THE CERN EDMS – ENGINEERING AND EQUIPMENT DATA MANAGEMENT SYSTEM

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Abstract

The CERN EDMS has extended its capabilities from the management of engineering data to the domain of equipment data management by linking together two commercial systems. The combined system now supports more than 3500 users and manages more than 250,000 drawings, more than 30,000 documents and information about more than 3200 accelerator and detector components for the LHC. The paper presents the current architecture and the future challenges that will have to be met – managing the equipment data for the entire LHC until dismantling and maybe even further – and dealing with the several millions of components making up the LHC. A brief overview of the Web interface and the different mobile terminals now supported by the system is also given.

1 INTRODUCTION

The EDMS project was launched in June 1997 and became an official Service in 2000. Initially dedicated to the LHC project (machine and detectors) the scope of the Service has become CERN-wide, providing document, engineering and equipment data management services to any CERN unit or approved experiment. The EDMS Service status reports for 1999, 2000 and 2001 are available at the EDMS web site [1].

2 EVOLUTION OF THE SERVICE

During 2001 the use of the Service has become generalized as the tendency is towards general document management rather than engineering data only. The EDMS Service has become a part of the CERN information system infrastructure and is now expected to be available anytime from any point in the world 24 hours a day 365 days a year. The Christmas shutdown in 2001 was probably the last one for the foreseeable future!

The introduction of the context concept in late 2001 has been well received by the users. By creating a specific context for each project, the number of options a user has to select manually when creating documents can be minimized. The context is used to define naming, release procedures etc. automatically, simplifying the use of the system for an overwhelming majority of users.

The CDD migration project, with the objective to unify drawing and technical document management in the Organisation has made good progress. Engineering drawings are now visible simultaneously both in CDD and EDMS and enabling the use of the powerful configuration management tools of CADIM/EDB. The shutdown of CDD is now expected in a time frame of 6-12 months.

The design of the Manufacturing and Test Folder (MTF) has evolved and a more generalised approach has been taken giving very good results for the manufacturing follow-up of LHC equipment in general. The main magnet groups in the LHC division have made the MTF their principal tool to trace the evolution of each of the many thousands of magnets for the accelerator, see [2] for more details.

3 SYSTEM ARCHITECTURE

The architecture of the EDMS is schematically depicted in Figure 1. CADIM/EDB* is a commercial engineering data management system from Eigner, a German company, MP5 is a commercial asset tracking and maintenance management system from Datastream Inc., an American company. The EDMS Common Layer and the Web interfaces insulate a large majority of users from the inherent complexities of these systems. Access to other application specific databases, such as magnet measurement repositories or cryogenic thermometer calibrations can be provided on a case-by-case basis through the Common Layer mechanism.

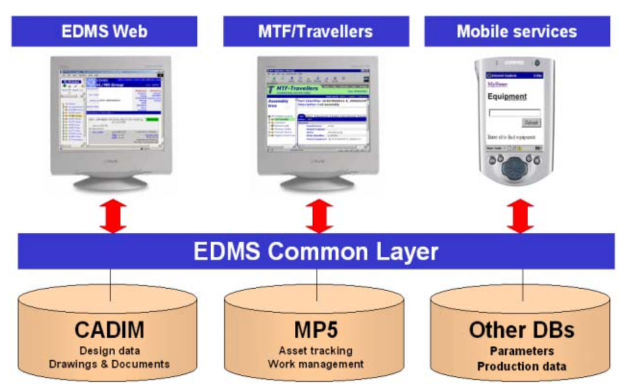

Figure 1- EDMS architecture

3.1 EDMS Web and the Action Broker

The original EDMS Web interface, Tuovi, was developed in collaboration between CERN and the Helsinki Institute of Physics (HIP) in Finland, using the available CADIM/EDB application program interface (API). HIP later spun off the Tuovi developments into a

* CADIM/EDB, Eigner, MP5 are trademarks of their respective owners.

commercial company, Single Source OY. This company, after further developments of the software, now markets it as the Kronodoc[†] document management system [3].

The evolution of Tuovi into a commercial product, duplicating features already existing in CADIM/EDB combined with the release of a new API from Eigner in Java technology forced the EDMS Service to review the entire Web implementation.

