CERN'S GLOBAL EQUIPMENT DATA REPOSITORY

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Abstract

Infor EAM/MTF is the official equipment maintenance and asset tracking system at CERN. It has become a central repository where data gathered during equipment's lifecycle are stored: equipment specifications, nominal values, results of manufacturing tests, measurements, non conformities, commissioning data, breakdowns, maintenance interventions, etc. It has not been designed to be a database for control applications, even though it helps and is complementary to their information systems. Also, some of the data logged by any control application that might be of interest to other systems can be made publicly available through MTF. Some major benefits of the collaboration between Infor EAM/MTF and control systems are the enforcement of the CERN Naming Conventions and the access to equipment data in a standardized way, regardless of the equipment's type. Data in Infor EAM/MTF is available to control clients via a web interface or in a more tailored and efficient way by directly accessing the Oracle databases upon which Infor EAM/MTF is built. Some examples of data sharing between Infor EAM/MTF and control applications are presented in this paper.

INTRODUCTION

Infor EAM [1], formerly called Datastream7 or D7I, is the asset tracking and maintenance management system used at CERN since 1997. In 1996, Agile PLM, formerly Axalant, was purchased as the PLM (Product Life Cycle Management) tool for the LHC (Large Hadron Collider) accelerator, to help manage the engineering design documentation and it is the main component of CERN's EDMS (Engineering Data Management System) [1].

Between design and operation and maintenance we had a gap to cover. So it was decided to combine and adapt the best features of each of these tools to provide new applications that would support the engineers during the manufacturing, installation, commissioning and dismantling of the LHC equipment. The MTF was thus born to cover all the "as built" aspects of the accelerator and has grown now to become the CERN's global equipment data repository.

ARCHITECTURE OF THE SYSTEM

The main feature of the architecture is the EDMS Common Layer. As both tools, Infor EAM and Agile PLM rely on Oracle databases for their data storage, and being Oracle extensively used at CERN for many in-house developed applications, it was natural to build the layer on top of these databases. (See Figure 1).

The EDMS Common Layer consists of a set of views and procedures that deals with the in/out flow of data and access rights. All our equipment repository applications access Infor EAM and Agile PLM data through this layer.

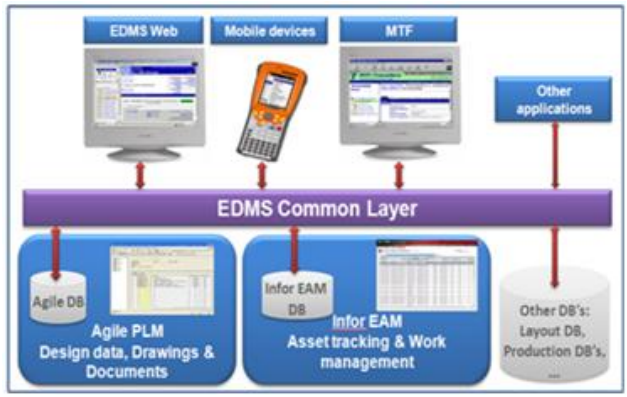

Figure 1: EDMS Common Layer architecture.

The MTF is one of the applications plugged into the EDMS Common Layer. It is mainly a web interface that permits easy data exchange with the underlying tools.

CERN profits from the capabilities of Infor EAM to manage jobs (tests, interventions, breakdowns...) and asset tracking (what is installed where, historic of positions...) and the powerful management of documents in Agile PLM.

The MTF also transparently fetches (and feeds) data from the LHC Layout Database which describes the accelerator installation in detail.

Main benefits of this architecture are:

- Applications can access the stored data in a standard way without detailed knowledge of the design of the databases below or even in which database the data is stored. For instance, a user consulting the result of the magnetic test of a dipole does not know that the equipment information is stored in Infor EAM whilst the Excel spreadsheet with the results is in Agile PLM.
- Application programs are less dependent on upgrades and changes in the underlying tools
- If a migration to another equipment data management tool is required we would only need to adapt the EDMS Common Layer and all the applications plugged into it will continue to work.

