HiLumi LHC

FP7 High Luminosity Large Hadron Collider Design Study

Deliverable Report

Collaboration Model for the HL-LHC Construction Phase

Brüning, O (CERN)

12 October 2015

The HiLumi LHC Design Study is included in the High Luminosity LHC project and is partly funded by the European Commission within the Framework Programme 7 Capacities Specific Programme, Grant Agreement 284404.

This work is part of HiLumi LHC Work Package **1: Project Management & Technical Coordination**.

The electronic version of this HiLumi LHC Publication is available via the HiLumi LHC web site <http://hilumilhc.web.cern.ch> or on the CERN Document Server at the following URL: <http://cds.cern.ch/search?p=CERN-ACC-2015-0124>

Grant Agreement No: 284404

HILUMI LHC

FP7 High Luminosity Large Hadron Collider Design Study

Seventh Framework Programme, Capacities Specific Programme, Research Infrastructures, Collaborative Project, Design Study

DELIVERABLE REPORT

COLLABORATION MODEL FOR THE HL-LHC CONSTRUCTION PHASE

DELIVERABLE: D1.11

Document identifier:	HILUMILHC-Del-D1-11-v1.0
Due date of deliverable:	End of Month 48 (October 2015)
Report release date:	08/10/2015
Work package:	WP1: Project Management
Lead beneficiary:	CERN
Document status:	Final

Abstract:

With the end of the EU funded HiLumi Design study the HL-LHC project undergoes the transition from a design study to a construction and production project. The project organization needs to be adapted to this transition in order to assure a proper integration of the project work packages into the general CERN management structure while still maintaining a platform for international collaborations.

The HiLumi LHC Design Study is included in the High Luminosity LHC project and is partly funded by the European Commission within the Framework Programme 7 Capacities Specific Programme, Grant Agreement 284404. HiLumi LHC began in November 2011 and will run for 4 years.

Delivery Slip

	Name	Partner	Date
Authored by	O. Brüning	CERN	30/07/2015
Edited by	Lucio Rossi	CERN	09/08/2015
Reviewed by	Frederick Bordry L. Rossi, Project coordinator	CERN CERN	19/08/2015
Approved by	Steering Committee		08/10/2015

TABLE OF CONTENTS

Executive summary

With the finalization and publication of the Technical Design Report (TDR) and the integration of the HL-LHC project into the CERN MTP, the project is transforming from a Design Study to a Construction Project. This transition implies a change of focus from general design concepts and optimizations to explicit hardware prototyping and quality control during component production. These changes require a re-optimization of the project structure that assures an efficient integration of the project and its collaborating institutes into the CERN structure and assures a solid interface between the technical equipment groups at CERN and the individual work packages of the HL-LHC project.

1. PROJECT GOVERNANCE DURING THE DESIGN PHASE

The organization of the HL-LHC project during the design phase was closely modelled along the collaboration model of the LHC experiments. Figure 1 shows the overall project structure during the HL-LHC design phase.

