

# HiLumi LHC

FP7 High Luminosity Large Hadron Collider Design Study

## Milestone Report

# Chart for Industry Participation to the HL-LHC Construction

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FP7 High Luminosity Large Hadron Collider Design Study  
Seventh Framework Programme, Capacities Specific Programme, Research Infrastructures,  
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## MILESTONE REPORT

# CHART FOR INDUSTRY PARTICIPATION TO THE HL-LHC CONSTRUCTION

## MILESTONE: MS24

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### Abstract:

The HL-LHC project has the challenge ahead of producing its future components in the European industry. The necessary technologies for some of those components are at the cutting edge of science, and are currently not just not on the market, but are not even being considered by commercial suppliers due to their novelty and low volume production demands.

The HL-LHC project has prepared a roadmap to fill the gap between the technological needs of the project and the existing market. A special effort has been done to get small and medium industries on board and to explore the potential of industry from the 21 member states.

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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.

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**Delivery Slip**

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## Executive summary

*The HL-LHC project has the challenge ahead of producing its future components in the European industry. The necessary technologies for some of those components are at the cutting edge of science, and are currently not just not on the market, but are not even being considered by commercial suppliers due to their novelty and low volume production demands.*

*The HL-LHC project has prepared a roadmap to fill the gap between the technological needs of the project and the existing market. A special effort has been done to get small and medium industries on board and to explore the potential of industry from the 21 member states.*

## 1. INTRODUCTION

The HL-LHC Project is a novel configuration of the Large Hadron Collider, aiming at increasing the luminosity by a factor five or more above the nominal LHC design, so as to also increase the integrated luminosity. Such a challenge implies the modification or the replacement of hardware that could:

- become vulnerable to breakdown and accelerated aging, or because they may become a bottleneck for operation in a higher radiation environment;
- actively contribute to increase the integrated luminosity.

Approximately 1.2 km of the LHC machine will be replaced by new components. Even if the industrial effort will be smaller than that of the LHC construction, HL-LHC represents in some way the biggest collider in construction and more than half of the components are new and contain challenging technology. HL-LHC needs industry with experience in the sector to produce them, but nearly ten years have lapsed since the end of the LHC big construction series when European industry was used to producing accelerator components. Since then several of the LHC components producers have stopped their specialized design and production lines or have moved to other markets. In addition, future procurement needs are based on smaller production series and therefore will be less appealing to big producers, and as such it would not be interesting for them to reopen those business lines.

The following chapter describes the different strategies of the HL-LHC project to rebuild a network of industries able to produce all the components needed to make HL-LHC possible.

## 2. DESCRIPTION

The main working axis developed are the following:

- Make or Buy strategy;
- Present market classification;
- Enhancement of awareness;
- Strategic alliances with universities and research centres;
- Development with industrial partners.

### 2.1. MAKE OR BUY STRATEGY

HL-LHC has developed its full Product Breakdown Structure. For each one of the major components, the project has developed the subassemblies and analysed what is presently the best production strategy. Some basic points analysed are:

- Do we need to develop the design by ourselves or is industry able to do it?
- Do we need in-house manufactured models and prototypes before looking for suppliers?

- Can we modify the subassemblies structure so that it is easier for industry to produce them?
- Do we presently have suppliers who can produce or which could be helped to produce the components?
- Do we have local research centres that can support the industry to fill the gap?
- Should we be the components assemblers or is industry able to do it?
- Can this be installed by industry?

The information is available to the community and has different presentation formats that expand from sortable lists to maps such as the one shown in Figure 1.

