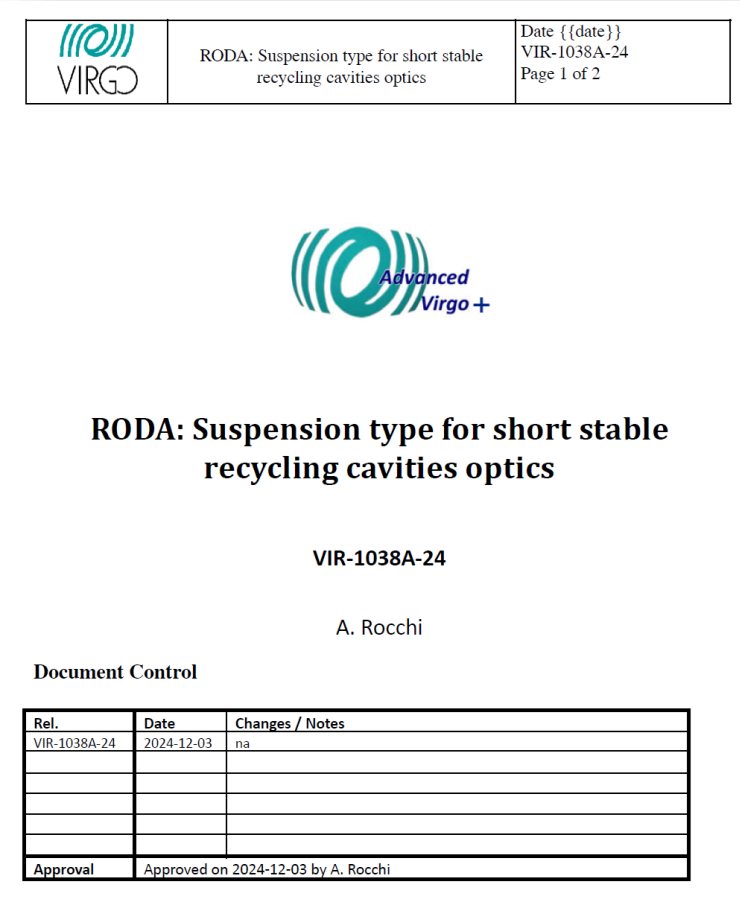
- Technical Management
  - TDR editing, production of WBS, Project Execution Plan and budget plan
- Configuration Control Management
  - Manages technical and financial change requests
- System Engineering
  - Manages Design, Production Readiness Reviews (PRR), Validation and Reception Reviews (VRR)
  - Manages Requirements Verification Matrices (together with Risk Manager)
- Interface Management
  - Defines the Interface Control process through Interface Control Documents (ICDs) for each system unit and managing cross-system unit interfaces
- Risk Management
  - Organizes and implements the risk management policy with a focus on global system performance and interface knowledge, maintains the Project Risk Registry
  - Develops a Requirements Management Plan (together with the System Engineer)

Project management processes

- QA/QC Management
  - Prepares and maintains the Quality Assurance Plan (QAP), Quality Assurance documentation, ensures the traceability of key components, manages non-conformities
- On-site Integration Management
  - Responsible for organizing and coordinating the installation activities on site
  - Manages the integration aspects of the overall mid- and long-term project planning (together with the Technical Manager)

Record Of Decision/Agreement

- Standard process within LVK to record decisions
- Includes all stakeholders, decision responsible and supporting documentation



VIRGO	RODA: Suspension type for short stable recycling cavities optics	Date {{date}} VIR-1038A-24 Page 1 of 2

