

MANUFACTURING AND TEST FOLDER: MTF

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Abstract

The Manufacturing and Test Folder (MTF) application is an integral part of the Engineering Data Management System (EDMS) at CERN and was developed to capture manufacturing and test data for the LHC project. The basic requirement was to provide traceability of large quantities of complex parts manufactured in a geographically distributed environment. This implies that a wide range of data such as information about manufacturer, manufacturing procedures, test results, non-conformities notices and other related documentation have to be stored and retrieved from nearly any place in the world. The MTF application is now in production since almost a year and manages today an impressive amount of important technical information about LHC equipment. This includes general data such as part identifiers and manufacturer name but also very specific properties of the individual equipment. An important part of the MTF is the workflow tracking capabilities, handling data and documentation about the different steps in the manufacturing and test processes. For each individual step, information about scheduling, applicable standards, results and possible non-conformities can be stored and retrieved. The Manufacturing and Test Folder was developed using the EDMS Common Layer, our interface to two mainline commercial applications; CADIM/EDB for project and document management and MP5 for equipment management. MP5 is the LHC Asset tracking and maintenance management system that will also be used to provide support for the INB (Installations Nucleaires de Base) traceability regulation activities.

1. INTRODUCTION

The MTF project (formerly known as ‘Travellers’) is a part of CERN’s EDMS (Engineering Data Management System) [1] and was launched during 2000; it became an official service in March 2001.

Although originally dedicated to the Large Hadron Collider (LHC) machine, access to it is also increasingly requested by the LHC experiments, not only as a manufacturing coordination tool but also as an equipment management tool in its own right.

2. EVOLUTION OF THE SERVICE

The original clients for the MTF application were the magnet groups in the LHC division. They rapidly realised that the coordination effort for the thousands of magnets needed for the accelerator would be huge if a paper-based

system was to be used. These groups formulated the original requirements having the management of quite complex parts in mind – an LHC magnet may be assembled out of thousands of parts – which, if on one hand made the prototyping phase a bit more lengthy than expected, on the other, supplied a very solid basis for future developments.

As the LHC magnets are closely interrelated with many other systems in the accelerator, increasingly, other groups collaborating with the magnet groups became aware of the MTF’s existence. These groups became interested to use it in their own project activities with the result that the MTF is becoming the central point for equipment management issues in the LHC project. The underlying MTF design objective to try to provide a place where one group “posts” data and information about its equipment for the benefit of the rest of the LHC project is becoming reality.

A pilot project related to the management of production and testing tools data is being concluded; the objective is to link this information to the equipment actually produced and tested with the said tooling.

The use of the MTF from mobile devices such as Personal Digital Assistants (PDA) is also being considered as a possible future direction as a consequence of the nature and constraints of the industrial environments where the MTF is being used. A successful pilot project was completed during 2001.

In the future and even after the equipment’s removal from the accelerator or from a LHC detector, the MTF will permit the continued tracing of its lifecycle, as required by French INB laws.

3. SYSTEM ARCHITECTURE

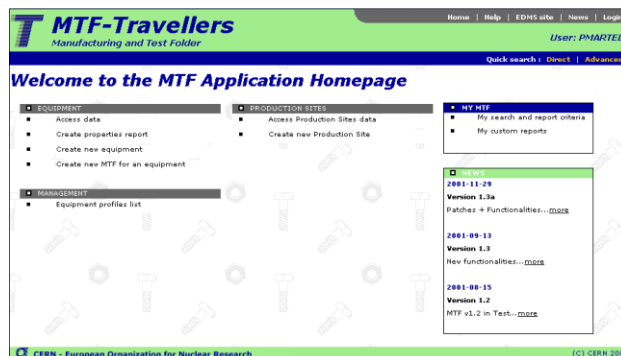


Figure 1: The MTF Homepage

As a part of CERN’s EDMS, the MTF is a Web based application built on top of the EDMS Common Layer mechanism [1].

*CADIM/EDB, Eigner, MP5, Datastream, Excel, Access, Microsoft and Oracle are trademarks of their respective owners

In general terms, the MTF relies on CADIM/EDB* (from Eigner) functionalities as they relate to equipment design and document management while using Datastream's MP5 for equipment and workflow issues.

