

Architecture and Functions of Database Management System for Tracking and Management of Tools

Zornitsa Zaharieva¹, Roman Zahariev²

¹ Sofia University "St. Kliment Ohridski", Faculty of Mathematics and Informatics, Bulgaria

² Central Laboratory of Mechatronics & Instrumentation, 1113 Sofia

Abstract: *This work addresses the Manufacturing and Test Folder (MTF) System and in particular its extension – the Tools Folder, which will not only manage basic technical characteristics about the tools, but will also handle more advanced information like calibrations and inspection results and track changes of these over time. It will also be able to log all operations performed on the tools. The MTF and especially its web-based interface was first created to facilitate the production follow-up and capturing of test data for equipment to be installed in the Large Hadron Collider (LHC) at CERN (The European Organization for Nuclear Research). Now the functionality of MTF is being extended to also include the handling of important tools used at CERN . This new functionality of the MTF is implemented in the Tools Folder, and will become essential for the correct and optimal usage of complex and valuable tools throughout their life cycles at CERN.*

Key words: *Management and Tracking of Equipment, Tools Folder, Engineering Data Management System at CERN, MTF, Web Interface, Oracle Databases, PL/SQL.*

1. Introduction

The original idea behind the MTF was to capture information from the manufacturing and test phases for equipment to be installed in the future LHC at CERN[5]. However, several groups at CERN identified similar needs concerning the handling of complex and important tooling that is being used at CERN. Since these tools are being used in a rather different way than normal machine equipment the computerised tool to track them must reflect this.

The data kept about tools is complex and includes both basic information such as: technical parameters, inventory numbers, responsible people, parent-child relationships

among the tools, documents related to the tools; and more complicated data such as: history of all operations that have been performed with/to the tools (reception, every-day use of the tool, lending of tools inside or outside CERN, repair, calibration), details for each of these operations, and also values of different calibrations, inspections and checkups. Moreover some of the tools may be radioactively contaminated, which makes it even more important to keep track of them and the stored data must be in accordance with the adopted INB (Installations Nucleaires de Base) procedures.

2. MTF – system architecture and means for realizing it

The manufacturing and Test Folder – MTF is an integral part of the CERN Engineering Data Management System (EDMS) [6] – Fig. 1.

The CERN EDMS has a multi-tier architecture and combines the logic coming from two commercial engineering data management systems. Targeted web applications have been specially developed for the CERN users on top of these commercial tools. The main module for design data and documentation is called CADIM/EDB, which is an engineering data management system, provided by E i g n e r [2].

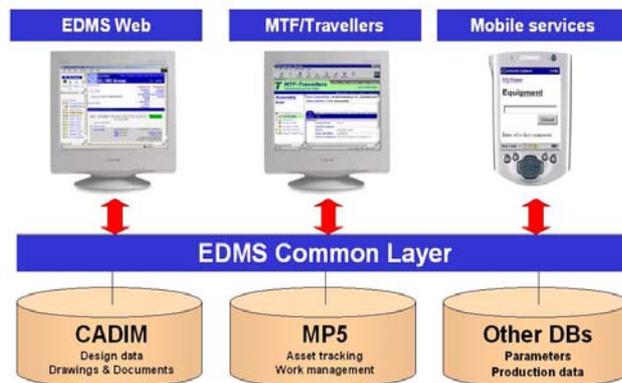


Fig. 1. The Engineering and Data Management System Architecture [6]

The module that covers equipment and work management is MP5i, which is an asset tracking and management system, developed and sold by DataStream [1].

Both of these systems are tailored to the CERN needs, using standard customisation tools and they are both integrated on a database level into one single corporate engineering information backbone.

CADIM/EDB and MP5i are based on an Oracle database, which also is the most commonly used database management system in the engineering domain at CERN.

The MTF web interface is written in PL/SQL (Procedure Language extensions to SQL). PL/SQL is a programming language, which is closely integrated into the SQL language and adds programming constructs and the flexibility of a programming language to the standard relational database language. It is a powerful programming language, and it allows the use of an object-oriented design [3].

The MTF web interface is easy to use and it separates the users from the complexity of the underlying systems. The data for every Tool is represented on a separate page that has different tabs (Main, Made Of, Equipment Data, Calibrations, Operations, and Documents) – Fig. 2.

By clicking on a given tab, the user is able to see the information related to it, to edit it and to save any changes.