Advanced Virgo +

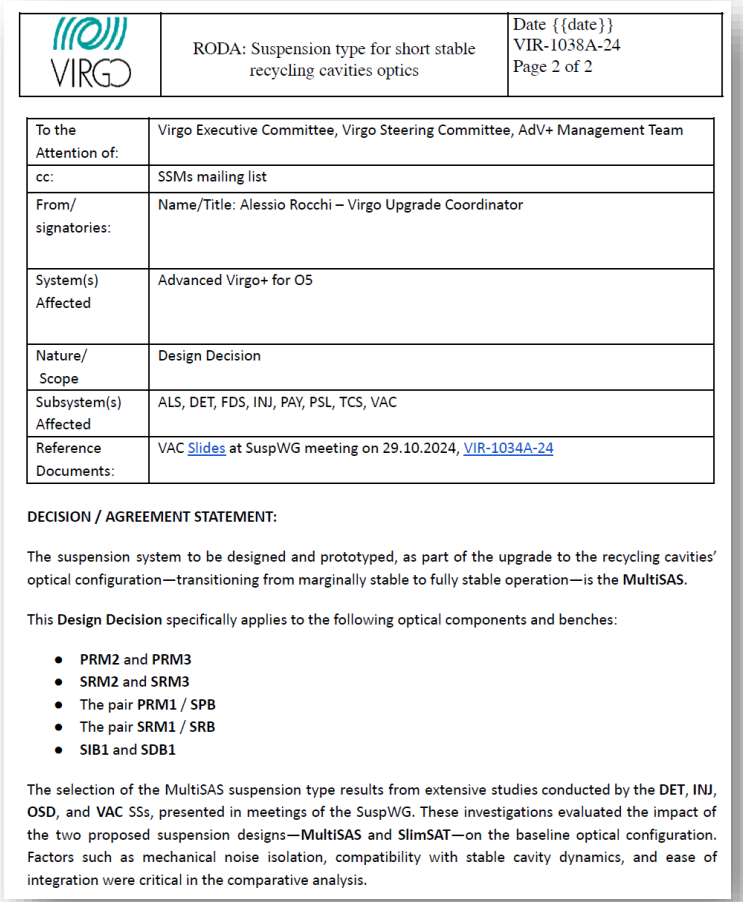
RODA: Suspension type for short stable recycling cavities optics

VIR-1038A-24

A. Rocchi

Document Control

Rel.	Date	Changes / Notes
VIR-1038A-24	2024-12-03	na
Approval	Approved on 2024-12-03 by A. Rocchi	



VIRGO	RODA: Suspension type for short stable recycling cavities optics	Date {{date}} VIR-1038A-24 Page 2 of 2

To the Attention of:	Virgo Executive Committee, Virgo Steering Committee, AdV+ Management Team
cc:	SSMs mailing list
From/ signatories:	Name/Title: Alessio Rocchi – Virgo Upgrade Coordinator
System(s) Affected	Advanced Virgo+ for O5
Nature/ Scope	Design Decision
Subsystem(s) Affected	ALS, DET, FDS, INJ, PAY, PSL, TCS, VAC
Reference Documents:	VAC Slides at SuspWG meeting on 29.10.2024, VIR-1034A-24

DECISION / AGREEMENT STATEMENT:

The suspension system to be designed and prototyped, as part of the upgrade to the recycling cavities' optical configuration—transitioning from marginally stable to fully stable operation—is the **MultiSAS**.

This **Design Decision** specifically applies to the following optical components and benches:

- **PRM2** and **PRM3**
- **SRM2** and **SRM3**
- The pair **PRM1** / **SPB**
- The pair **SRM1** / **SRB**
- **SIB1** and **SDB1**

The selection of the MultiSAS suspension type results from extensive studies conducted by the **DET**, **INJ**, **OSD**, and **VAC** SSs, presented in meetings of the SuspWG. These investigations evaluated the impact of the two proposed suspension designs—**MultiSAS** and **SlimSAT**—on the baseline optical configuration. Factors such as mechanical noise isolation, compatibility with stable cavity dynamics, and ease of integration were critical in the comparative analysis.

Planning management – WBS

- Upgrade WBS almost coincident with list of deliverables (our PBS)
- Very few activities, in any case functional to the deliverables, have been included in the Virgo Members Database