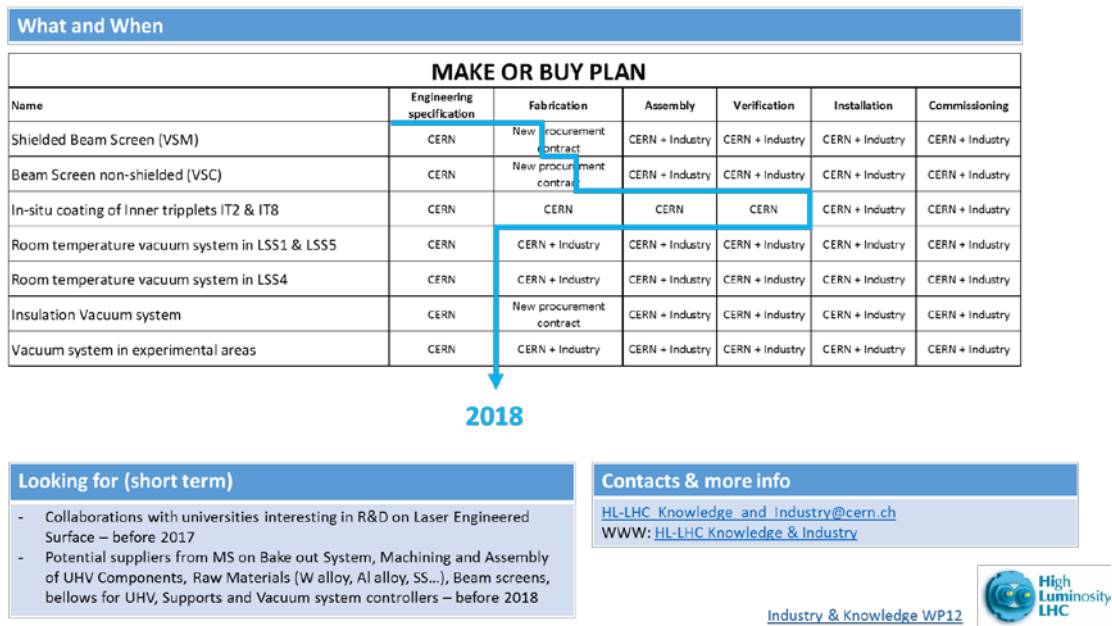


Figure 1: Example of simplified Make or Buy Plan

## 2.2. PRESENT MARKET CLASSIFICATION

The decision to produce certain subassemblies in industry depends strongly on the market. To take a knowledgeable decision it is important to have a clear view of potential suppliers and risks. For this reason, we have identified sectors where we want to have suppliers classified and qualified when needed inside a complete and actualized roster. To complete the list, we have created several mechanisms:

- Discussion with experts from the different sectors;
- Analysis of the orders inside the project and on other similar projects;
- Discussion with the CERN purchasing department and its network;
- Discussion with the national Industrial Liaison Officers and Knowledge Transfer Officers;
- Ad-hoc market research.

The information is available to the community and has different presentation formats that expand from sortable lists to maps such as the one shown in Figure 2.

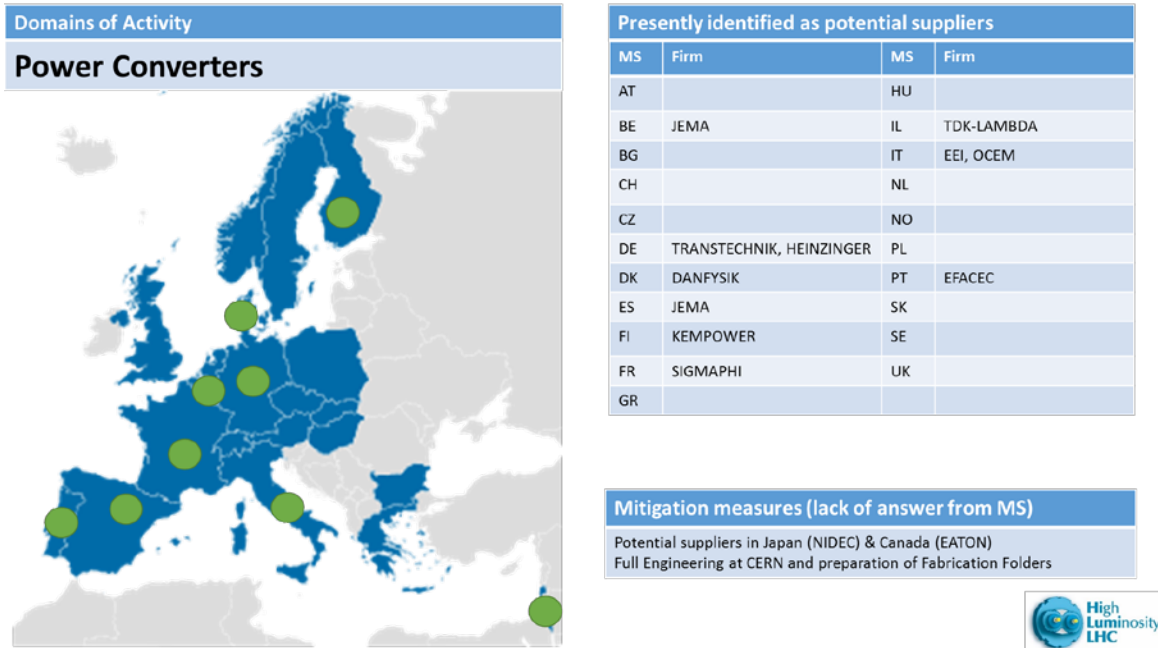


Figure 2: Example of Map of potential Suppliers for power converters in CERN Member states. The green point indicates that there is at least one supplier identified in the country

### 2.3. ENHANCEMENT OF AWARENESS

The analysis of the list has shown that the industries of several countries are under-represented (see Figure 3). To ensure that we reach industry that could potentially be interested and interesting for the sector we have established several mechanisms:

- Monitor a list of companies by nation/sector and its evolution with time;
- Make awareness campaigns targeting under-represented nations and sectors;
- Inform and discuss with national representatives;
- Contact national research labs and universities to link to their networks.

