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EP-DT Support to LHCb

This work package summarises the support by the EP-DT group to the LHCb experiment from 2017 to 2021 (end of LS2). It describes the DT involvement (deliverables and allocated DT resources) in projects related to maintenance and operation of the present detector, and the responsibilities regarding the development and construction of new detectors. DT resources for the services of the experiment are summarized as well. Estimations regarding the dismantling of parts of the present detector and the installation of the upgraded detector are also given.

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1. Scope of the work package

This document is a collaboration agreement between the EP-DT group (DT) and the LHCb CERN Team for the period from 2017 to the end of the Long Shutdown 2 (LS2), currently at the end of February 2021. The agreed commitments cover the following:

- Participation to the **maintenance and operation of the current LHCb detector** until the end of LHC Run II (2015-2018). This includes participation to the operation of the experiment as such, contributions to some of its sub-systems, and contributions through the DT services. Details are given in Section 2 of this document.
- Contributions to the **preparation of several sub-systems for the upgrade of the LHCb detector**, as defined in the MoU for the upgraded experiment (CERN/RRB 2014-105). This activity started already in 2013 and will continue until LS2. Details are given in Section 3.
- Participation to the **dismantling** of some sub-systems of the current detector and the **installation of the upgraded detector** during LS2 (Jan. 2019 – Feb. 2021). Details are given in Section 4.

The use of DT space and infrastructure for a given project is also listed in this document (Section 5).

Wherever a separate, valid agreement already exists for a specific project, it remains valid and will be referenced in the corresponding section below. In particular, this document is a continuation of the previous agreements EDMS 456837, 456842 and 970156 made between the DT group (or its predecessors, e.g. DT2, TA2, and TA3) and the LHCb CERN team. Expertise developed over the past years during the construction and operation phases of LHCb and the R&D phase of its upgrade shall be available to LHCb on the medium term.

With this workpackage the DT group guarantees the availability of DT staff personnel allocated for a given period of time to the experiment. Expenses for materials or the cost of employing the DT Field Support Unit (FSU) have to be covered by the experiment, including travels of DT staff to project meetings. DT resources allocated to projects are assigned for a given period of time to the experiment personnel budget code in APT, and they are listed in the corresponding sections of this document.

DT resources working in common services (namely on gas systems, detector cooling and magnet controls) are not accounted as resources allocated to a given experiment. These projects are considered common services to all LHC experiments.

This document comes into effect as soon as approved by all parties and should be valid until the end of LS2. In case the conditions laid down in this document change, each party can request a revision. At the end of the validity period this document shall be revised by both parties.

It is understood that unforeseen situations can require interventions which go beyond the scope of the tasks detailed below. Those will be discussed on an ad-hoc basis.

The CERN LHCb Team Leader and the DT-LHCb Experiment Contact Person manage this WP. These positions are presently filled by A. Schopper and B. Schmidt, respectively.

2. Maintenance and operation for the present LHCb detector

The support to the current LHCb detector provided by DT covers these tasks:

- Operation and maintenance of LHCb sub-detectors with direct DT involvement. This includes also the provision of expert services for these sub-systems and the participation in work to be carried out during the Year-End-Technical-Stop (YETS) periods;
- Maintenance and operation support for the common services like gas, cooling and magnet controls.

2.1 Maintenance and operation of detector systems with DT involvement

This sub-section specifies the deliverables provided by DT and outlines the maintenance, operation and repair work (when appropriate) of the following sub-detectors with direct DT involvement:

- *Dipole Magnet:*

  DT (resp. TA3) coordinated the construction and assembling of the LHCb Dipole Magnet and provides technical support for the mechanical verifications which are performed to keep the system reliable and the operations safe. This includes in particular the verification of mechanical connections between the triplet clamps and the yoke, and also visual checks of EPDM spacers and of hydraulic and electrical connections once per year.

  Resources: Provided by the DT magnet support team, not accounted specifically

- *VELO:*

  DT participated in the assembling of the VELO detector and provided the required tooling to handle the detector halves. DT will continue providing technical and engineering support for VELO (and SMOG), including support for the vacuum pump systems, logistics and handling of the VELO replacement detector.

  Resources: Less than 0.1 FTE of Raphael Dumps

- *RICH:*

  DT contributed to the delivery of the RICH 2 opto-mechanics system and participated to the integration of the services of the RICH detectors. DT coordinated also the HPD project and will participate in the overall maintenance in collaboration with EP/ESE (electronics) and EP/LBO (mechanics and logistics).