Subsytem	Code	Deliverable
ALS	ALS.02	ALS - Improved ALS robustness
	ALS.03	ALS - ALS adaptation to stable cavities
CAL	CAL.01	CAL - Newtonian calibrators
	CAL.02	CAL - Dark fringe sensors frequency response calibrator
	CAL.03	CAL - Calibrators based on end-bench scattered light
	CAL.04	CAL - Photon calibrators
CRD	CRD.01	CRD - Development plan for O5 coating
DAQ	DAQ.01	DAQ - Timing distribution upgrade
	DAQ.02	DAQ - Real Time PC upgrade
	DAQ.03	DAQ - Acquisition system update
DET	DET.04	DET - Photodiode sensing and quadrant scattered light noise reduction
	DET.05	DET - Updated cameras for the monitoring of laser beams
	DET.07	DET - Picomotor multiplexer boards for lower thermal load in the bench electronic boxes
	DET.08	DET - SRB bench
	DET.09	DET - SDB1 bench
	DET.10	DET - SDB2 reshuffling
	DET.11	DET - SPOB bench
EMS	EMS.01	EMS - General EMS upgrades: sensors and actuators
FDS	FDS.01	FDS - Squeezing to ITF mode matching control system
	FDS.02	FDS - System redesign for compatibility with Stable Cavities
	FDS.03	FDS - Electronics upgrades
	FDS.04	FDS - AEI Squeezing source maintenance
	FDS.05	FDS - SQB1 bench upgrades
	FDS.06	FDS - Subcarrier source upgrades
	FDS.07	FDS - EQB1 bench upgrades
	FDS.08	FDS - FC Mirror temperature monitoring
IME	IME.01	IME - Mitigation of water chillers in the terminal buildings
	IME.02	IME - Noise mitigation of Central Building air handling units
	IME.03	IME - Upgrade of some UPS for magnetic noise mitigation
	IME.04	IME - Mitigation of air compressors in the terminal buildings
	IME.05	IME - Soundproofed rooms for NEB and WEB racks
INF	INF.01	INF - Roof opening works
	INF.02	INF - CEB experimental hall modification works
	INF.04	INF - Central hall infrastructure disassembly and reassembly
INJ	INJ.03	INJ - Re-engineered INJ electronics
	INJ.04	INJ - Upgraded IMC payload
	INJ.05	INJ - New benches for stable cavities (SIB1 and PRB)
	INJ.06	INJ - Existing benches modifications for stable cavities (EIB, SIB2)
	INJ.07	INJ - Replaced IMC end mirror
	INJ.08	INJ - ITF Beam Pointing System
	INJ.09	INJ - EIB upgrades from Commissioning experience
	INJ.10	INJ - SIB1 upgrades from Commissioning experience
		INJ - IMC alignment control improvements (TBC)
ISC	ISC.01	ISC - Locking acquisition design
	ISC.02	ISC - Steady state locking scheme design
	ISC.03	ISC - Automatic Alignment scheme design
MIR	MIR.05	MIR - Upgraded cleaning machine
	MIR.06	MIR - Upgraded coater
	MIR.07	MIR - Upgraded scattering bench
	MIR.08	MIR - Upgraded absorption bench
	MIR.11	MIR - New compensation plates
	MIR.12	MIR - Point absorber characterization bench
	MIR.13	MIR - Stable Recycling Cavity mirrors
MPC	MPC.01	MPC - Prototyping of mirror position control electronics
	MPC.02	MPC - Construction/Installation of mirror position control electronics
NNC	NNC.01	NNC - NNC software for enhanced cancellation