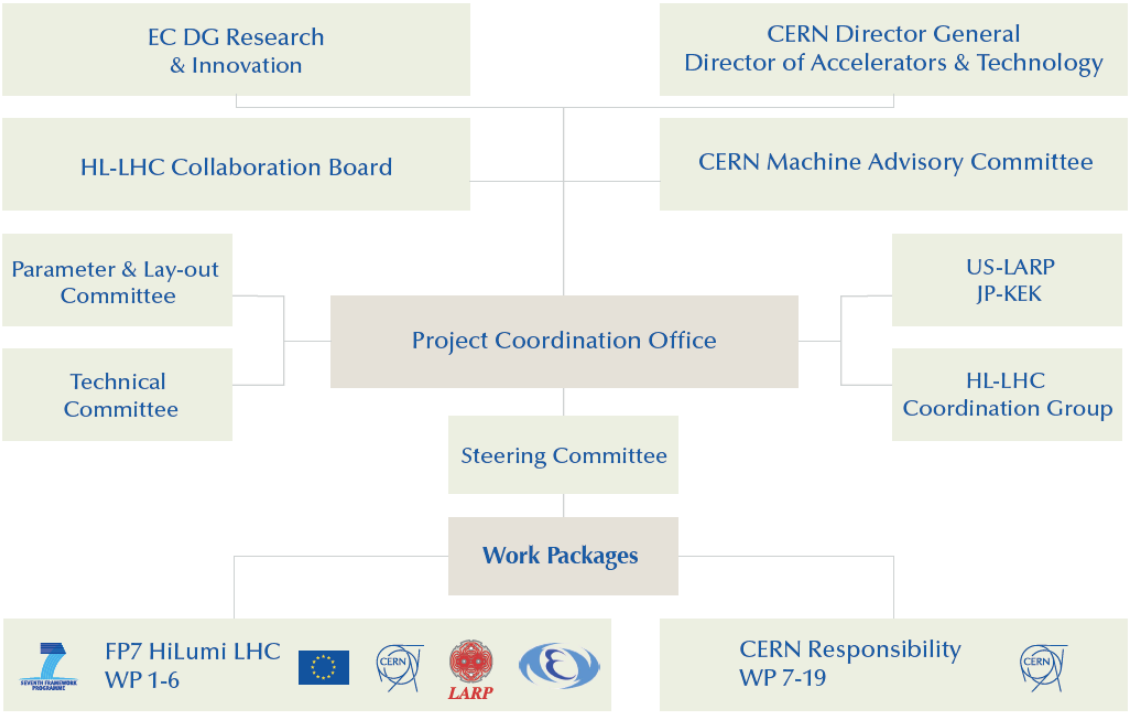

Figure 1: *The organization of the EU funded HiLumi LHC Design Study*

1.1. THE MAIN HL-LHC BODIES FOR THE PROJECT ORGANIZATION DURING THE DESIGN PHASE

The main bodies of the HL-LHC project during the design phase are:

- The EC DG Research and Innovation office is the official link of the HL-LHC project to the EU funding agencies.

- The CERN Director General (DG) and Director of Accelerators & Technology represent the link of the HL-LHC project to the CERN management.
- The HL-LHC Collaboration Board is a top-level body for managing the relations with the collaboration partners.
- The CERN Machine Advisory Committee (C-MAC) is an external international scientific advisory board for the CERN accelerator complex and its upgrades. It meets at least once per year and has the function of scientific Advisory Committee for HiLumi LHC as foreseen in its Institution.
- The HL-LHC Project Coordination Office is the main coordination body for the HL-LHC project. It meets weekly and its composition consists of the HL-LHC project leader and his deputy, the HL-LHC Technical Coordinator, the HL-LHC Safety Officer, the HL-LHC Budget officer and the HL-LHC Integration Officer.
- US-LARP and JP-KEK represents the link to the two non-member state collaborators foreseeing major hardware contributions to the HL-LHC project (triplet magnets, crab cavities and new superconducting D1 separation dipole).
- The HL-LHC Coordination Group is a forum for dialog and coordination of goals, parameters & plans for the HL-LHC project, between the CERN management, the LHC experiments, and the LHC Injector Upgrade Project LIU. It is chaired by HL-LHC Project Leader and has representatives from all experiments (spokes persons and technical coordinators), LHC operations, LIU, the CERN Research and A&T Directors and the HL-LHC Technical coordinator.
- The HL-LHC Technical Committee (HL-LHC TC) discusses the technical baseline of the project and drives the generation of Technical Specifications for the individual HL-LHC components, the HL-LHC layout and the integration aspects. It meets approximately on a bi-weekly rate and features detailed technical discussions.
- The HL-LHC Parameter and Layout Committee (HL-LHC PLC) establishes and maintains a coherent and dynamic list of all HL-LHC parameters and its associated hardware layout. It meets approximately once per month.
- The HL-LHC Steering Committee is a forum for information exchange between all HL-LHC Work Package leaders and the USLARP representatives. It meets approximately once per month. For the FP7 WP is the body to approve baseline, milestones and deliverable reports and to manage the FP7 collaboration.
- The HL-LHC project features a total of 19 Work Packages, of which 6 are organized under the EU funded HiLumi LHC Design Study. The remaining 13 Work Packages are not part of the EU funded HiLumi LHC Design Study but of the CERN HL-LHC project and 2 of these 13 Work Packages are strictly speaking not required for the HL-LHC project (High Energy LHC and High Field Magnet development) but are naturally related to the other HL-LHC studies.

Figure 2 shows the individual work packages of the project. Work packages 1 to 6 are part of the EU funded HiLumi LHC Design Study and represent the core work packages during the HL-LHC design phase. Work packages 7 to 17 are vital work packages for the project but are not part of the EU funded design study and work packages 19 and 19 are strictly speaking not

part of the HL-LHC project but have strong synergies with the HL-LHC related developments.