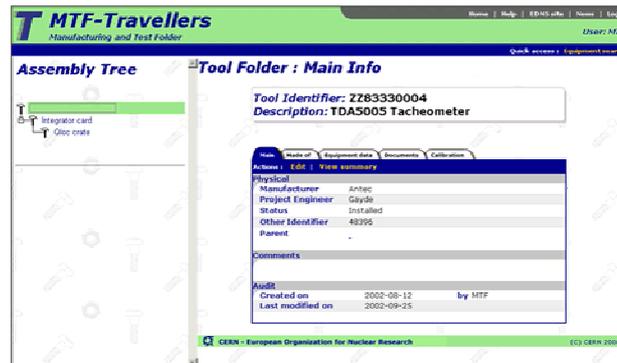


Fig. 2. Representation of a tool on the MTF web interface

The assembly tree, shown on the left side of the web page (Fig. 2), graphically depicts the parent-child relationships between the tools.

3. Functionality developed for the Tools Folder

Part of the functionality that is available for the Tools Folder is the same as the previously existing functionality for other equipment registered in the MTF: storing basic data for the tools (Main tab, Equipment data tab), referencing parent equipment or documents (Made Of tab, Documents tab). The new functionality introduced for Tools is the possibility to declare operations done with/to the tools – the Operations tab, and the option to store calibrations or inspection results – the Calibrations tab. New reports have been developed to meet the specific needs of the tooling.

The Tools Folder is highly customisable which allows easy mapping of the previously existing paper-based procedures that were used for the management and follow-up of equipment [7].

Every tool belongs to a class and a category, following a predefined classification. Profiles are created within the system on the basis of this classification.

When a tool is declared in MTF it is assigned an identifier. The tool identifiers follow the existing rules for naming equipment in MTF, which are in accordance with the quality assurance procedures, adopted by CERN for the LHC project [4].

3.1. Basic data kept for the tools

The main data kept for the tool is separated into two tabs – Main tab and Equipment Data tab. The information stored under the Main tab is one and the same for all tools, for example - manufacturer's name, status, other identifier (if it exists), project engineer (the person responsible for the tool).

The information shown on the Equipment data tab is specific to the type of the tool (its class and category) and is determined by the profile of the tool (Fig. 3). The data on both tabs can be edited and the changes saved.

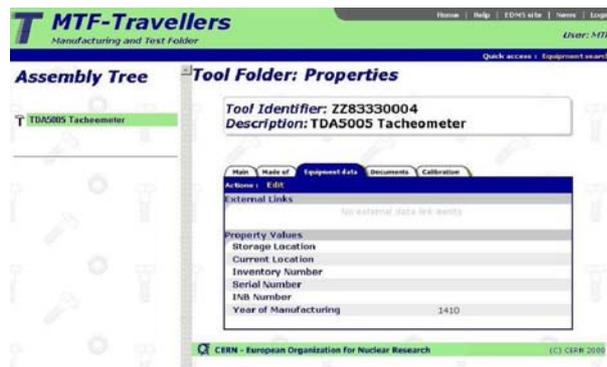


Fig. 3. The equipment data tab

3.2. Parent-child relationships

The tab Made Of gives information and keeps track of the relationships between the tools. The user can find there a list of all “children” declared for a particular tool, and can click on a link to go directly to the web page with the information for the child.

A child can be a tool or any other equipment declared in MTF (component, material, etc.)

There is a step-by-step wizard for attaching and detaching a child – it guides the user through a sequence of web pages that helps him to select the proper child.

3.3. History log of all operations

Part of the new functionality for the Tools Folder, which is still under development, is found under the Operations tab. This is a list of all operations that are performed on a tool (e.g. Reception, Check-up, Loan, Repair, Measurement, Calibration, etc).

The equipment that is declared as tools is comparatively hard to track, since it constantly moves from one place to another, it is used by different people, in different projects. For this reason the procedure for declaring a new operation should be very flexible and cover all possible situations and operations that might need to be registered. The user has the option to create an operation from the web interface without the need to predefine it as part of a sequence of operations.

Every operation has a status and a result so at any moment the user knows whether a particular operation has finished and what the outcome of it was. Other attributes that are kept for every operation include duration of the operation, starting date, location, person responsible for the tool during the operation, etc. Documents that are created in EDMS can also be attached to the operation.

3.4. Calibrations

Another new feature of the MTF web interface is the possibility to store calibration or inspection results for the tools (Fig. 4).

The list of attributes that have to be inspected depends on the tool’s profile and is different for the different classes declared within the system.