The Java daemon developed by Eigner to manage CADIM/EDB processes has been encapsulated in an EDMS Action Broker (EAB) using Java technology. The associated reorganization of the underlying interface software into horizontal layers with better defined interfaces made the EDMS Web software code simpler and the system more robust. The EDMS Common Layer API, written in PL/SQL, has also been encapsulated in the same action broker, resulting in a single EDMS programming API based on modern software technology

As the standard Web http protocol is used to communicate with the EAB, other client programs than the EDMS Web server can interact with the system. This opens the route to the construction of new interesting EDMS Web-powered applications such as e.g. a non-interactive EDMS e-mail client.

The large volumes of e-mail and faxes being created in the MTF context of the LHC project require extensions to the current data management tools. The basic user requirement can be summarized as follows:

An EDMS document associated with the sender should be created automatically when an e-mail with the appropriate meta-data and data files attached is received by the EDMS e-mail service.

A prototype e-mail client has proven the technical feasibility of the approach. Problems found concern mainly security and intrusion issues. Further investigations will be needed to find technically sound solutions that can be implemented at an acceptable cost.

3.3 *Export/Import*

The EDMS import/export system was designed to perform massive manipulation of data (e.g. creation of entire structures, upload of large numbers of files), too time consuming to handle manually with the EDMS Web or CADIM/EDB native interfaces. The system relies on an XML based description of the data. Over the past 3 years, it has been extensively used to import considerable amounts of data (LHC, CMS, ATLAS, ...) or to perform complete migrations (ALICE, TIS). The present system comprises an engine to import/export data to/from the EDMS in the form of XML files, and data transformation modules to convert XML to/from other data formats (e.g. Excel sheets, graphics diagrams).

In operation, a number of limitations in the system have appeared. As the import/export of data is presently done by the support team, any scaling-up of this service will be difficult and expensive. The import/export functionality must become sufficiently robust and simple to be used in the framework of a project–wide "data aid" service.

The EAB XML Client will be a new version of the EDMS import/export system that reads XML import files and writes XML export files using the EAB features to communicate with CADIM/EDB in batch mode.

[†] Kronodoc is a registered trademark of Single Source Oy.

4 ENGINEERING DATA

By engineering data we mean engineering oriented text documents, drawings, 3D models, project and assembly breakdown structures as well as specific databases for equipment related to accelerators or detectors.

The underlying CADIM/EDB and MP5 systems have extensive structure management tools. The most advanced projects supported by the EDMS Service have today moved from using project break down structures (PBS) only, to using as-built structures (ABS) as well and they are preparing the use of as-installed structures. An ABS is used to manage engineering and equipment data for the manufacturing and assembly phases, often in association with the MTF application; the as-installed structures will be used to manage machine layouts and machine/experiment commissioning and maintenance activities.

A full set of Web based document management tools covering the complete life-cycle of equipment and documents is now available. These tools include support for sophisticated reporting and management of non-conforming equipment to keep track of the actions taken when expensive equipment does not follow the specified requirements. Document visibility in the system range from public (i.e. world wide) to strictly confidential (no access except for authorised individuals).

The management of 3D models has been evolving with the requirements originating in the LHC experiments. Using a combination of standardised CERN reference co-ordinate systems and the CDD features, an approval procedure for 3D models has been implemented. For more details on this subject, please refer to [4].

Consult

The Consult CAD application permits the visualisation and exchange of 3D data using the Web. The 3D models may be downloaded, optionally also transforming the model data from one CAD-system format to another on the fly. Consult is designed for the exchange of data inside experimental collaborations, exchanges where a formal and contractual, more constraining approach is not appropriate [5].

HPGL viewer

The HPGL viewer is an integral part of the CERN drawing management system. This application is maintained by CERN and is distributed freely to collaborating institutes and firms under contract to CERN. For other organisations and commercial companies a fee is charged to cover expenses incurred by the distribution and maintenance, see [6].