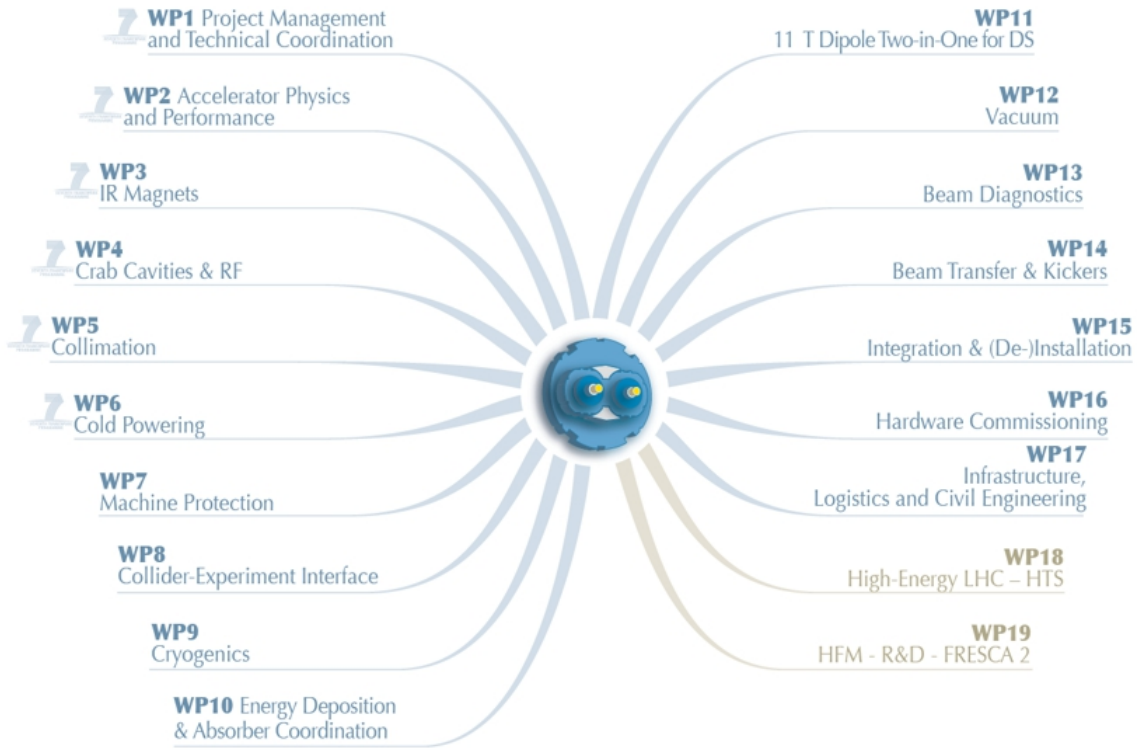

Figure 2: *The individual Work Packages of the HL-LHC project*

1.2. THE CERN BODIES FOR THE ACCELERATOR OPERATION

The CERN Accelerator and Technology Sector (A&TS) has three departments (BEams. TEchnology and ENgineering). It meets regularly with all three department heads and the planning officers at the Accelerator & Technology Sector Management Board (ATSMB). The ATSMB invites twice per month the leaders of the main accelerator projects and studies (e.g. HL-LHC and LIU) to an Extended Accelerator & Technology Sector Management Board (EATSMB). The A&T Sector has two main committees for running the CERN accelerator complex:

- The LHC Machine Committee (LMC) for all matters relevant for the operation of the LHC;
- The Injector and Experimental Facility Committee (IEFC) for all matters relevant for the operation of the LHC injector complex, the experimental areas, the Rex-Isolde complex and the CTF3 test facility.

The core LMC membership consists of the Director of Accelerators and Technology (DAT), three A&TS department heads, the group leaders of the departments, representatives from the

LHC experiments and the HL-LHC project, the LHC machine coordinators, and representatives from the key working groups that look after the LHC operation (e.g. Machine Protection Panel, LHC Beam Operation Committee etc.).

The core IEFC membership consists of the DAT, the three A&TS department heads (or their alternates), the group leaders of the departments (or their alternates), representatives from the experimental areas of the LHC injector complex and the LIU project, the LHC injector complex machine supervisors, and representatives from the key working groups that look after the LHC injector complex operation (e.g. Machine Study Working Group, Facility Operation Meeting etc.). Figure 3 shows a schematic overview of the Committee structure of the CERN A&T Sector for the operation of the CERN accelerator complex.