Isolating the user from the complexity of the underlying systems, the MTF supplies a transparent and seamless path to go from the design of a piece of equipment to any of its physical instantiations (including commissioning, maintenance and disposal) and back.

4. OPERATION

4.1 Definition of Equipment Profiles

Before using the MTF to trace the life-cycle of an equipment, the equipment itself and its manufacturing process have to be "declared" to the system; this involves the definition of all important properties for the equipment as well as those manufacturing and test steps that are relevant (e.g. where some kind of data or information are gathered). In the MTF context this is known as the equipment's profile.

To create the equipment profile in an easy but still systematic way a helper application, "AX", was implemented in Microsoft Access*. Once the profile has been defined (off-line) in AX, it is imported into the MTF and the actual equipment description is created and ready to be used.

4.2 Equipment Creation

Once an equipment profile has been defined in MTF, the system is able to use it to create any number of instantiations. As in our case most pieces of equipment have to be uniquely identified, a mechanism to generate and attribute identifiers (or Ids) to equipment was created.

Because the Id generation rules for the accelerator are very different from those of the LHC experimental detectors this mechanism was designed and developed with enough flexibility to accommodate almost any rule.

Generating equipment descriptions in the MTF implies also the automatic generation of all its manufacturing and test steps (with a "Pending" status) for later update.

4.3 Documents

An important feature of the MTF is the ability to associate any number of documents with equipment. Presently, links between an equipment and a document have been identified for: workflow diagrams representing the manufacturing process, applicable standards to be used during manufacturing and test, documents containing results of a test or manufacturing step and non-conformities describing a deviation from or a non-compliance with the technical specification.

Such documents being in all aspects also normal EDMS documents, can profit from all the access controls, document lifecycle features and flexibility inherent in the EDMS.

4.4 MTF Access and Update Via the Web

The consultation and update of a piece of equipment's Manufacturing and Test Folder information can be done via the Web.

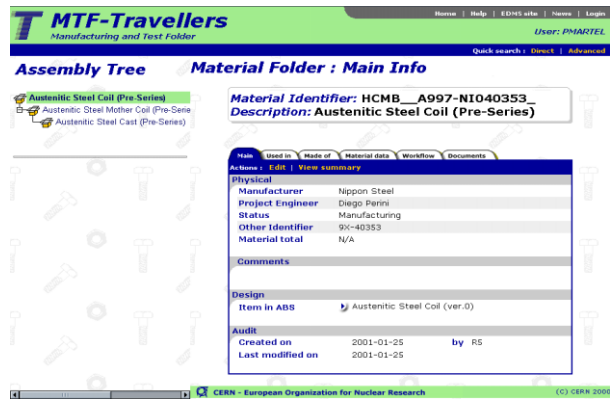


Figure 2: Equipment (Material) Main Info page

Typical aspects of a piece of equipment include information about a possible parent and/or children equipment, property values, workflow (list of manufacturing and test steps), technical specifications and any eventual non-conformities reported during manufacturing.

Typical modifications of MTF data are updates of equipment status, property values, manufacturing and test step status, test and measurement results, creation of links to documents, creation of an extra manufacturing step or the repetition of an existing one, etc.

4.5 MTF Update Via the Import Mechanism

As some users do not have a fast Internet connection and/or the amount of modifications required is too large to be done over the Web manually, an alternative MTF data update mechanism exists.

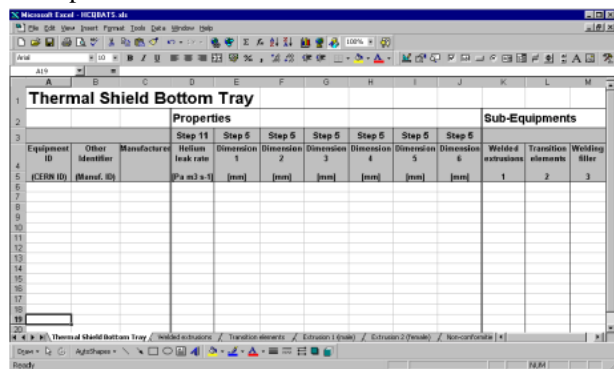


Figure 3: An equipment description Excel template.

