The CERN Engineering Data Management System - A status report

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Abstract

The Engineering Data Management System at CERN (CEDAR/EDMS) has been in production since more than 18 months. The initial objectives of managing the technical documentation for the LHC project (Collider and experiments) have been met and CEDAR/EDMS has now become a CERN-wide service. The development of quality assurance plans has played a major role in getting the system accepted and used by both the Collider project participants and the experimental teams. The extensive use of the World Wide Web has enabled the CERN EDMS team to provide a truly global service not only inside CERN but world-wide to all the institutes participating in the Collider construction and in the experimental collaborations. The new challenge for the service is now to manage the data describing the equipment which is being built and will be installed during the next years. The paper describes the current state of the service and the challenges ahead.

1 INTRODUCTION

The guiding principle behind the development since the EDMS project [1] start has been to first add new features to the working environment before migrating what is already in production and part of our users' daily tool box. This concerns in particular the CAD environment of CERN where the CADIM/EDB[1] system provides some features that in fact duplicate features in the CAD production environment; however modifications here have to be introduced with extreme care. The EDMS project had to first prove that simple documents can be managed before pretending to be able to manage CAD data in an environment as complex as that of CERN. Managing documents with a distributed approval process has however proved to be considerably more difficult than initially envisaged. The impact of an EDMS introduction on the working environment and the end-users should not be underestimated.

A general requirement of all interface developments is that the "business rules" must be the same in proprietary interfaces as in any custom-made interfaces manipulating the same data. This implies that no business rules should be located in any interface at all to avoid inconsistent data or behaviour.

The World Wide Web interface developments grew out of the TuoviWDM [2] effort at CERN. The Web was not considered as a serious future technology by the EDM systems suppliers where resources had to be invested when CADIM/EDB was purchased (1997). More details of the EDMS Service and the directions planned are available in the EDMS Overview [3] and EDMS Technical Roadmap [4].

With the successful demonstration of the system's document management capabilities the EDMS project has now matured into a CERN wide EDMS Service.

2 STRUCTURE AND CONFIGURATION MANAGEMENT

The structure management issues are usually complex and will require several iterations before they are completely settled. Structures and data that may change in time require configuration management tools to track and control their evolution. The Configuration Management (CM) is a process that ensures consistency among the parameters and the requirements, the physical and functional configuration of the object in question and its documentation, as inevitable changes occur during the object's life-cycle.

The different lifecycles of documents and of structures have been defined and implemented in the EDMS to help the project management teams to track project evolution. Changes to documents and structures as well as the creation of variants must be controlled. The management of hardware baselines, including use of Engineering Change Requests (ECR) to steer the evolution of the designs is becoming a routine procedure albeit still with much manual intervention.

Version and variant handling are two different issues, but are often discussed in the same context since they have certain common problems. Version handling is closely related to the question of release procedures. For both versions and variants, it must be settled whether the release procedures should be applied directly to documents/drawings or to the associated nodes in a structure.

The configuration management tasks have had a strong influence on the Quality Assurance Plans (QAP) for both the LHC machine and the LHC experiments. The implementation of these processes in the EDMS is relatively simple once they have been defined and agreed upon. CADIM/EDB has a data structure designed to

[1] CADIM/EDB is a trademark of Eigner&Partner

support configuration management and it is important to follow the basic CADIM/EDB concepts as closely as possible to benefit from the system's configuration management tools. A recommendation on how to name the nodes of the different structures created in CADIM/EDB and the possible addition of new attribute fields of the nodes is required.

The structure management tasks interact with many other activites and in particular with management of large assemblies within the CAD system.

3 DOCUMENT MANAGEMENT CAPABILITIES

The principal activity of document management is the administration, archiving and control of access to documents stored in the system. Documents can be categorised in specific document types (text files, drawings, FEA analysis etc.). The document types are used for a clear description of the individual document type. Documents may have states (in work, under approval, released, obsolete, etc.) and the state transition is controlled by release procedures defined by the user. A number of release procedure exists already in the system and may be adapted to new requirements.

Extensive search functionality and full document search are features that already exists or will be provided. Changes (creator, change of status, modifier, version generation etc.) are registered in the history log.

A complete drawing life-cycle management is already provided by CERN Drawing Directory (CDD)[5]; CDD will however be migrated into EDMS for reasons of homogeneity and support. Initially, drawings managed by CDD will be made accessible for inclusion into structures in EDMS but the approval process, life-cycle state changes etc. will use the original Web interface until the migration is completed.

A distributed text document approval process with approval list management using a Web interface is now in production. The approval process project implied a review of the document attributes and how documents and meta-data are entered into the system. A number of organisational questions such as the relation user-to-group(s) and user-to-equipment-codes have also been analysed in that context. With the increased use of Engineering Change Request procedures the version handling in EDMS must be also aligned with the respective QAP definitions of versioning and revision.

Conversion to standard formats is required for long term archiving and provides the users a simplified file exchange and access. Conversion tools to the principal text document formats, Postscript and PDF as well as 3D formats (like STEP, IGES or VRML) are in pre-production tests.