5 EQUIPMENT DATA

5.1 The manufacturing and test folder (MTF)

The complexity of the MTF data models and their interactions with CADIM/EDB make the import of new manufacturing data a very delicate operation. Such data must be extensively analysed and checked before it is inserted in the database and irretrievably changes the equipment information stored. The data arrives from the manufacturer in an Excel file, the basic structure of which has been generated automatically from the MTF database, to reflect the nature of the specific equipment (its properties, manufacturing workflow steps, etc.). After verification of the data by the project engineer, it is transformed into an intermediate format and finally imported into the MTF database. In theory we did expect to be able to automate this process to a very large extent. In practice, many human operations are necessary and the time needed to check and transform data is such that it will soon become impossible to face the flow of new data coming from users. It is clear that import can neither be left completely to users, nor it can be fully automated. Nevertheless, there are possibilities to automate the operations partially, and to organise the import such that it can be handled in cooperation between project engineers and "data aid" persons. Figure 2 shows the MTF report related to a LHC cryogenic dipole – the results of warm magnetic field measurements. Such reports can be generated for a set of equipment parameters, extracted into a spreadsheet for further analysis with more powerful mathematical tools. For more detailed information, see also [2] presented at this conference.

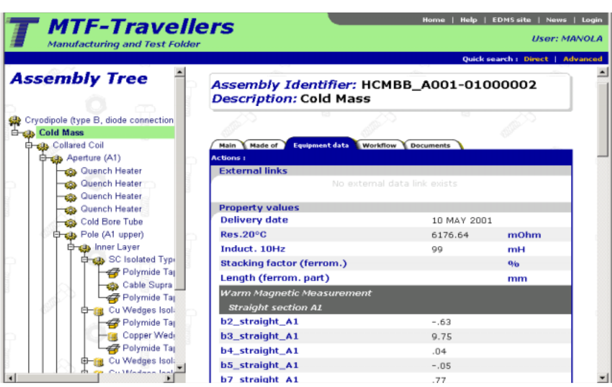

Figure 2 - LHC cryodipole parameters

6 MOBILE DEVICES

Mobile terminal access is also available, but the inherent limitations of such terminals must however be taken into account when accessing data. Trying to view large drawings is not appropriate here. Typical mobile devices are standard GSM telephones or palm-top type systems with GSM connectivity having an integrated barcode reader. A prototype service has been developed for a laboratory environment permitting us to envisage a full-scale development [7].

7 USAGE STATISTICS

The present document creation rate is most encouraging, more than 1000 documents are created per month and more than 5000 distinct host machines are accessing the system each month, Figures 2 and 3, proving that the CERN EDMS Service has today reached a mature stage.

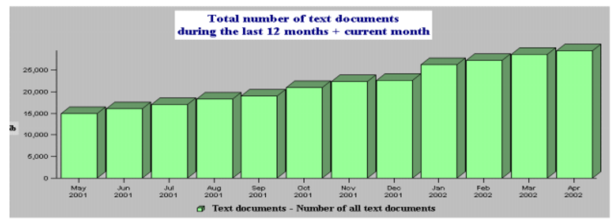

Figure 3 - Document creation rate

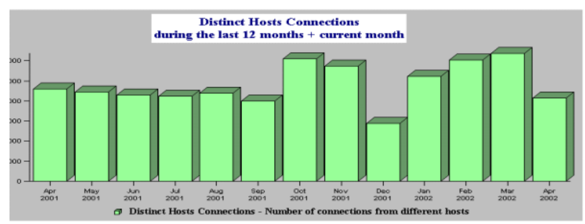

Figure 4 -Monthly access count - distinct hosts

8 REFERENCES

[1] The EDMS service Web site URL: http://edms.cern.ch

[2] Manufacturing and Test Folder: MTF
P. Martel, et. al , CERN, Geneva; this conference

[3] Single Source Oy; URL: http://www.kronodoc.com/

[4] Engineering Design Management and Tools for the CERN EDMS; C. Andrews et al; this conference.

[5] The Consult web site, URL: http://wwwconsult.CERN.ch:8001/HTML/consult_home_page_en.htm

[6] The CERN HPGL viewer Web site, URL: http://cern.web.cern.ch/CERN/Divisions/EST/CAD/hpglviewer.html

[7] Mobile services in the CERN EDMS ;D. Widegren; European Datastream User Conference 2001; URL: http://edms.cern.ch/document/308781/1