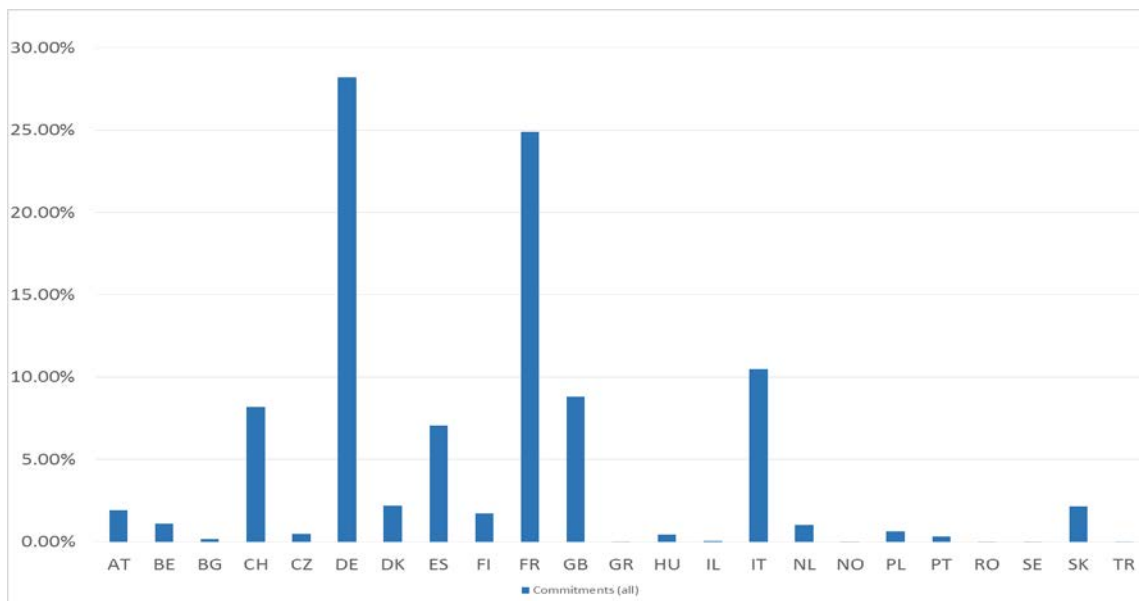


Figure 3: Distribution of commitments for HL-LHC orders (2013 – Present)

## 2.4. STRATEGIC ALLIANCES WITH UNIVERSITIES AND RESEARCH CENTRES

Local universities and research centres are key partners to find and access competent SMEs willing to work in the science domain. These alliances are not only interesting to expand the network of suppliers but also to fill competence gaps, to ensure industrial follow up and to train students that could move afterwards to industry. Our intention is to continue expanding the network to reach all member states. Present status is shown in Figure 4.

