The CEDAR Project

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Abstract

The LHC project at CERN requires both the handling of a huge amount of engineering information and the control of the coherence of this information as the design work evolves on the machine and the experiments. A commercial Engineering Data Management System, (EDMS), is being implemented to manage data for the design, construction, installation and maintenance of both the accelerator and the experiments. This CERN-wide project is called CEDAR[1]. The World Wide Web is used to make the information accessible at CERN and in the external collaborating laboratories around the world. In this paper we describe the objectives of the CEDAR project, the different subprojects in the machine and the experiments as well as the first results of the implementation work.

1 INTRODUCTION

The LHC project at CERN requires the management of huge amounts of engineering and project data in the progress from design to construction to operation.

The data must not only be produced, it must be captured in its various formats, organized, and its coherence kept under control. An Engineering Data Management System (EDMS) is being set up to handle this task. The implementation effort is managed as a CERN-wide project, since both the Collider and the LHC experiments have expressed their need of such a system.

The rationale for introducing an EDMS now at CERN is twofold: never before has CERN built such large detectors and such a complex accelerator with so many participants in so many countries over such a long time period; the age profile of the CERN population is such that a large number of the staff constructing both detectors and machine will retire long before the LHC does. The teams that will operate and maintain the machine and the detectors will have to possess documentation that describes the installed equipment and the reasons for design decisions taken decades earlier.

2 INTRODUCING AN ENGINEERING DATA MANAGEMENT SYSTEM

The introduction of an EDMS into any organisation requires more than computing technology, in fact the computing aspect may be the easiest part of the entire enterprise. CERN has a long experience in managing CAD drawings with computers, the Oracle Drawings Directory was in limited use more than 10 years ago. The successor, the CERN Drawings Directory (CDD)[2][1], designed to manage all CERN drawings, was put into production at the same time that a CERN wide EDMS Task Force was contemplating a global engineering data management solution for the entire LHC project. CDD, with its large drawing database is now being merged into the EDMS as a subsystem.

CERN invented the Web to distribute information about experiments and data among physicists. Using the Web to search for information is now part of our culture. However, before being able to provide anything else than limited amounts of data with access and versions kept under control on the Web, or elsewhere, a number of basic, even elementary procedures and processes have to be defined. If the procedures and processes exist they have to be formalise; if they do not exist they also have to be defined and agreed upon by the user community. For instance, the rules for circulation and approval of engineering documents have to be defined and documented before being implemented in a computer system.

A large part of the initial effort of the CEDAR project was devoted to this task, making progress look very slow. In this respect the advent of the personal computer has perhaps created more problems than it has solved. Collecting data and documents created and stored on a variety of formats on many different types of platforms is not an easy task.

The standardisation of word processing tools, providing uniform templates might seem to be outside the reach of the EDMS proper. However, if the end-user cannot produce documents that later can be retrieved and printed at his local printer or reviewed on his computer screen, what is the use of the system?

An EDMS is however much more than a document management system, its strength lies in the management of structures, known at CERN as product, work or assembly breakdown structures, describing the equipment being built. These structures and the engineering data, that is linked to them, will describe the Collider and the experiments throughout their life-cycles, from an as-designed structure to as-built and finally as-installed and operated. Traditional project management support can also be provided by extraction of bills-of-materials,

[1] CEDAR = CERN EDMS for Detectors and Accelerators

[2] As a figure of merit: CDD manages 150.000+ drawings today

indications of design and fabrication progress, etc. How to describe such complex devices as the detectors and the Collider in structures suitable for design validation, procurement and manufacturing has been, and remains, one of our most hotly discussed topics.

3 PROJECT DESCRIPTION

3.1 Project objective

The objective of the EDMS project is:
To provide access to the correct engineering data needed to design, build, install and operate the LHC and the experiments for the life of the project.

3.2 Project history

The EDMS project was born as the physicists and engineers started to plan in detail how to build and assemble the large detectors of the LHC experiments, ATLAS and CMS. The need for a tool for managing engineering data, not only drawings became clear. The accelerator sector joined the EDMS Task Force [2], created to study solutions to this problem. To avoid embarking blindly on an immediate full-scale adventure, three pilot projects were made using a commercial system, one in the accelerator sector and one in each of the experiments. Only after the pilots had been successfully completed was a large-scale deployment envisaged. All information available from industry indicated that this was the correct way to introduce such a complex system in an existing engineering organisation. After the pilot projects the system CADIM/EDB from Eigner&Partner was selected.

CERN and many of the collaborating institutes have complex computing environments, with PC:s, Macintoshes and various dialects of Unix happily mixed. Providing support on a global scale for such a mix of platforms is not realistic. Fortunately the Java programming environment in Web-browsers evolved in time to provide a World Wide execution platform independent of the computers used.

4 PROJECT ACTIVITIES

The CEDAR project is supported by the EST and IT divisions. EST is responsible for end-user support and general use of CADIM/EDB while IT provides the computing infrastructure, database and CADIM/EDB system oriented support. In addition to day-to-day support, a system as complex as this does not operate as an autonomous black box, working groups have been created to analyse and propose specific actions and solutions in the following domains:

- EDMS architecture
- CAD 2D and 3D model management
- Document handling and management

A dedicated working group for the quality assurance plan (QAP) of the Collider also collaborates closely with the CEDAR team.

