

EUROPEAN ORGANIZATION FOR NUCLEAR
RESEARCH

ENGINEERING DEPARTMENT

Upgrade of laser and electron beam welding database

Summer student project

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Abstract

The main purpose of this project was to fix existing issues and update the existing database holding parameters of laser-beam and electron-beam welding machines. Moreover, the database had to be extended to hold the data for the new machines that arrived recently at the workshop. As a solution — the database had to be migrated to Oracle framework, the new user interface (using APEX) had to be designed and implemented with the integration with the CERN web services (EDMS, Phonebook, JMT, CDD and EDH).

1 The problem

The project description includes fixation of bugs and errors in existing database solution. After a detailed study of the existing application and the database design, it has been decided to migrate the database to Oracle — framework that not only has a support from the company side, but also there exists a dedicated department at Cern (IT-DB) that will take care of backups and database maintenance. In addition to the database, a new, user-friendly user interface will be implemented.

1.1 Analysis of existing solution

The existing database have been created in 1996. During this time, the database have been user intensively but no maintenance work have been performed on it and it was simply upgraded to be compatible with the new version of Microsoft Access. This resulted with multiple not desired pop-ups showing up randomly during the usage of the program as well as before even opening it, outdated, not user-friendly user interface, not working features (e.g. look up of personnel details in the Phonebook), database not suitable for having new machines at workshop. All the errors and not working features had to be recreated in the new solution. Moreover, the old database had a form of a .mdb file, which was shared to all the operators by access to the server on which the file was stored.

The design of the old database is presented in the Fig. 1. There were existing multiple violation of the basic database design rules: not atomic columns, tables without primary keys, data redundancy, allocation of the memory with multiple null values.

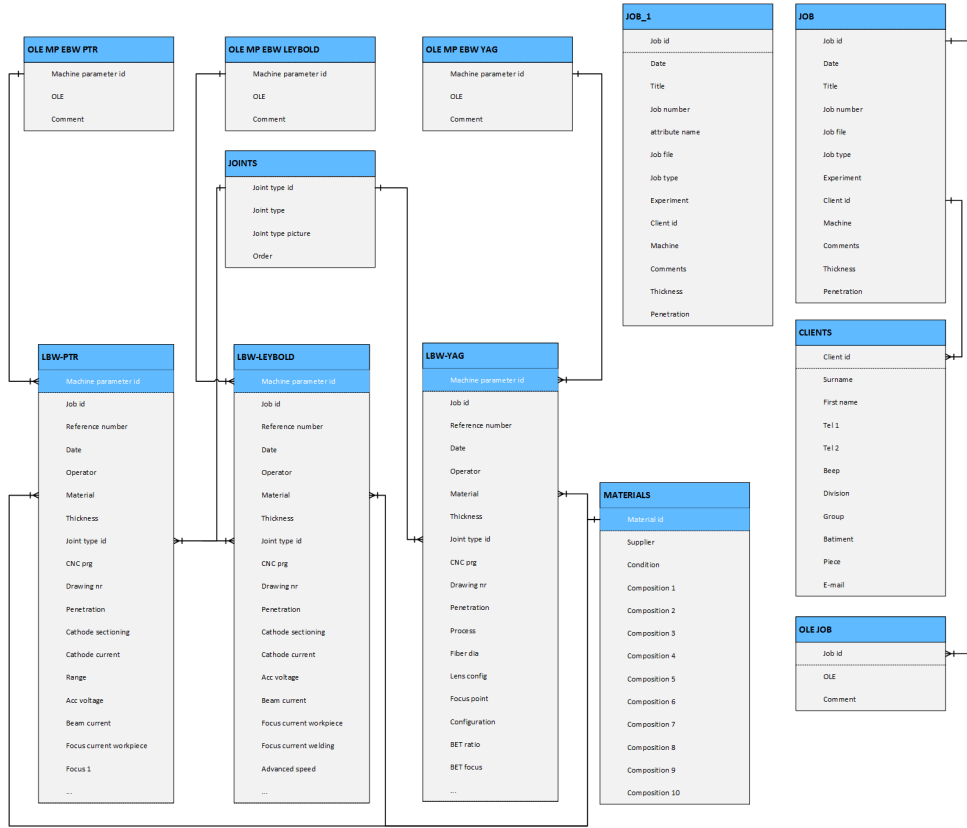


Figure 1: Old database design

2 Solution

As an easy solution for all above mentioned problems, a fix for the undesirable pop-ups in the existing user interface could be applied and a new table for the new machine could be added. However, this would not resolve all the issues that appeared during the eighteen years of the database usage. As a better, long-term solution the redesigning, the implementation of the database, migration of the data from old database to the new and development of the new user interface for accessing the data have to be performed. In this case, to provide the portable access to the database, it has been decided to develop a web application. The web application will be communicating with multiple web services that exist at Cern (EDH — materials, JMT — job itineraries, CDD — drawings, and Phonebook — detailed contact information to client and operator of a job) (Figure 2). Since the database will not replicate the data stored in all external databases (EDH, JMT, etc.) and will only store a specific link to it (e.g. job number, person ID) the data outdateness have been prevented.