Planning management – WBS tables

PSL **AdV+Ph2 planning file**

Subsystem WBS table

SS Statistics	Committed	Cost
Project	13	703
In-kind	0	0
Total SS		

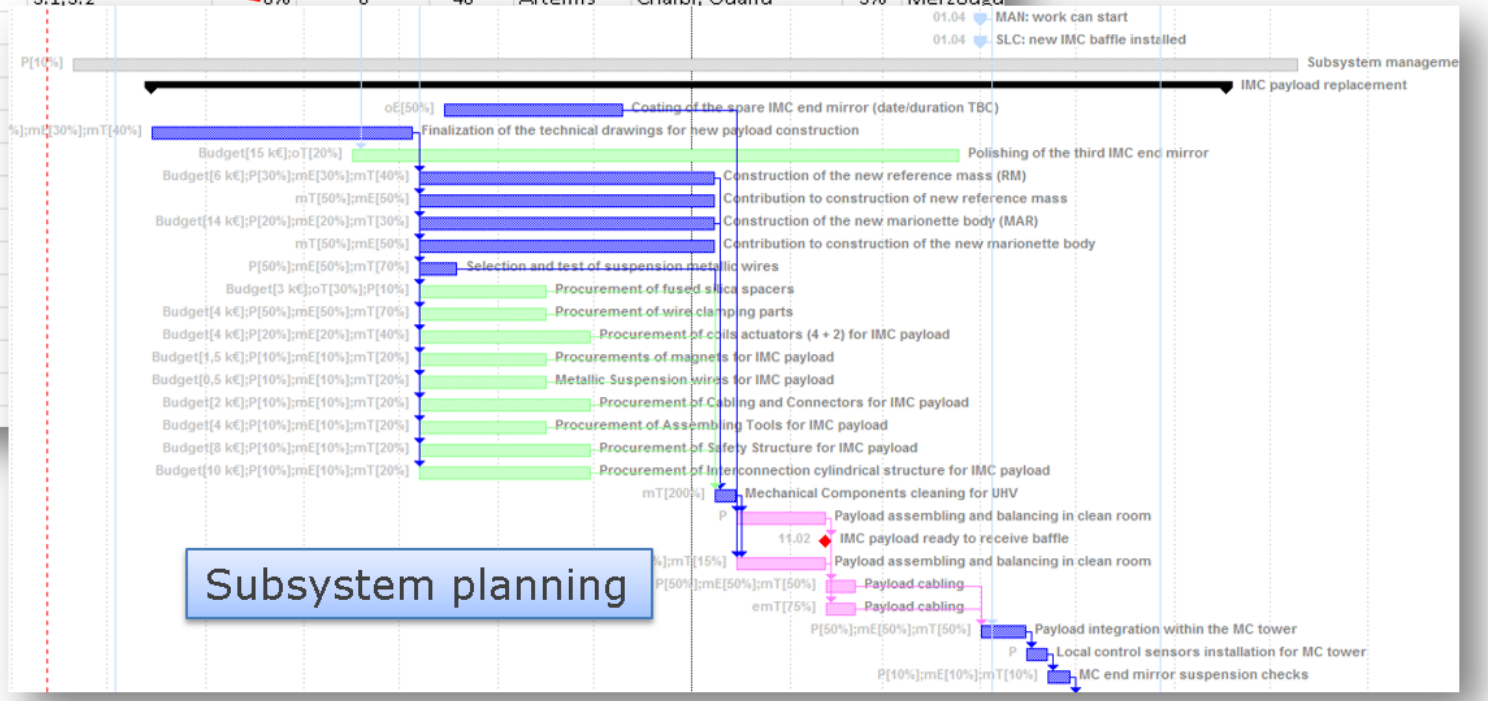
Progress

Budget

Workforce

	Works			Schedule information		Progress		Resources				
No.	**Task**	**Subtask**	**Type**	**Duration**	**Predecessors**	**%done**	**Committed**	**Cost**	**Lab**	**Name1**	**%_1**	**Name2**
D1	MAN: End of post-O4 commissioning		D	0 days	20/06/25							
D03	MAN: Budget available (TDR approved)		D	0 days	31/03/25							
D2	INJ: IMC locked		D	0 days	01/08/25							
20	Subsystem management		M						Artemis	Chaibi, Oualid	10%	
3	New Pre-ModeCleaner											
3.1		Design of the vacuum chamber		1 mon	D03	0%	0	0	Artemis	Chaibi, Oualid	10%	Merzougu
3.2		Design of the PZT maintaining system and mechanical simulations		3 mon	D03	0%	0	0	Artemis	Chaibi, Oualid	10%	Merzougu
3.3		Order of the PMC mechanics, vacuum chamber, vacuum elements and	E	4 mon	3.1,3.2	0%	0	40	Artemis	Chaibi, Oualid	5%	Merzougu
3.4		Order of the PMC mirrors	E	6 mon								
3.41		Order of the coatings and PZTs	E	6 mon								
3.5		Test of the PMC mirrors at low power and throughput measurement		3 mon								
3.6		Mounting of the PZT, Mechanical and vacuum tests, PZT-TF measurem		2 mon								
3.7		PMC lock at low power		2 mon								
3.8		Injection of high power beam and PMC validation		1 mon								
3.9		Order of mirrors actuators for PMC automatic alignment	E	6 mon								
3.10		Manufacture and test of the automatic alignment at low power		4 mon								
3.11		validation of the PMC automatic alignment at high power		1 mon								
4	Upgraded laser power stabilization											
4.11		Design of the optical box		10 mon								
4.2		Order of the Optical box mechanics and optics	E	6 mon								
4.3		Characterization of the photodiodes		3 mon								

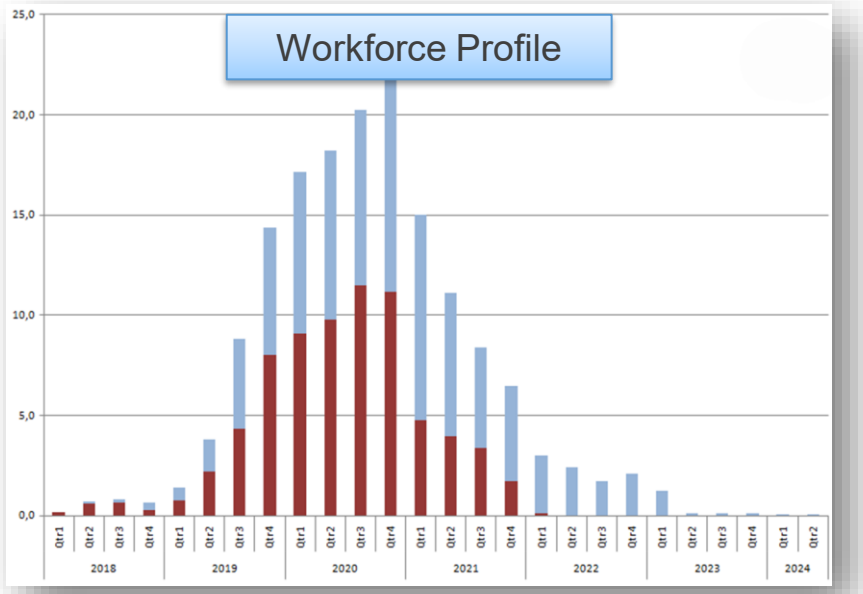
Subsystem planning compilation



Subsystem planning

Project WBS

- Upgrade and Commissioning already integrated under the same infrastructure
- WBS used to build the planning and to extract resource profiles, critical path, …