However, while both the LMC and the IEFC committees include representatives from the A&TS management, their composition does not really overlap in practice as the participation from group leaders and department heads is shared between the group leaders and their alternates.

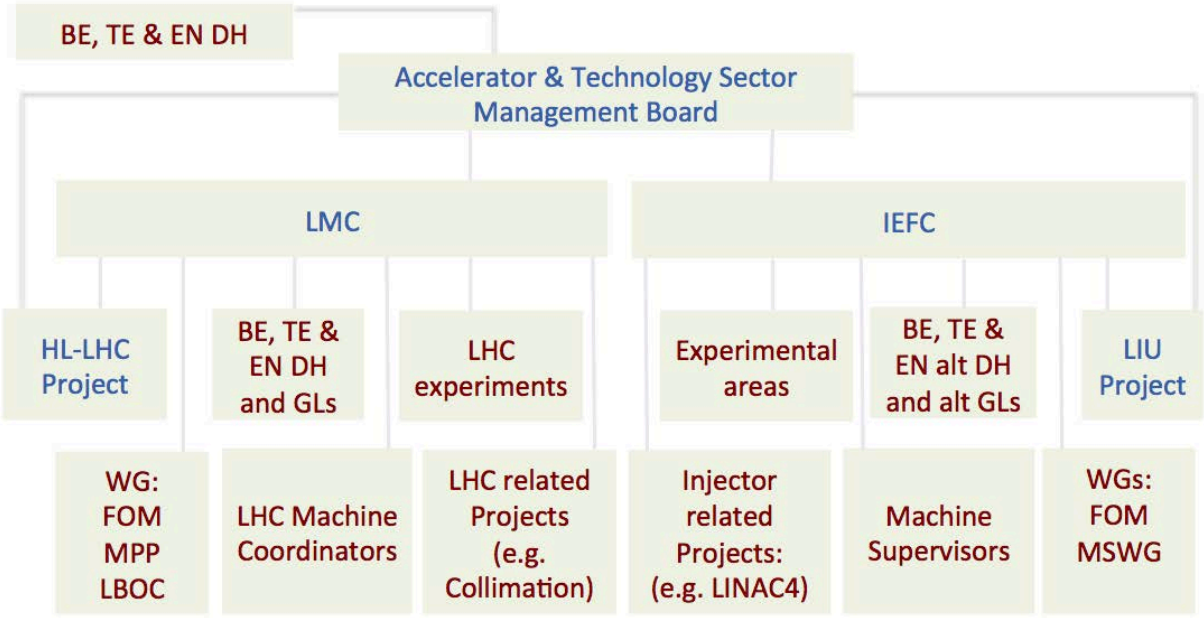

Figure 3: Committee structure of the CERN A&T Sector for the operation of the CERN accelerator complex.

1.3. THE MAIN CERN COMMITTEES RELEVANT FOR THE HL-LHC PROJECT ORGANIZATION

The CERN LMC has naturally a very close link to the HL-LHC project and includes in its mandate the discussion of HL-LHC related issues. However, during the operation period of the LHC there remains only little time for dedicated discussion of HL-LHC related aspects. Rather, the HL-LHC representatives to the LMC monitor developments and installation in the LHC and discuss their potential impact on the HL-LHC project in the HL-LHC Technical Committee and the individual working groups. This setup works well during the design phase of the HL-LHC project. However, as the project transitions from a design study to a construction project, a closer link between the HL-LHC related working groups and the technical equipment groups of the CERN departments becomes increasingly important.

Likewise, the IEFC has naturally a very close link to the LIU project and includes in its mandate the discussion of LIU related issues. As the LIU project transitions from a Design Study to an implementation project a close coordination of the LIU and HL-LHC projects becomes increasingly important.

However, due to the effectively split setup of the IEFC and LMC committees such coordination via the LMC and IEFC committees become rather impractical and a closer coordination of the two LIU and HL-LHC project and the CERN AT&S management becomes desirable.