Fig. 4. The calibrations tab

3.5. Attaching documents

Attaching a document to a tool is a reasonably simple operation, since the Tools folder is a part of the Engineering Data Management System (the tool for handling technical documentation at CERN). Any document, including drawings and CAD-models, previously declared in EDMS can be referenced by a tool. If it is not declared, the Tools interface gives the user the option to create the document first within EDMS and after that to make a link to the tool.

3.6. Reporting utilities

There is a set of reports developed specially for the needs of the users of the Tools Folder.

Each report can be accessed from a web-page, where the user can fill in a form with the filtering criteria (an example is shown in Fig. 5).



Fig. 5. An example of a web-page for entering filtering criteria

The report is generated on-line and the user can immediately see the report results on the screen – Fig. 6.

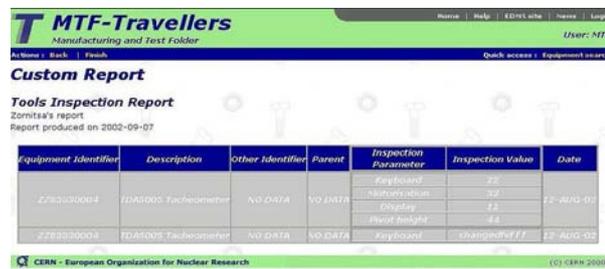


Fig. 6. An example of a generated report web-page

4. Wireless terminal access

To facilitate the usage of the MTF and consequently the usage of the Tools Folder, users will also be able to work with the system from wireless mobile terminals in the near future.

These hand-held devices are equipped with a barcode reader for simplifying input of data and ensuring that information for the correct equipment gets registered in the system.

Communication with the Internet is achieved either through the use of a Wireless Local Area Network (WLAN) or over a normal GSM connection [8].

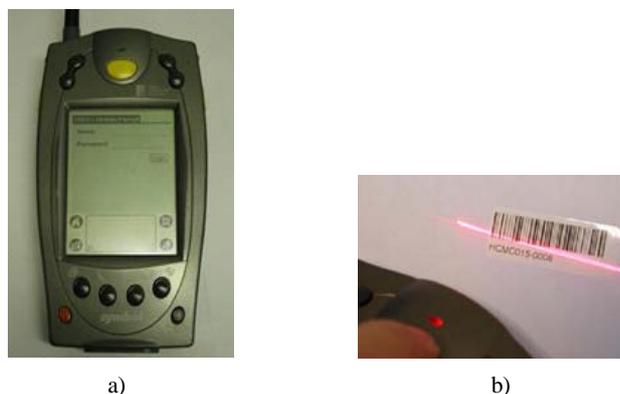


Fig. 7. An example of Symbol's SPT 1734 terminal that can be used for accessing the web interface through a wireless connection

The users will be able to receive information for a particular tool, to check its status or to view the last calibration results. In addition they will be able not only to browse through this information, but also to change it and to immediately send the updates for the tool they work with back to the system. The main advantage, of course, is that all this can be done independently of location and the data can be checked or reported back to the central database directly from where the actual work is taking place.

5. Conclusion

The Tools Folder was developed in order to facilitate the users in their every day management of tools. There have been different methods, previously used (e.g. paper forms) in order to keep a record of the operations done with/to a tool, check-up results, status and state changes. All of the previously used methods proved to be rather tedious and inefficient.

The first users of the new Tools folder will be the Positioning Metrology and Surveying Group (SU) from the Engineering Support and Technology Division (EST), and the Magnet Test and Analysis Group (MTA) from the LHC Division at CERN.

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Архитектура и функции на система за управление на данни при проследяване и контролиране на инструменти

Зорница Захариева¹, Роман Захариев²

¹ *Софийски университет "Св. Климент Охридски", Факултет по математика и информатика*

² *Централна лаборатория по мехатроника и приборостроене, 1113 София*

(Резюме)

Статията разглежда система за проследяване и управление на информация за налични инструменти и в частност нейното файлово разширение (TF). Системата съдържа не само основните технически характеристики на инструментите, но също така и актуална информация като калибровка, резултати от технически прегледи и промени във времето. Тя също така съхранява всички операции, извършвани върху инструментите. Системата и нейният Web-базиран интерфейс бяха първоначално създадени с цел да облекчат събирането и отразяването на данните от тестване на екипировката, инсталирана в големия ускорител (LHC) на Европейския център за ядрени изследвания (CERN). Понастоящем работата на системата е разширена така, че включва информация относно всички важни инструменти, използвани в CERN. Тази нова възможност е включена в TF и ще бъде съществена част от правилното и оптимално използване на сложни и ценни инструменти по време на техния работен цикъл в CERN