  During YETS or whenever required, DT prepares for the insertion/extraction of HPDs columns for the RICH detectors.

  DT coordinates the HPD repair and replacement, including lab testing (in collaboration with EP-ESE (electronics) and EP-LBO (mechanics and logistics)).

  Resources: 0.3 FTE of Thierry Gys and 0.3 FTE of Didier Piedigrossi

- *Calorimeter:*

  DT participated in the construction and integration of the calorimeter system and will provide technical support, in particular for sub-detector movements and logistics.

  Resources: Less than 0.1 FTE of Robert Kristic

- *Muon System:*

  DT delivered the MWPCs for the inner part of the Muon system (7 regions) and will provide technical support in the future for muon chambers of the regions under direct CERN responsibility in collaboration with PNPI. This includes also participation in the operation of the Muon System during data-taking periods.

  DT coordinated the integration of the services for the Muon detector (e.g. moving systems, movable platforms, air-cooling systems) and will participate in their maintenance. In collaboration with EP-LBO, DT carries out the preparation for access, in particular the installation of the movable platforms to access the muon stations.

  Resources: 0.1 FTE of Burkhard Schmidt

- *Forward Shower Counters:*

  During LS1 of the LHC five planes of plastic scintillators with light-guides, read-out by high-current compliant PMTs, were installed in the LHC tunnel on either side of LHCb. This system, named HERSCHEL, was prepared with technical support from DT. For the maintenance of this system DT provides advice and limited support through its scintillator workshop. Resources required for the replacement of the scintillators due to ageing have to be provided by LHCb.

  Resources: 0.1 FTE of Raphael Dumps, who is leading also the Scintillator workshop

2.2 Maintenance and operation support through common DT services

DT has established common service agreements with the LHC experiments for maintenance and operation of gas systems, magnet controls, and recently also CO_2-based cooling systems. As these projects are considered common EP services to all LHC experiments, corresponding DT resources are not accounted against a given experiment.

- *Gas Systems:*

  DT and the LHC experiments have a common workpackage (EDMS 1721624 and previous agreement 867594) that describes the service provided by EP-DT to maintain and operate the LHC detector gas systems.

- *Magnet Controls:*

  DT and the 4 main LHC experiments have a common workpackage (EDMS 1561470 and previous agreement 803428) that identifies all tasks for preventive and corrective maintenance of LHC systems for the experimental magnets control and safety systems and DSS, for the period 2016-2018.

- *Detector cooling:*

  DT and LHCb have a workpackage (EDMS 1556960) for the design, construction, installation and commissioning of CO_2 cooling plants for two sub-systems of the upgraded detector: the Upstream Tracker (UT) and the upgraded VELO. DT is also constructing CO_2 cooling plants (called LUCASZ) for the commissioning of the VELO and UT detectors. A workpackage for the LUCASZ units is under preparation (EDMS 1739320).

3. DT contributions to the LHCb detector upgrade

During the past three years physicists, engineers and technicians of DT got involved in the upgrade of the LHCb detector. Contributions have been made for the R&D, which led to the upgrade TDRs for the VELO (CERN/LHCC 2013-021), the detectors used for Particle Identification (RICH, Calorimeter and Muon Systems, CERN/LHCC 2013-022), and the Tracking Detectors (Upstream Tracker (UT) and Scintillating Fibre Tracker (SciFi), CERN/LHCC 2014-001). The sharing of responsibilities for the construction of the upgraded experiment is summarized in a Memorandum of Understanding (CERN/RRB 2014-105). The DT contribution to the various projects for the years 2017 and 2018 is summarized in the following.

3.1 VELO

The upgraded VELO will be based on modules with hybrid silicon pixel sensors, readout by the radiation hard VeloPix ASIC. The CO_2 cooling system for the upgraded VELO uses an evaporator based on silicon micro-channel substrates, integrated into the detector modules. Other parts of the upgraded VELO detector reuse parts of the current detector, in particular the vacuum tank.