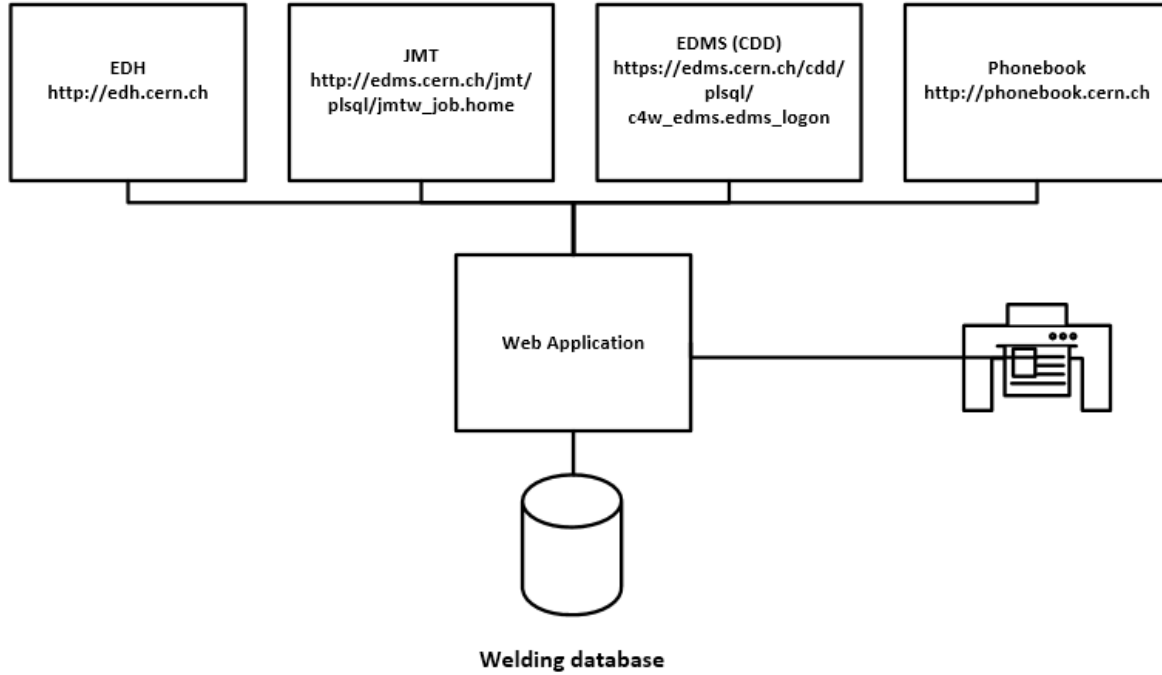


Figure 2: Architecture of the new system

2.1 Database design

The database have been redesigned using Oracle database framework. All tables in the database have primary keys and the relations between tables have been established by use of foreign keys. Additionally, the uniqueness and presence of some of the values in the database have been enforced by appropriate constraints in order to achieve the continuous integrity. To optimize the access to data, indexes on foreign keys have been introduced. Moreover, to maintain the data removal, appropriate „delete on cascade” foreign keys were applied, so that the child entities that were belonging to the parent („has-a” relation) were removed when the parent was removed. The database have been also extended to hold the parameters for the new welding machine. The database diagram is presented in Appendix A.

2.2 User interface

In order to provide easy access to the database, appropriate user interface had to be designed. It has been decided to implement the web application, so that the access to the database will be possible by use of any device with Internet connection and a browser. This gives an opportunity to have e.g. a tablet while using the welding machines and inputting the parameters to the database in real time. The sample pictures of crucial screens are presented in Appendix B.

3 Implementation

The whole process of system development have been started with appropriate requirements specification and documentation. Multiple discussions with machine operators

have been performed about existing issues and suggestions that they had in mind regarding new features of the new database and web application. To document the discussion results, some of the UML diagrams (e.g. use case, architecture) together with database scheme have been created to plan what and how has to be implemented.

The database design have been implemented using Oracle framework. Since there exist a web application framework compatible with Oracle databases — Application Express (APEX) — it has been decided to use this framework while developing the web application. The web application have been shown few time to the operators while development phase in order to gain the feedback about the implemented features. Moreover, the web application have been carefully tested at the end of the project on Internet Explorer and Mozilla Firefox. However the implementation have been performed under Mozilla Firefox and using this browser the user get the best impression from the user interface.