2. PROJECT GOVERNANCE AFTER THE DESIGN PHASE

The organization of the HL-LHC project during the design phase was closely modelled along the collaboration model of the LHC experiments, which works well as long as small expert groups at CERN and external laboratories drive conceptual studies. Figure 1 shows the overall project structure during the HL-LHC design phase. However, as the HL-LHC project transitions from a Design Study to a Construction Project a closer integration of the project with the CERN equipment groups and management of the A&T Sector becomes increasingly important. Opposite to the experiment where CERN's share is only 20% to the upgrades, for HL-LHC, CERN will contribute about 80% of the total resources and will ultimately be the sole responsible for the machine upgrade. The CERN Council has endorsed the total Cost To Completion (CTC) of the project with its main installation during Long Shutdown 3 (LS3) by 2026 and the implementation of final components during Long Shutdown 4 (LS4) by 2030 (e.g. second phase of Crab Cavity installation). CERN Council formerly approves the budget planning only over a sliding 5-year window and with a revision of the planning on a yearly basis, the so-called CERN Medium Term Plan (MTP). The actual budget allocation is then formerly approved on a yearly basis. While the HL-LHC has a dedicated budget allocation within the CERN MTP (MTP), the A&T Sector and its technical equipment groups manage the human resources and the technical infrastructures at CERN. As the HL-LHC project enters the phase of prototype and equipment production and testing a closer integration of the HL-LHC project with the CERN equipment groups and the LIU project becomes therefore increasingly important as the HL-LHC progresses towards a production project.

2.1. THE MAIN COMMITTEES RELEVANT FOR THE HL-LHC PROJECT ORGANIZATION

A separation of the HL-LHC Technical Committee and the Parameter & Layout Committee was sensible during the design phase when parameters and layout still evolve regularly. However, with the publication of the HL-LHC Technical Design report (TDR) the HL-LHC parameter set and layout should become much more stable while the technical discussions in the HL-LHC TC will focus more on the prototyping and testing of equipment. It seems therefore logical to combine the HL-LHC TC and PLC into one Technical Coordination Committee (TCC) after the HL-LHC design phase and to involve closer the A&TS group leaders in the discussions of this new HL-LHC TCC.

The collaborations with the external partners under the EU funded HiLumi LHC Design Study come formally to an end with the end of the EU funding period (December of 2015). However, the HL-LHC project is in the process of developing collaboration agreements with

its international partners in order to assure a continued international involvement in the HL-LHC project beyond the EU funded HiLumi LHC Design Study. The most prominent examples for such a continued international contribution are the in-kind US and Japanese production projects for the HL-LHC triplet magnets, crab cavities and new superconducting D1 magnet that evolved out of the JP-KEK and USLARP R&D collaborations. The preparations of other agreements for hardware deliverables, further R&D studies with hardware deliverables or manpower contributions to the HL-LHC project are on-going with several other partner institutes (e.g. with the UK who was the strongest external partner in the EU funded HiLumi LHC Design Study and, for example, CEA, INFN and CIEMAT). A continuation of a Collaboration Board or Committee seems therefore well justified and necessary. However with the key difference that members of the new CB must are engaging their own resources in the HL-LHC project.

Recent developments for the HL-LHC and LIU projects (e.g. decisions on the Crab Cavity test installation win the SPS and the COLDEX installation in the SPS for electron cloud and vacuum studies) have shown that the de-facto separation of the IEFC and LMC committees does not provide the most efficient setup for taking urgent actions and decisions that will affect both the HL-LHC and the LIU projects. The CERN management is therefore in the process of setting up a dedicated HL-LHC & LIU Executive Committee under the chairmanship of the director of accelerators.

The continuation of the CERN Coordination Group (CG) seems likewise necessary as the projects and the experiments require regular and efficient exchange of information between the HL-LHC and LIU projects, the CERN management and the experiments as they enter the implementation phase of their upgrades. The final composition of the new CG will be determined in agreement with the new CERN HL-LHC & LIU Executive Committee.

However, the continuation of a Steering Committee that assures a smooth exchange of information between the different HL-LHC Work Packages is less obvious. One could argue that the new HL-LHC TCC will assure the exchange of information between the different work packages and that extended meetings of the HL-LHC Project Office can look after other outstanding issues. We therefore suppress the Steering Committee in the post HiLumi project period.

Figure 4 summarizes the above considerations for the HL-LHC Project governance after the end of the EU funded HiLumi LHC Design Study.

Figure 4: The HL-LHC project governance after the end of the EU funded HiLumi Design Study.

Figure 5 summarizes the organization of the A&T Sector for the post EU funded HiLumi LHC Design Study.