This mechanism is based on a set of Excel "templates", worksheets generated "on user demand" from the equipment profiles in MTF. The templates are sent to the users and imported into the MTF when returned to the EDMS Service. Even though this import mechanism does not support all operations available in the Web interface, it allows the rapid update of large quantities of data in a single operation, for the most recurrent operations.

The import mechanism generates a full log of the modifications received and any resulting error messages are returned to the user for further examination and correction.

4.6 Reporting

The MTF project was initially known as the “Travellers” project. The name “Traveller” was used as the system is intended to replace a real (in contrast to virtual) notice book that accompanies every LHC magnet. The notice book (travelling along with magnet) contains a complete log of all events related to the magnet and its subcomponents lifecycle and characteristics.

To permit the MTF to replace this paper trail, the ability of the system to generate printed reports of equipment characteristics and lifecycle information was fundamental to its acceptance.

With the new possibilities available in the MTF, cross equipment reports are implemented and an “on-the-fly” report generation mechanism exists. This permits users to compare values for any set of properties across any selection of equipment, enabling a statistical production follow-up to catch drifts and monitor trends.

4.7 External Data

Sometimes not all data about a certain equipment is stored in its MTF, be it because some data is not really relevant to other users or because some data has a format that is not easily handled by the MTF. Not all equipment life-cycle data is stored in MTF, either for reasons of size and formatting conflicts or simply for absence of relevance to the overall objectives.

For those cases a link can be established between the MTF and any other Oracle database where such data is managed, i.e. a relationship can be established between a certain type of equipment and a certain table in another, externally accessible Oracle database. In this case the MTF only requires access authorization and a rule on how to select the relevant records from the external table that are related to one or more equipment Ids in MTF.

Data from external sources may also be integrated into any of the previous mentioned reports for further analysis.

5. BUSINESS AND QUALITY ASSURANCE RULES

The MTF was created in close collaboration with the LHC project Quality Assurance working group, with the result that the approved working rules for the LHC are also automatically enforced by the MTF.

This implies that if a group has business rules that conflict with the LHC Quality Assurance Plan, they can not be implemented (in the system) and must be made compliant with the QAP before using MTF.

6. USAGE STATISTICS

The number of equipment created since MTF became a production service is very encouraging, with more than 8000 equipment already being followed with MTF. (see Fig. 4).

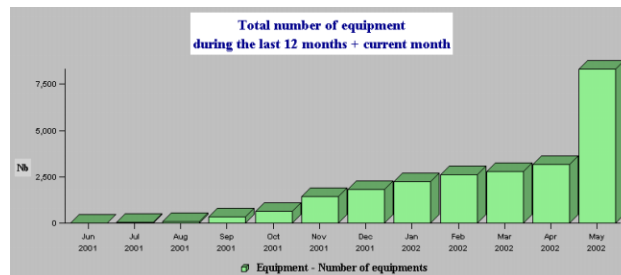


Figure 4: Total number of equipment

Also, it is interesting to monitor the growing amount of file downloads for documents linked to an equipment, as this is a good measure of how well the MTF is replacing the paper Traveller. If the MTF is consulted about the same equipment (and its associated files) from different places, it is indeed replacing several paper copies of a “distributed log book”.

7. CONCLUSION

The MTF has proven to be an appropriate tool for the follow-up of the manufacturing process of complicated equipment for the LHC. It now being extended to support other domains within the LHC project, domains where no tool existed to do such a job, or where other tools were being used or developed.

The MTF’s value as the “central point for equipment knowledge” has been demonstrated and it is now being adopted by the LHC experiments. In the end this will permit the entire LHC community to profit from common and shared knowledge of equipment management issues.

Its value as a policy enforcement tool has also been well proved during its short production life; groups that were not following the LHC-QAP for historical reasons have changed their behaviour in order to profit from MTF’s capabilities.

The MTF is also a good example where the union of two initially disjoint commercial systems results in a third system having new functionalities not existing in either of the original systems.

8. REFERENCES

[1] The CERN EDMS – Engineering and Equipment Data Management System
T. Pettersson et. al, CERN, Geneva; this conference.