4 CAE DATA INTEGRATION

The two main CAD systems used at CERN are Euclid[2] and Autocad. Euclid has its own integrated database management tools which permit the EDMS to manage the Euclid data using only 3D model meta-data in a loose coupling.

A Robcad system is used to simulate the installation and integration scenarios for both the LHC and the detectors.

Providing CAD data management in the EDMS is strongly related to the progress of the standardisation and homogenisation of working methods and procedures primarily in the CERN design offices. During the last two years a large effort has been expended to unify the Euclid working enviroments and to provide an environment where computerised approval and release procedures of 3D CAD data can be supported. In parallel with these efforts initial evaluations of the third-party CADIM/EDB CAD interfaces have been made. An assessment of the CADIM/EDB Euclid interface indicated that the major effort and the necessary changes to the current working environment required would not be accepted by either the user community or the project engineers. Euclid's integrated database management tool suite makes a loose integration with the EDMS an acceptable solution.

The AutoCad interface has been similarly been assessed and will also require changes to the current environment. Considering however the complete absence of database management tools for this application a change will ultimately have to be accepted by the user community.

A pilot project to use EDMS to manage electronic CAD (Electronic Design Automation - EDA) has been successfully completed [6]. The results indicate that many of the present user community requirements can be satisfied within the new framework. A limited EDA production service has now been offered since the spring of 2000.

The management of CAD data is also closely related to the subject of managing structures. A pilot study of the CADIM/EDB features as they relate to the CERN environment has been made indicating that further analysis and reflection is required before any implementation work can be undertaken. Major issues here are how to handle release procedures for structures and version management of structures.

Visualisation of 2D and 3D models is provided respectively by the CERN HPGL viewer[7] and the Consult application using a third party viewer[8].

[2] Euclid, Autocad and Robcad are trademarks of their respective owners.

5 PRODUCTION AND EQUIPMENT DATA MANAGEMENT

As equipment moves through its life-cycle, from inception to design to manufacturing, installation, operations, maintenance and finally decommissioning, information about this will have to be captured. The basic EDMS system platform provides the tools necessary to build the appropriate applications today.

The EDMS common layer offers the possibility to link engineering data from the conceptual phase, i.e. drawings and specifications, to actual item manufacturing data such as test, status and measurement protocols as well as manufacturing drawings. Project engineers both at CERN and on the contractor's site can via the Web easily follow progress, inspect manufacturing and measurement data for each item using a set of coordinated tools.

As in other Web applications where private or confidential data is concerned, each user may be given a specific login account and password.

With the experiments and the Collider entering into the manufacturing phase, production and equipment data bases will become important. The installation and future operation of the large amounts of equipment must also be taken into consideration.

The large number of complicated equipment items built around the World will require tracking of progress and quality certificates. Problems of quality in manufactured parts requires that the concerned project engineer at CERN or elsewhere is informed and can take corrective action as soon as possible to minimise costs and rejection. The Manufacturing Test Folder (MTF/Traveller) is the computerised version of the paper folder accompanying any equipment being built. Via a Web interface the project engineer at CERN or at a factory site can consult and update engineering data (specifications, drawings etc) and equipment data such as measurement protocolls, quality certificates etc for any equipment. Non-conformance of equipment can be notified via e-mail and actions to rectify problem situations can rapidly be scheduled. Current key users today are: the Collider magnet group for the tracing of the more than 1200 dipoles from construction to installation in the tunnel and subsequent operation; the CMS experiment for the construction of the super-conducting magnet cable production facility and the actual production of the cable itself.

A first version of the application has been built and delivered to the user groups for evaluation, Figure [1].

6 CONCLUSION

The EDMS Service is now well in production and has shown that is can successfully manage engineering documents of practically any type. The distributed approval procedures for both technical documentation and drawings permit the world-wide collaborations of CERN's LHC project to actively participate in the design work of the Collider and the detectors.

The extension of the EDMS Service to manage equipment data is a major challenge for the years to come.

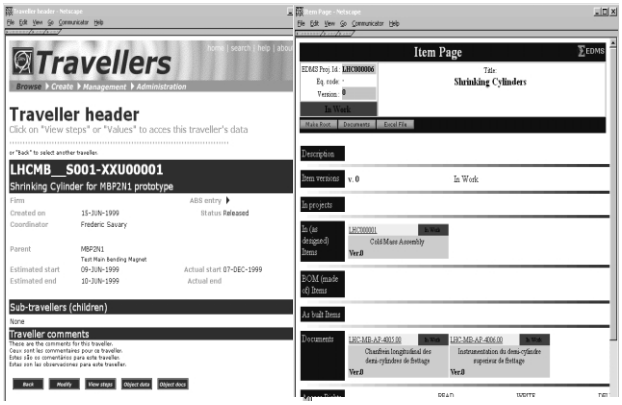

Figure 1 - Equipment and Engineering data

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