4.1 Base Practices and Procedures

The introduction of an EDM system requires a number of base practices to be put in place before a large community of sophisticated users are invited to used it. Experience from the pilot projects showed that no progress with the users could be expected if such practices are not firmly in place and documented. Two of the most important are conventions of item and document naming schemes - the name of an item or a document must be coherent with the overall scheme and cannot be left to the whim of a particular engineer. Application of the conventions must be enforced to avoid anarchy.

4.2 CADIM/EDB

CADIM/EDB is an industrial EDMS. Like most such systems it keeps information (meta-data) describing engineering data objects in a database - in our case Oracle. Items are assembled into structures that in turn may be linked into projects. Items are described by associated documents, which may contain texts, drawings and other engineering information. The system provides interfaces to CAD tools and M/S Office; links to other databases may be created. The complexity and the scale of the LHC project induced the vendor, who has twelve years experience in the area, to participate in joint projects with CERN in areas of common interest.

4.3 TuoviWDM

The present Web interface to CADIM/EDB is TuoviWDM, developed by the Helsinki Institute of Physics in a technology transfer program at CERN. TuoviWDM (for Web Data Management) enables platform independent sharing of engineering documents on the Web. Using both Java and HTML it can be programmed to access document databases, either commercial EDM systems or in-house systems. In our case it gives access to CADIM /EDB and CDD as well as to its own local data-sets.

5 INSTANCES OF THE EDMS

CEDAR currently supports the Collider and three LHC experiments, below a short description of the progress in each is given. Reference [3] gives the URL of the CEDAR project and links to the instances described below.

5.1 ALICE

Alice has not yet entirely embraced CEDAR. The collaboration members tried it out (only a total of 70 text documents, drawings and other items were entered) and feel now that they have not the resources to bring a new system, which they judge not ready, into their workload. They are at present fully occupied with transforming and transferring 3D data files between the different Alice member institutes but fully intend to come back to CEDAR, at a later stage.

5.2 ATLAS

TuoviWDM has been used since summer 1997 to collect and approve documents for Atlas. The most active users have been in Technical Coordination, LAr, Magnet and Muon detector. Parallel pilot projects using CADIM/EDB have been run in the Magnet, TRT and Tile calorimeter. All Atlas projects are at present migrating to CADIM/EDB, using Tuovi as a user interface. Atlas draughtsmen in the CERN drawing offices are also using CDD to manage drawings.

5.3 CMS

CMS will use CEDAR to manage its engineering data more and more carefully. CDD is replacing the old CADD file server. A release procedure for all document types, compatible with what CDD provides for drawing management, has been set up. Users can access the up-to-date CMS parameter book directly from the TuoviWDM Web interface. In parallel to the above activities, much work has been devoted to defining Product Breakdown Structures (PBS) for the different sub-projects. The set of all PBS's forms the coherent CMS Baseline: high level structures contain items that are the starting point for smaller product structures. All these product structures may be linked together to make a single big product structure.

The CMS-CRISTAL project - an ambitious and painstaking process of growing many thousands of large crystals - starts production mid-1998. The short term requirement to manage the crystal production was stronger than participating completely in the CEDAR project. But the work of the architecture group will ensure the compatibility between the CEDAR and the CRISTAL data models so that in the future the systems will be able to collaborate.

5.4 LHC

The implementation of CEDAR in the Collider project reflects the needs of its management team that recognized early on that only strict control of the design data and documents could maintain the consistency of the project. Practically all drawings for the Collider are now under control, with complete life-cycle procedures implemented. A LHC Baseline has been established to make all released, officially approved, information available to all project collaborators including those outside CERN[3]. Documents and data under version control belong to the baseline, documents that describe the technical background, project reports and project notes do not. LHC project reports and notes, stored in the CERN library's document server, can be referenced and accessed from the EDMS too.

Work group spaces allow documents in work and proposals to be exchanged between participants in various sub-system projects such as the main dipole group, the insertion magnet builders and others. A clear distinction is made between documents in the work group space and in the baseline space.

6 THE FUTURE

The vision of an all encompassing EDMS that we had when embarking on the pilot projects for product selection remains valid but it has been tempered by cold reality. Providing adequate access to enginnering data across the diverse and complex environment at CERN, not to mention several hundred university institutions and national laboratories across the globe, requires a large number of basic procedures and work processes to be either defined or adapted. The effort to define standards for documents and drawings, approbation and submission procedures was underestimated - as was resistance to change. Not every engineer, secretary, designer or physicist will let colleagues look at work in progress nor provide a comprehensive documentation of work done. Strong support from the top management in both the Collider project and the two large experiments. ATLAS and CMS, coupled with the sheer impossibility of managing such large projects 'as usual' provide ample incentive to continue. The main effort in both the Collider and the experiments during the winter 1997 and spring 1998 was to establish base practices and design baselines. This effort will continue during the remainder of 1998 until complete baselines for the Collider and experiments exist and can be put under configuration control.

References

1. CERN-EST-96-004; CDD CERN Drawings Directory User's manual: Version 1.1 . by Delamare, C ; Fernandez, I ; Jeannin, F ; Petit, S; URL: http://wwwlhc01.cern.ch/cdd/
2. CERN-LHC-97-003-VAC; CERN EDMS study 96: progress report - second progress report of the Engineering Data Management System Task Force. 31 Jan 1997 . by Dittus, F ; et al. (14 p) . 1997
3. URL: http://edms.cern.ch/

[3] CEA and IN2P3 in France, BNL and FNAL in U.S are regular users.