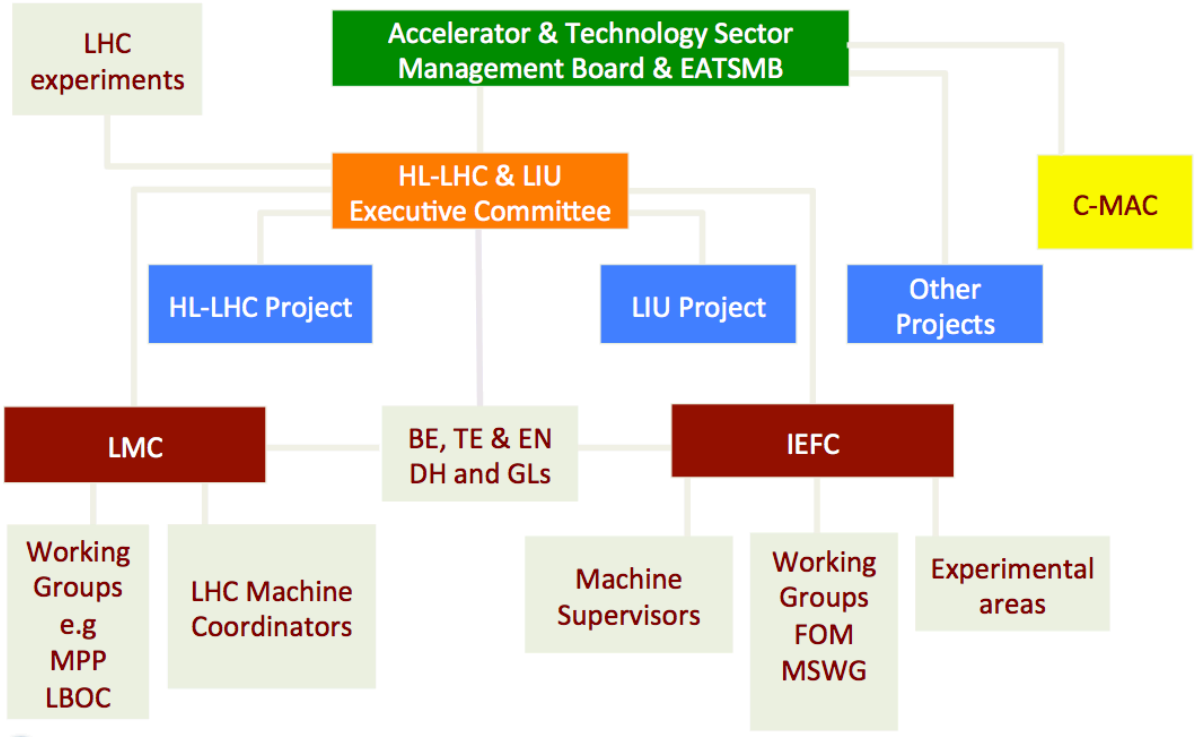

Figure 5: The CERN A&T Sector organization after the end of the EU funded HiLumi LHC Design Study.

2.2. THE HL-LHC PROJECT OFFICE ORGANIZATION

The HL-LHC Project Office is composed of the HL-LHC project leader and his deputy, the project Safety Officer and Budget Officer, a unit for Knowledge Transfer (KT), outreach and communications, a Project Office Manager, a Technical Infrastructure Officer, A Resource, Configuration and Quality Control Officer and an Integration and Installation Officer.

- The project leader and his deputy are responsible for the project definition and strategy, they report to the CERN management and the Collaboration board and are responsible for the coordination of the technical work packages and the collaborations.
- The Safety officer provides guidelines and safety standards.
- The Budget Officer manages the HL-LHC budget and provides the link to the Sector and departmental planning officers.
- The KT and Outreach unite looks after liaisons with industry and communicates developments of the project to the outside world.
- The Technical Infrastructure Officer (TIO) looks after the civil engineering work and the environmental impact studies, the general infrastructure requirements (e.g. electrical distribution and cooling and ventilation, access and alarms), the overall logistics and provides the link to the infrastructure for equipment tests.
- The Configuration, Quality and Resource Officer (QRO) looks after the technical project baseline and its documentation (e.g. Technical Design report and Technical Specifications), the overall quality control and risk management, the EVM resource and purchasing planning.
- The Integration and Installation Officer (IIO) looks after the overall equipment layout and its integration study of the HL-LHC project into the existing LHC infrastructure, including survey and alignment and the planning for an eventual de-installation of the equipment.
- The Project Office Manager (POM) coordinates the activities between the HL-LHC officers, looks after the interface with the host states for the civil engineering works and is responsible for the safety follow-up and its implementation.

Figure 6 illustrates the organization of the HL-LHC Project Office after the end of the EU funded HiLumi LHC Design Study.

Figure 6: The HL-LHC Project Office.