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**COMPUTERIZED ASSET MANAGEMENT AND
MAINTENANCE SYSTEMS IN ST**

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Abstract

The ST division manages and therefore maintains the CERN technical installations. A maintenance database application exists for every technical domain. A total of six different databases were built during the last 10 years and are based on the RAPIER maintenance program. As the Computerized Asset Management and Maintenance Systems (CAMMS) technology has evolved, the RAPIER system has become obsolete. Therefore we are forced to migrate to its latest version, MP5, before the year 2000. The migration path must be defined, leading from the current situation to a fully operational MP5 application. The major elements of each migration path consist in determining the functionality to use, defining the operation of it, adapting and/or creating procedures, converting data and providing training. A migration is always a process of change. The migration presents a unique opportunity to evaluate the current implementations, adapt them to the requirements and exploit the new features offered. Obsolete data and inconsistencies will be removed and the errors corrected.

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1 INTRODUCTION

The ST division manages and therefore maintains the CERN technical installations. There is a maintenance database-application (running RAPIER R4 product) in every technical domain of the division, i.e. Cooling and Ventilation for Accelerators and Sites, CERN Patrimony Civil Engineering, Telecommunications, Access Control, Personnel Safety, Heavy Handling and Transport, Power Suppliers and Electricity for Accelerators and Sites. Many people in the division work on the maintenance of the installations and most of us are directly or indirectly concerned with it.

The Computerized Asset Management and Maintenance System (CAMMS) technology has evolved a lot and now is the moment to move to this new technology. For this, it is first necessary to redefine needs, clean up all the ST Maintenance Technical Installations databases and redefine the maintenance procedures. The new product, MP5, has to be in production for the end of 1999, so we have to make up our minds and hurry up! The migration to the new product is a difficult process: It requires the participation of many different people, working hard and carefully. A divisional project has been defined for that purpose. A common divisional strategy seems mandatory, not only for the migration process but also especially in the future for applying a unique and standard maintenance in all the groups.

2 MIGRATION PROCESS

In general, for all the installations of MP5 a migration path must be defined, leading from the current situation to the desired one of a fully operational MP5 system. Each migration path contains some general elements like training, determining which functions to use and how, adapting and/or creating procedures, and also data conversion if certain (basic) data exist in an electronic format.

A migration is always a process of change of which the impact on the organization depends on the differences between the existing and the new situation. The impact could be relatively small if the existing situation is a previous release of MP5 and could be enormous if the existing situation does not involve a computerized maintenance at all. Somewhere in between these two extremes is the migration to MP5 starting from an old RAPIER V4I release, which is our case, and which will be discussed in detail below.

2.1 The migration to MP5 involving a conversion from RAPIER 4

Although MP5 has been based on RAPIER V4I.20, the migration to MP5 should not be underestimated. The navigation has been completely redesigned, and the functionality has been enhanced significantly. Which functions to use and how are still questions to be answered.

Also, many years of using and developing RAPIER resulted in a unique database, which could contribute greatly to the added value of MP5, although not necessarily by converting all data in the R4 database as straightforwardly as possible. In fact the migration to MP5 presents a unique opportunity to evaluate the current implementation and adapt it to the current requirements and the new possibilities offered by MP5. Obsolete data can be removed, errors corrected and inconsistencies removed. In this light, the conversion path must

be seen as a starting point, which should be adapted to the customer's need for an optimal result. The data conversion can then form an integral part of the total migration process.

3 MIGRATION PREPARATION PHASE

This section presents the steps to be followed in a migration to MP5, see Refs. [1]–[2]. Only the steps which require a special effort and involve the collaboration of different groups are discussed in detail.

In a first phase the following steps are identified:

- 1) Clean up of the current database,
- 2) General Information set-up in MP5,
- 3) Definition of Asset's basic data,
- 4) Definition of Stores' basic data,
- 5) Definition of Work's basic data,
- 6) RAPIER data conversion and migration (when possible, for steps 2–5),
- 7) History migration.

3.1 Clean up of the current database

RAPIER version 4 was originally an Oracle V5, SQL*Forms 2.0 application. Subsequent releases have been adapted to Oracle V6 and Forms 3.0 but inherited the technical limitations of the original. Of importance here, and one of the fundamental differences with the new Oracle 7 based MP5 is the increased level of consistency checking in the database. In MP5 most, if not all, dependencies that exist between tables and columns are explicitly enforced by means of database constraints. In R4 only two types of constraints have been enforced:

- primary key (through the definition of a unique index for each table) at table level
- not null, at column level.