- Operations & Maintenance not yet integrated

Subsystem	Responsible	Last compiled version
INTERFEROMETER		
OSD – Optical Simulations and Design	S. Steinlechner	PDF, MPP, LOG
PSL – Pre-Stabilized Laser	W.Chaibi	PDF, MPP, LOG
INJ – Injection	M.Gosselin	PDF, MPP, LOG
DET – Detection	R.Gouaty	PDF, MPP, LOG
SLC – Scattered Light Control	L-M.Mir	PDF, MPP, LOG
FDS – Frequency Dependent Squeezing	J.-P.Zendri	PDF, MPP, LOG
TCS – Thermal Compensation System	I.Nardecchia	PDF, MPP, LOG
SUSPENSIONS & MIRRORS		
MIR – Mirrors	L.Pinard	PDF, MPP, LOG
PAY – Payloads	E.Majorana	PDF, MPP, LOG
SBE – Suspended Benches	H.Bulten	PDF, MPP, LOG
SAT – Super Attenuators	V.Boschi	PDF, MPP, LOG
RCS – Recycling Cavity Suspensions	A.Bertolini, M.Razzano	PDF, MPP, LOG
CRD – Coating Research and Development	M.Bazzan	PDF, MPP, LOG
ELECTRONICS, SOFTWARE & CONTROLS		
ALS – Auxiliary Laser System	C. De Rossi	PDF, MPP, LOG
ISC – Interferometer Sensing & Control	J.Casanueva	PDF, MPP, LOG
DAQ – Data Acquisition	S. Viret	PDF, MPP, LOG
CAL – Calibration	L.Rolland	PDF, MPP, LOG
MPC – Mirror Position Control	A.Gennai	PDF, MPP, LOG
ENVIRONMENT		
NNC – Newtonian Noise Cancellation	J.Harms	PDF, MPP, LOG
INF – Infrastructures	A.Paoli	PDF, MPP, LOG
VAC – Vacuum	A.Pasqualetti	PDF, MPP, LOG
EMS – Environmental Monitoring System	R.De Rosa	PDF, MPP, LOG
IME – Infrastructure Modifications for Environmental noise mitigation	I.Fiori	PDF, MPP, LOG
COMMISSIONING, MANAGEMENT		
REC – ITF recovery	F.Sorrentino	PDF, MPP, LOG
COM – Commissioning	M.Was	PDF, MPP, LOG
MAN – Management	A. Rocchi	PDF, MPP, LOG
EGO – EGO activities	N.N.	PDF, MPP, LOG

Conclusions

- Project Management
  - Update of existing document to harmonize the three phases
  - New OBS and stakeholder analysis
  - All major PM processes are foreseen (and existing in many cases) in the plan
- WBS and planning
  - Common infrastructure for Upgrade and Commissioning existing and well established
  - Integration of Operations & Maintenance to be done

Extra slides

Project Office

- Technical & Configuration Manager (H. Heitmann)
  - TDR editing, production of WBS, Project Execution Plan and budget plan, manages technical and financial change requests
- System Engineer (F. Carbognani)
  - Manages Design, Production Readiness Reviews (PRR), Validation and Reception Reviews (VRR)
  - Manages Requirements Verification Matrices (together with Risk Manager)
- Interface Manager (M. Galimberti)
  - Defines the Interface Control process through Interface Control Documents (ICDs) for each subsystem and managing cross-subsystem interfaces
- Risk Manager (F. Sorrentino)
  - Organizes and implements the risk management policy with a focus on global system performance and interface knowledge, maintains the AdV+ Risk Registry
  - Develops a Requirements Management Plan (together with the System Engineer)

Project Office

- QA/QC Manager (to be hired)
  - Prepares and maintains the Quality Assurance Plan (QAP), Quality Assurance documentation, ensures the traceability of key components, manages non-conformities
- On-site Integration Manager (to be hired)
  - Responsible for organizing and coordinating the installation activities of the AdV+ Project on site
  - Manages the integration aspects of the overall mid- and long-term project planning (together with the Technical Manager)
- Liaison to Commissioning (M. Was)
- Liaison to Virgo_nEXT Project (V. Fafone)