The DT contribution to the VELO project consists mainly in engineering support for the module design and the integration of detector elements into the base mechanics. A tertiary vacuum for the safety valve mechanism of the CO_2 cooling system has been proposed and integrated into the mechanical infrastructure of the detector. Several setups for tests of detector elements have been designed and constructed, including a telescope for beam-tests. Continued support is provided for the VELO test-beam activities. DT provides also advice for the final design of the micro-channel devices and participates in their validation. This includes performance tests and reliability studies on the modules, also referred to as ageing tests. Furthermore, the motion system for the VELO detector will be overhauled. The controls part of it will be carried out by the DT-DI section. A dedicated workpackage summarizing the task and the responsibilities is under preparation (EDMS 1739314).

Resources: 0.6 FTE of Raphael Dumps. Support will be given for the development of the micro-channel devices by the DT-DD section, and for the motion system control by the DT-DI section.

3.2 Upstream Tracker (UT)

The UT detector consists of four planar layers of silicon micro-strip sensors, covering an area of approximately 1.5m x 1.3m, and replaces the present Tracker Turicensis (TT).

DT contribution to the UT project is focussed on the integration and infrastructure of the device. This includes in particular the design and construction of frames on which the staves with the silicon sensors and the SALT readout chips are mounted, and a detector box which accommodates the CO_2 cooled staves. The box has to provide thermal insulation, a light-tight environment and electrical shielding to the ambient for the staves. The interface of the detector box to the LHC vacuum chamber has to fulfil the requirements agreed upon with the LHC vacuum group (TE-VSC). Furthermore, the detector box has to be integrated in the existing infrastructure for the TT detector. The mechanical integration and cooling for the peripheral electronics and the LV distribution has to be provided as well by DT.

In the past two years members of the DT group carried out R&D work for the frames and the detector box with its interface to the vacuum chamber, which led to an EDR for these components in June 2016. The PRR for the detector box and frames are planned for summer 2017, followed by the production of these components in a company.

The integration studies for the various UT detector components are led by a member of the DT group. Reviews in relation to the detector integration are foreseen during 2017 in order to finalize the design of the mechanical components related to the integration of UT in the LHCb experiment. The members of DT involved in these studies will be assisted by a Technical Student or a Fellow provided by LHCb.

Resources: 0.4 FTE of Burkhard Schmidt and 0.1 FTE of Joao Batista

Support is also provided through the DT Composite Lab for the activities on the detector box.

3.3 Scintillating Fibre Tracker (SciFi)

The SciFi detector is a large scintillating fibre tracker with a total active surface area of about $300m^2$ and a resolution of better than 100μm, which replaces the Inner (silicon micro-strips) and Outer (gas straw tubes) Tracker detectors currently installed downstream of the LHCb dipole magnet.

The DT contribution to the SciFi project consists mainly in the procurement and Quality Assurance (QA) of 11’000km of scintillating fibres with a diameter of 250μm. A member of the DT group acts as leader of the work package for Fibre procurement and QA, as well as deputy leader for the SciFi project.

During the R&D and prototyping phase of the project in the years 2013-2015, DT made major contributions to the characterisation, radiation qualification and performance optimisation of the scintillating fibres, including the development of a novel type of nanostructured fibres. A DT team built a fibre scanning machine (financial contributions by LHCb), following a design by RWTH Aachen. Several irradiation campaigns on dedicated samples and on full size fibre mats were performed in cooperation with the DT Irradiation team. Test stands were prepared which allow the rapid qualification of the geometrical and optical fibre parameters. A setup for x-ray radiation qualification was also prepared. A market survey and a call for tender were successfully conducted for the procurement of the fibres for the SciFi project.

The SciFi production plan foresees all fibres to be procured, qualified and re-distributed by CERN. This activity is scheduled to last between 21 and 24 months and started in May 2016. It entails a high volume of repetitive handling, measurement, documentation and logistics work. To monitor the stability of the fibres in time, witness samples of all delivered batches will be maintained in a dark and T-controlled lab and a sub-set of them will be regularly re-measured. All 11'000 km of fibres are foreseen to run through the diameter scanner to produce bump maps, which serve as input for the fibre winding machines at the four mat winding centres. Large bumps are eliminated by an in-situ hot drawing method, integrated in the fibre scanner. It simplifies and accelerates the fibre mat winding at the four mat production centres. The DT staff working on the QA for the fibres is assisted by a fellow and a student provided by the CERN team resp. the LHCb collaboration.