All other dependencies and restrictions were taken care of in the RAPIER application itself. This gave ample opportunity to 'correct' most unwanted results of a premature *commit* using the Oracle tool SQL*Plus. As a result of these corrections and (occasionally) bugs in RAPIER functions or previous conversions, the existence of orphans (child records of which the parent has been deleted), strange values and funny code is not unlikely and the number of inconsistencies is expected to increase with the age of the database.

Therefore it has been decided that all known inconsistencies, i.e. all the inconsistencies that will violate an MP5 constraint if converted without correction, and a number of others, must be corrected prior to the actual data conversion. To this purpose, R4 database is monitored for suspected inconsistencies and listings of all detected inconsistencies are produced. Corrections must then be carried out using the R4 functions or, more likely, SQL*Plus, according to the customer's requirements: In the case of 'orphan' records the customer may decide to remove the orphan, to nullify the reference, or to add the missing parent. The removal of one record may itself create new orphans: Monitoring and correcting inconsistencies is an iterative process which must be repeated until the last monitoring run yields no further inconsistencies.

3.2 Definition of MP5 data

MP5 General Information, Asset's basic data, Stores' basic data, and Work's basic data have to be defined by each service following the guidelines given by the ST Maintenance Project Working Group. The process should be the following:

- define new needs,
- study current implementation in order to identify obsolete elements (mark them as not to be considered for the migration) and still valid elements which might have to be converted to map the new needs,
- define new needs not solved with any valid element existing in the old system,
- prepare a Migration Specifications document containing the results of the above study,
- present the Migration Specifications document to the ST Maintenance Project Working Group for approval.

4 MAINTENANCE SYSTEMS IN ST

In ST division there exist a total of six RAPIER maintenance databases plus one COSWIN database (HM group). An overview of the dimension of each database in terms of number of main type of objects (equipment, systems, classes, routines, stock, users) and type of maintenance done are presented respectively in Table 1 and Table 2.

Table 1
Overview of ST Technical Installations Maintenance databases: objects managed

Technical Installation	No. Equipment	No. Systems	No. Classes	No. Routines	Stock article	No. Users
Cooling Ventilation	36290	91	211	883	17003	12
Civil Engineering	-	17	13	-	-	14
Electricity	91504	11	177	100	-	70
Monitoring and Control	19488	111	55	615	-	50
Heavy Handling	2800	22	7	1300	17600	14

Table 2

Overview of ST Technical Installations Maintenance databases: type of interventions

Technical Installation	Preventive Maintenance	Conditional Maintenance	Corrective Maintenance	Improvement
Cooling Ventilation	X	X	X	X
Civil Engineering			X	
Electricity	X	X	X	X
Monitoring and Control	X		X	
Heavy Handling	X		X	X

5 STRATEGY PLANNING

5.1 Strategy

A divisional strategy has been defined; we can summarize its main points as follows.

- 1) CERN-wide databases are used: personnel, budget codes, currencies, suppliers, stores.
- 2) ST-wide databases are used: CERN Patrimony.
- 3) The LHC Naming convention has to be followed for the codification of objects. This consists in beginning with the letter/s assigned for the System/Subsystem to which the objects belong. In ST we have decided to go further in the application of the LHC Naming convention and apply it not only to the objects (maintained) but also to other main elements of the system.
- 4) The ST Maintenance Working Group should define, for all of ST division, standards concerning the following elements:
 - job type;
 - job status;
 - procedures (divisional, group) where the different sequences of actions during interventions are specified;
 - job card;
 - criteria for retrieving information concerning the interventions;
 - safety permits;
 - conditions for interventions (shutdown machines, etc.);
 - job priorities;
 - requirement, action, cause and failure codes;
 - performance indicators.

The objective is to define a common way of doing maintenance, based on a standard set of maintenance procedures, a common language, and supported by a unique CAMMS.

5.2 Planning

- Study and definition of the Migration Specifications document, to be done in parallel in all the groups (see Ref. [2]).
- Pilot project with the Telecom service. The aim is to prepare and test the migration process tools and programs, get experience and test the MP5 product itself, and evaluate the support and training given by the MP5 vendor. This is foreseen for the end of February and the training is scheduled for the middle of February.
- The first MP5 training session is addressed to the Telecom team plus all the ST Maintenance Managers.
- As soon as the pilot project is in production and validated, start the migration of the other services.

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References

- [1] User's Guide: MP5 Version 5.4, Datastream Sysems, Inc.
- [2] Pedro Martel (EST/ISS) and Eva Sánchez-Corral (ST/DI), Rapier DB Migration Procedure to MP5. ST Division RAPIER Migration Process (draft). Presented to ST Maintenance Working Group 11/12/98.