There are other applications using the Common Layer, as the EDMS Web, and many specialized views are provided to different equipment groups to enable them to access our data more efficiently. The control system applications use some of these views to profit from the data stored in MTF.

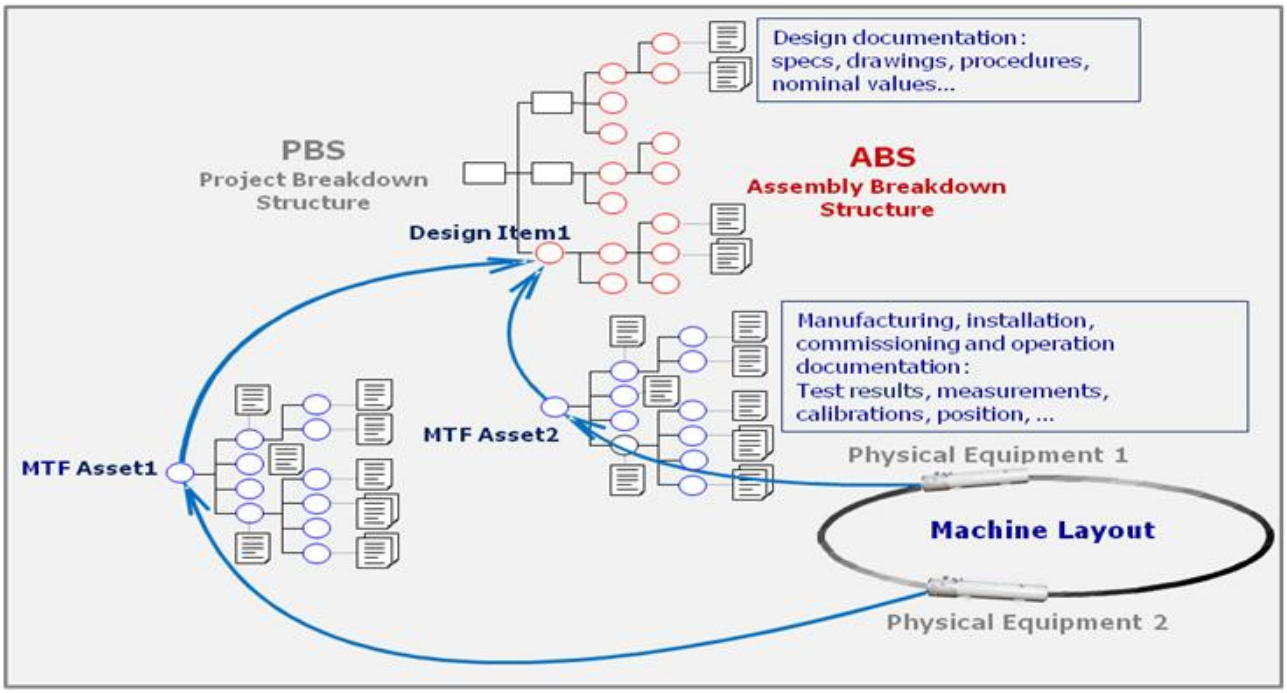

Figure 2: MTF data, from design to manufacturing and vice versa.

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"Octupole corrector in the cold mass at position 21.245km is not working properly". What is its identification number? Can we see the manufacturer magnetic tests? Which copper was used in its cable? Which other cables were done with the same copper? Where are they installed? Was any non-conformity recorded during the cold mass installation? Was this corrector a replacement of another one? Do we have spare correctors of the same type? Where are they stored? Can I see the specification and drawings for that type of corrector?

"Design of the central jack for main dipoles has changed". How many jacks are done following the old version? Where are they? We need a new version of the specification, drawings and installation procedures. Can we schedule the replacement of the old installed ones?