Resources: 0.9 FTE of Christian Joram, 0.3 FTE of Thomas Schneider,
0.4 FTE Robert Kristic

3.4 RICH

The upgraded RICH system will consist of a re-designed RICH 1 detector, an essentially unchanged RICH 2, and new photodetectors that can be read out at 40 MHz.

The DT contribution to the RICH upgrade is carried out in close collaboration with members of the EP-LBO group. It consists mainly of support for test-beam activities, renovation of laboratory installations for prototyping (e.g. MiniDAQ readout system). Furthermore, MaPMT columns will be assembled, commissioned and stored at CERN prior to their installation in the experiment.

The MaPMT is established as the baseline technology for the RICH photon detector, read out by a customized ASIC named CLARO. Prototypes of the system, consisting of several MaPMTs together with the accompanying front-end and acquisition electronics and mechanics, have been evaluated in a series of test-beams in the years 2014 – 2016 with strong involvement of DT members. PRRs have been carried out successfully during summer 2016 and the tendering process for the electronics components has started.

Resources: 0.3 FTE of Thierry Gys and 0.3 FTE of Didier Piedigrossi

3.5 TORCH

A time-of-flight system (TORCH) has been proposed to complement the current PID capabilities in the low momentum range. R&D on this project has been carried out in the context of an ERC grant with active involvement of DT members for laboratory and test-beam activities. The work includes the evaluation of micro-channel plate photo-detectors. Procurement of material for a full TORCH module, in particular the quartz radiator plate and focussing optics, is ongoing. The related mechanics is under design in collaboration with EP-LBD. The DT contribution to this activity will be terminated in 2018.

Resources: Up to 0.3 FTE of Thierry Gys and 0.3 FTE of Didier Piedigrossi

3.6 Muon System

The upgrade of the Muon system consists of the design of new off-detector readout electronics, compliant with full 40 MHz readout, and the installation of additional shielding around the beam pipe in front of muon station M2.

The contribution of CERN and the DT group is limited to the additional shielding. Simulation studies have been carried out in the years 2013-2015 to optimize the shielding effect for the Muon system. The engineering design for the optimized layout has been carried out in 2016 and will be reviewed in January 2017, followed by the preparation of the production drawings.

The procurement of the new beam plugs under the HCAL detector and the additional shielding is scheduled for 2017.

The activity is coordinated by a member of the DT group, who is as well deputy leader of the Muon project. For the design work he is assisted by a Technical Student provided by LHCb.

Resources: 0.1 FTE of Burkhard Schmidt

4. DT contributions to Dismantling and Installation work in LS2

Several sub-detectors will be partially or completely disassembled at the beginning of LS2 in 2019 and new sub-systems or upgraded detector parts will be installed. The DT involvement in these detector systems has been outlined in the previous sections. Consequently, members of DT will also be involved in the dismantling and installation activities during LS2.

4.1 Contribution to the dismantling of the present detector

A DT member is preparing the procedures for the dismantling of the of LHCb sub-detectors in collaboration with the respective project leaders. Over the past year he has already prepared the overall Work and Safety Coordination Plan (WSCP, EDMS 1715689) for the dismantling, the Work Package Procedure (WPP, EDMS 1715687) and the Work Package Safety Plan (WPSP, EDMS 1715688). The same person is also preparing the procedures for the partial dismantling of the shielding wall between the UX-A and UX-B caverns, and the dismantling of the cooling plants for the VELO, TT and IT detectors).

Resources: 0.8 FTE of Mark Hatch in 2017 and 2018.

DT will be involved in dismantling work for the following sub-systems:

- *VELO:*

  The two VELO detector halves will be removed, using the dedicated tooling developed by a DT member. After the removal of some obsolete equipment (cables etc.), the motion system for the VELO detector needs to be overhauled. The possible work on the mechanical parts (motors, belts, etc.) will be carried out by a DT member.

  Resources: 0.1 FTE of Raphael Dumps

- *RICH:*

  DT will be involved in the dismantling of the RICH 1 and RICH 2 photon detector columns and related dismantling work.

  Resources: 0.1 FTE of Thierry Gys and 0.1 FTE of Didier Piedigrossi

- *Calorimeter:*

  The SPD and PS detectors are no longer needed with the new trigger strategy for the upgrade. DT will provide technical support, mainly for the required detector movements.