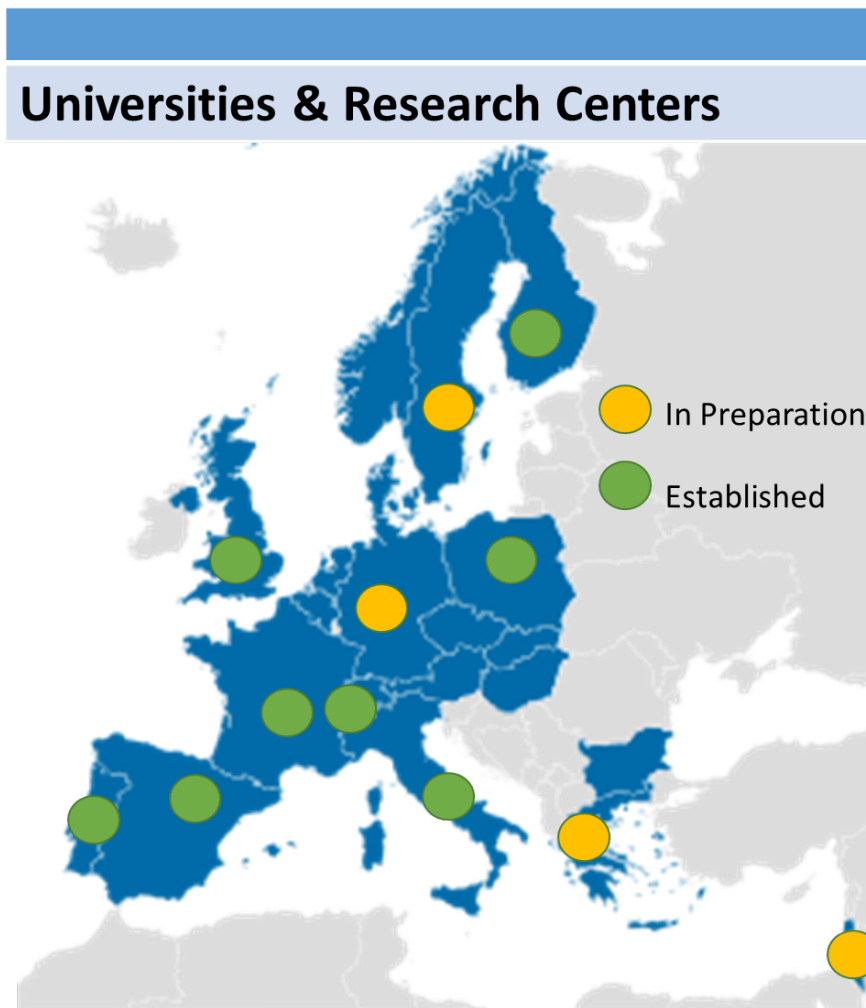


Figure 4: Countries (CERN Member States in blue) with a present, or under preparation, partnership with a university or research centre

## 2.5. DEVELOPMENT WITH INDUSTRIAL PARTNERS

HL-LHC has as an objective the development of partnerships not only with research institutions but also with industry. One of the first actions undertaken has been to apply for a H2020 Pre-commercial procurement action (PCP) on the Support to innovation, human resources, policy and international cooperation for research infrastructures program (INFRASUPP-2015-2) for the development of innovative quadrupole corrector magnets on the European industry.

We will continue analysing opportunities to enhance development and knowledge transfer to industry.



### 3. CONCLUSION

The HL-LHC project has to rebuild a network of industries able to produce all the components needed to make HL-LHC possible. To cope with this challenge the project is working on the following axis:

- Improve the Make or Buy strategy to request from industry what they can or could supply;
- Identify and classify industries with the potential to be HL-LHC suppliers;
- Enhance the awareness of the technologies needed, the challenges and the opportunities;
- Establish strategic alliances with universities and research centres that could partnership with industry;
- Develop industrial partnerships from the earliest development stage.

### 4. SOME EVENTS RELATED TO THE ACTIVITY

- L. Rossi, HL-LHC Program, technologies and opportunities, EUSPEN Meeting on Precision Engineering held at Thoiry, 3 May 2012.
- L. Rossi, HL-LHC Program, technologies and opportunities, Talk to ILO Forum, CERN 15 March 2012
- L. Rossi, LHC Upgrades Technology & opportunities, talk to German Industry visit to CERN, 6 Nov 2012.
- Workshop n.1 at CERN with Industry, Workshop on Superconducting Technologies for the Next Generation of Accelerators 4-5 December 2012 (<https://indico.cern.ch/event/216711/>)
- L. Rossi, Advanced SC Magnets and devices for the LHC upgrade, Academia-Industry Matching event, Madrid, 27-28 May 2013.
- O. Capatina; High Luminosity upgrade for the Large Hadron Collider; Precision Fair in the Netherlands; 12 November 2014
- I. Bejar Alonso, L. Rossi; HL Program, technologies and opportunities; Germany at CERN; 28-29 January 2014; <http://home.web.cern.ch/cern-people/updates/2014/01/germany-cern-exhibit>
- I. Bejar Alonso, HL-LHC Program, technologies and opportunities, Spain@CERN, 28-29 October 2014, <http://spain-at-cern.web.cern.ch/>
- I. Bejar Alonso; High Luminosity upgrade for the Large Hadron Collider; Université Haute-Savoie; 29 January 2015
- I. Bejar Alonso, M. Losasso; The HL-LHC project and its future procurement needs; ILO and ENET meetings 19-20 march 2015
- I. Bejar Alonso; The HL-LHC project: goals and impact - Industrial Opportunities day; Bologna; 11th June 2015
- Workshop Industry n. 2, HILUMI LHC goes to Industry, 25- 26 June 2015, CERN (<https://indico.cern.ch/event/387162/>)