These are the kind of questions that MTF is trying to answer: retrieve data from design to physical equipment and vice versa. Or from layout positions to equipment and design.

- Projects: folders that make up a PBS (Project Breakdown Structure)
- Items: equipment catalogue entries organized in ABS (Assembly Breakdown Structures)
- Documents
- Asset: a physical piece of equipment
- Slot: a functional position were an assembly or a piece of equipment is installed
- Location: a building or site
- Events: historic of assets and slots (creation, status changes ...) or jobs done on them (tests, maintenance interventions, breakdowns, inspections ...).

The three first entities are Agile PLM entities whilst the last four come from Infor EAM. All of them are transparently integrated through the Common Layer (See Figure 2).

Projects and items were created in the early phases of the LHC Project, project definition and equipment design, and the documents associated to them are technical specifications, drawings, engineering change requests, manufacturing procedures, contracts documentation...

Later on the project lifecycle, during the manufacturing phase, the system was populated with assets (with documents like test results, compliance certificates, non-conformity reports...).

During the installation and commissioning each equipment or assembly was associated to its slot in the LHC Layout and every intervention on an asset or slot is registered as an event.

Assets, slots and events can be associated to locations to implement the asset tracking functionalities.

CONTROL APPLICATIONS USING MTF

Although the MTF is not a part of any accelerator control system at CERN, it provides data about equipment to several software applications for control systems. It also stores information coming from such applications where data needs to be shared.

Cryogenic Instrumentation and Electronics

There are more than 12500 cryogenic instruments registered in MTF. They comprise a part of the Cryogenic Control System. To help configure and monitor this system a dedicated Cryogenic Instrumentation Expert

Tool (CIET) has been developed [3] [4]. It needs to access all the data about the instrumentation, a part of which is retrieved from MTF:

- Instrument state (good, defective, broken, wear, usable): it tells the Control System if the signals read from each channel have to be considered or must be discarded.
- Measured property values: correct design values to be adapted to each instrument. For instance the "dead length" or "active length" for the cryogenic level gauges.
- Identification of the instrument installed in a given machine position and its electronic card: tells the system what filter to apply to the obtained data.

LHC Control System Layout

The LHC Layout Database contains the complete definition of the electronics for the LHC Control System [5]. MTF completes this information by providing the identification and measured data of the physical equipment installed in the Layout functional positions. These positions are also imported into MTF and synchronized permitting the creation of links between positions and installed equipment.

LHC Control Devices Configuration

Some of the parameters that the Layout Database sends to the operational accelerator parameters space (included it the LSA database) are retrieved from MTF e.g. data required for on-line operation of the LHC beam loss monitors [5].

Another example is the asset management of Power Converters: the identifier for each individual power converter component is propagated to the Power Converters Configuration database in order to be used by the specific controls configuration tools [6].

STATISTICS

Table 1 gives some approximated numbers about the current use of MTF [7].

Table 1: Statistics

Registered active users	5.700
Support requests per year	5.000
Registered assets	1.150.000
New assets registered per month	5.000
Documents and drawings	900.000
Interventions (jobs) logged	1.900.000
Interventions logged per month	20.000

FUTURE DEVELOPMENTS

MTF is continuously evolving to fulfil the users' new requirements and to adapt to the different phases of the LHC Project.

The main future improvements planned are:

- CERN wide asset tracking for radio protection
- Changes in the architecture to profit from the web services that Infor EAM provides.
- Development of interfaces to be used by mobile devices to record data on the field.
- Integration with other commercial tools used at CERN for stores' management.
- More integration with the LHC Experiments' production databases.

CONCLUSIONS

MTF is the reference information system for LHC equipment data. The system provides the users with the means to enter and retrieve data, reporting, searching and browsing capabilities. But none of these efforts will be useful if the system does not contain complete and accurate data. No system is better than its data!

It is also part of the MTF team's mission to warn and convince the engineers on the importance of entering and checking their equipment data as soon as it is produced.

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