  Resources: 0.2 FTE of Robert Kristic

- *Muon System:*

  Also Muon station M1 is no longer needed with the new trigger strategy of the experiment and will therefore be removed, including a part of its infrastructure such as the cable chains. Since the FE-electronics on the chambers serves as spare components for the remaining part of the system, the disassembling has to be carried out with great care. A member of DT will be involved in the dismantling of M1, supervising the work for the chambers under the responsibility of CERN.

  Resources: 0.1 FTE of Burkhard Schmidt

- *Forward Shower Counters:*

  DT will be involved in the dismantling of Forward Shower Counters (HERSCHEL) and related dismantling work.

  Resources: 0.1 FTE of Raphael Dumps

4.2 Installation of the upgraded detector

After the dismantling work had been completed, infrastructure for the upgraded detector will be installed, followed by the installation of new detector components. A DT member is providing engineering support for the upgrade infrastructure and is regularly acting as reviewer in infrastructure related reviews for the upgrade. Another DT member is acting as CAD model manager. In this function he defined over the past year the envelopes of each subdetector for the upgrade phase (Version 4.0 of EDMS 330689) and has the task to update the LHCb CAD model according to the 'as built' situation, as the upgraded detector will be installed. The task includes also the integration of the detector services in the CAD model. During the past year this has been done for the CO_2 transfer lines for the VELO and UT detectors, for which also production drawings have been produced.

Resources: 0.3 FTE of Joao Batista and 1.0 FTE of Olivier Jamet
(both for the period of 2017 to 2020)

DT members will be involved in the installation and commissioning activity for the following subsystems. As more resources will be needed to complete the detector installation in a timely manner, the resource allocation should be reconsidered in due time.

- *VELO:*

  A member of DT will be involved in the planning, the logistics and installation for the upgraded VELO detector. Details of the DT contribution will be agreed with the LHCb CERN team and other VELO institutes.

  Resources: 0.4 FTE of Raphael Dumps

- *UT:*

  A member of the DT group coordinates the integration of the UT detector. This implies a strong involvement in the assembling and testing activities for UT in the new assembly hall at point 8 (building 3852), starting in 2018. It entails also an involvement in the installation of the UT detector with its services in the experiment. DT will contribute as well in training members of the UT institutes in the operation of the LUCASZ cooling plant at point 8. Details of the DT contribution to the installation of UT will be agreed upon with the LHCb CERN team and other UT institutes.

  Resources: 0.5 FTE of Burkhard Schmidt and 0.2 FTE of additional support

- *Scintillating Fibre Tracker:*

  The DT team intends to participate to integration, assembly and testing work foreseen to take place at point 8 (building 3852). Pre-assembled cold boxes, electronic boards and fibre modules will be integrated and tested, presumably at -40 °C, and finally be mounted into the C-frames. The activity will start in 2018 after completion of the fibre QA work. Details of the DT contribution will be agreed with the LHCb CERN team and other SciFi institutes.

  Resources: 0.9 FTE of Christian Joram, 0.3. FTE of Thomas Schneider and 0.2 FTE of Robert Kristic

- *RICH:*

  DT members will be involved in the installation of the photon-detector arrays for RICH 1 and RICH 2, and give support to other RICH related installation activities. Details of the DT contribution will be agreed with the LHCb CERN team and other RICH institutes.

  Resources: 0.8 FTE of Thierry Gys and 0.8 FTE of Didier Piedigrossi

- *Muon shielding*

  The new beam plug under HCAL and the additional shielding behind HCAL and in front of Muon station M2 has to be installed. This work will be carried out in close collaboration with the LHCb experimental area team and coordinated by a member of DT.

  Resources: 0.1 FTE of Burkhard Schmidt and 0.1 FTE of Robert Kristic

5. Laboratory infrastructure provided by DT

During the past years DT has set up a dedicated lab infrastructure, which has been used for the construction and testing of LHCb sub-detectors. This infrastructure together with some dedicated tooling shall be maintained and in some cases developed further. For the sub-detectors with direct CERN involvement the following parts are concerned:

- *VELO:*

  Maintain lab infrastructure in buildings 20-R (020 and 024), and 168-R (G16 and B17), for the control and testing of detector modules. This includes in particular position monitoring-, cooling- and vacuum- systems and auxiliary tooling for the testing and control of VELO modules.

- *UT:*

  Part of the lab in building 20 (R-028) is used for tests of the UT detector box and other small test stands of electronics components and sensors. Beyond that, it is foreseen to use the allocated space in the new assembly hall for the upgraded detector at point 8 (building 3852), which belongs however to LHCb.

  The UT group will also use the Departmental Silicon Facility (DSF), in particular the Wafer-Probe-Station there for test of the SALT 128 chip, and to intervene in case of need on the silicon sensor/staves in a very clean environment.

- *Scintillating Fibre Tracker:*

  Two labs 304-1-004 and 304-1-070 were refurbished and brought in a semi-clean state, appropriate for the handling of the fibres. The lab 304-1-004 including a small dark room was equipped with an air conditioning system and houses the set-ups for attenuation length, light yield and x-ray irradiation studies. For detector assembling, it is foreseen to use allocated space in the new assembly hall for the upgraded detector at point 8 (building 3852), which belongs to LHCb.

- *RICH:*

  Maintain appropriate lab infrastructure for work with HPDs and MaPMTs, as well as for opto-mechanics support. The lab space is located in buildings 16-R (013, 015, 021, 025, 029 and 049), 17-1-035 (crystal lab), 153-R (030, 032 and 034) and 169-S-030 (optics lab);

  Maintain and upgrade pulsed- and cw-laser systems and related optical system for monitoring and time-alignment of the photodetectors of RICH1 and RICH2 (in collaboration with EP-ESE for the pulsed trigger system) and related documentation;

  Maintain light leak detectors, in collaboration with EP-LBO.

- *Muon System:*

  Maintain lab infrastructure for chamber tests, currently in building 169-R (016 to 026).

The maintenance of the sub-detectors and the preparation for the YETS periods require the use of the workshops at point 8 and at CERN-Meyrin (presently building 21 and 162). DT will guarantee adequate work-shop access to perform these activities in good conditions. The maintenance of the workshop in point 8 is an LHCb responsibility.

6. Summary of Resource Estimates

To cover the activities described in this document, DT contribute with the personnel resources having the appropriate training and expertise. The personnel resources allocated to this work package are summarized in the following table.

Project	Activity	FTE 2017-2018		FTE 2019-2020	
LHCb	Detector operation and physics exploitation	0.3P	0.3	0.2P	0.2
VELO and HERSCHEL	Maintenance of current detector and upgrade related work	0.8T	0.8	0.8T	0.8
UT	Upgrade related work	0.4P, 0.1E	0.5	0.5P+0.2E	0.7
SciFi	Upgrade related work	0.9P, 0.3E, 0.4T	1.6	0.9P, 0.3E, 0.2T	1.4
RICH	Maintenance of current detector and upgrade related work	0.6P, 0.6T	1.2	0.9P, 0.9T	1.8
TORCH	Upgrade related work	0.3P, 0.3T	0.6	-	-
Muon and Calorimeter	Maintenance of current detector and upgrade related work	0.2P	0.2	0.2P; 0.2T	0.4
Technical Coordination	Engineering Support to the LHCb Technical Coordination	1.1E, 1.0T	2.1	0.3E, 1.0T	1.3
Total		**2.7P, 1.5E, 3.1T**	**7.3**	**2.7P, 0.8E, 3.1T**	**6.6**

(T = technician, E = engineer, P = physicist, e.g. 1T = 1 Full-Time-Equivalent technician.)

The following people have developed, over the past years, very specific competences and a deep knowledge of the LHCb detector. They should not be replaced by other members of the DT group, unless a proper plan for training and transfer of competence is put into operation.

- Joao Batista: Engineering support to UT, SciFi and Techn. Coord.
- Raphael Dumps: VELO, SMOG and HERSCHEL detector maintenance

- Thierry Gys : RICH maintenance and upgrade, TORCH
- Mark Hatch: Support to the Technical Coordination
- Olivier Jamet: Engineering support to the Technical Coordination
- Christian Joram: SciFi upgrade
- Robert Kristic: Calorimeter detector movements and SciFi upgrade
- Didier Piedigrossi: RICH maintenance and upgrade, TORCH
- Burkhard Schmidt : Muon System maintenance and upgrade, UT upgrade, LHC operation and physics
- Thomas Schneider : LHCb upgrade, in particular SciFi

The DT group contributes with personnel to this work package; all other expenses for material or FSU have to be borne by the LHCb collaboration.