The database right before the deployment to production have been tested by the machine operators and one hour training have been given to them. After one hour of a demo explanation how things are working, the operators were fully able to use the application. This proves that the user interface have been designed in an intuitive and user-friendly way.

4 Future work

The database and the web application could have a person from IT-DB department that will take care of their maintenance. The temporary solution for report generation has to be replaced by the new report generation inside web application when the Apex Listener will be supported by Cern (in few months from now). Moreover a specific graphic designer could be employed here in order to optimize and polish the web application layout. As mentioned at my last presentation of web application — it could be useful to have the possibility of assigning multiple EDMS links to a job, as well as the possibility of creating a sister job. Unfortunately, due to the tight time schedule, these two features were not implemented.

5 Conclusions

The new database and web application have been successfully created. All requested features have been implemented and existing bugs have been resolved. The new system provides the possibility for creating sister parameters, look up of the calculated parameters, access from portable devices, integration with Cern web services, report generation and improved search of jobs and parameters. The data from the old database have been migrated to the new one, as well as an appropriate data clean up have been performed. Personally, I think I gained significant experience and I improved a lot my knowledge in database and web application design.

A Database design

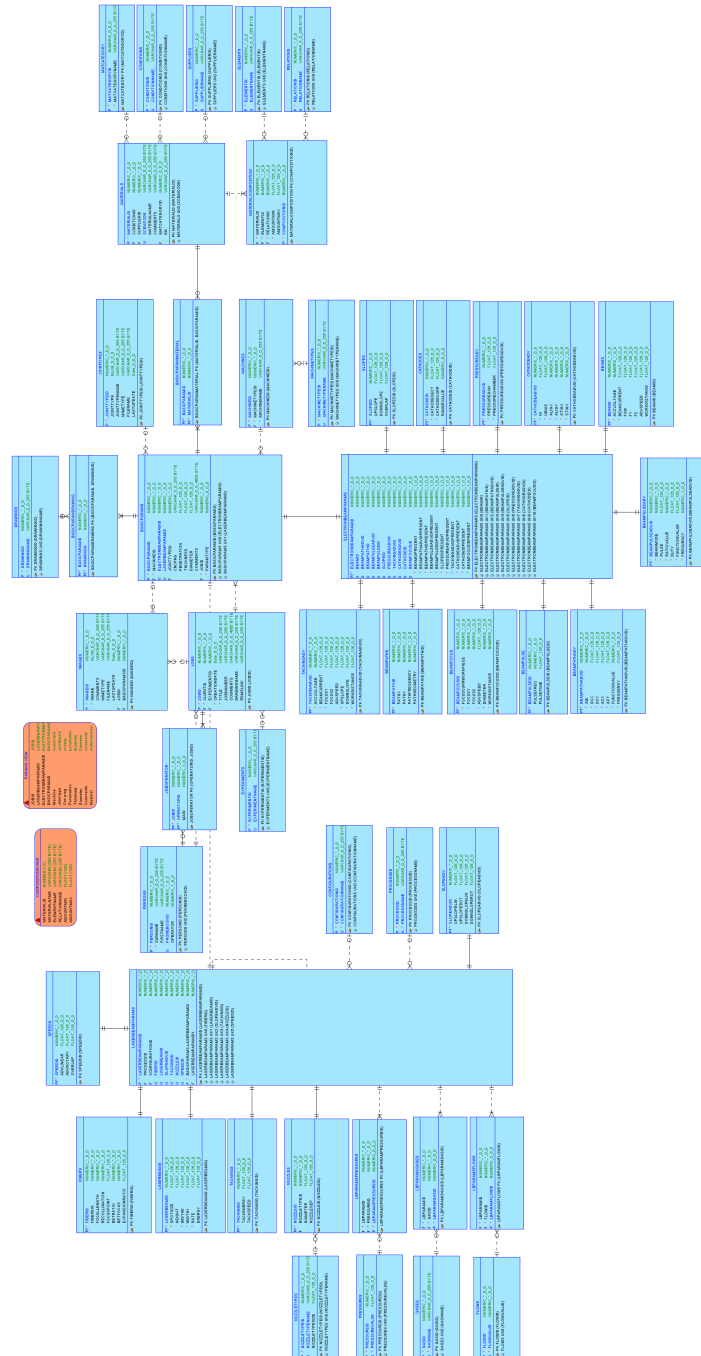


Figure 3: The logical representation of database design

B Web application screens

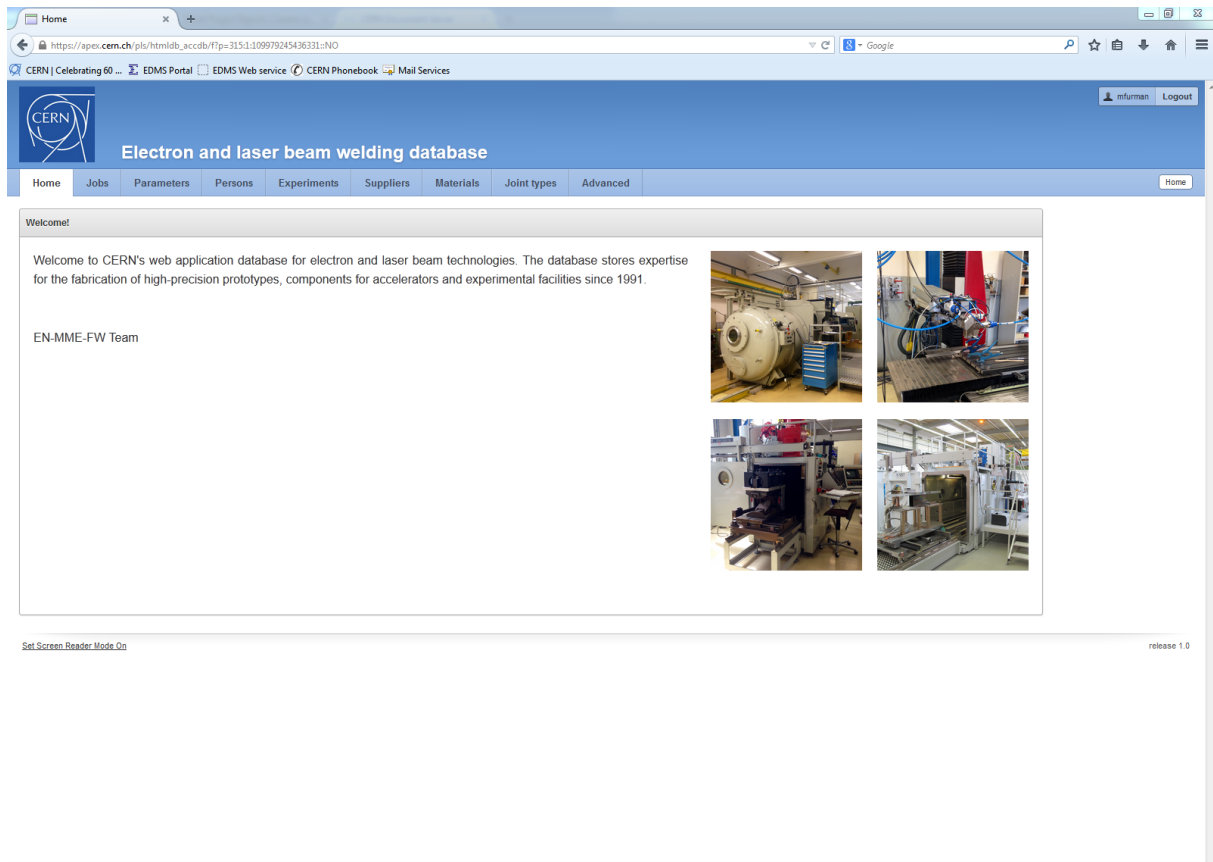


Figure 4: Home page of the web application

	Creation date	Title	Operator	Client	Experiment	Job number	Drawing	Edms link	Comments	Image
	27-AUG-14	Cavité monocellule	TARDY THIERRY	CALATRONI SERGIO	SPL	J3014084	-	-	Assemblage d'une monocellule	 Download Show
	27-AUG-14	TCDS Front panel LPM	SEXTON IAN	PEZZULLO GIUSEPPE	TCDS	J3019560	-	-	-	 Download Show
	27-AUG-14	Liner (Semion) chamber	SEXTON IAN	LEGGIERO LUIGI	SPS	J3019095	-	-	Laser cutting - three rectangular shapes	 Download Show
	27-AUG-14	Connectors for NA62 GTK micro-cooling	SEXTON IAN	ROMAGNOLI GIULIA	NA62	J3016240	-	-	-	 Download Show
	27-AUG-14	LIEB - Pb-Bi loop target shower plate	SEXTON IAN	DELONCA MELANIE	ISOLDE	J3012307	-	-	Drilling Ø100µm holes in 0.5mm stainless steel plate. Total number of holes = 55 000	 Download Show
	27-AUG-14	Silicium sreen	SEXTON IAN	MAZZONI STEFANO	CTF	-	-	-	SILICIUM WAFER CUTTING	-
	26-AUG-14	SMC Bladders	SEXTON IAN	PEREZ JUAN	HL-LHC	J3018331	-	-	-	-

Figure 5: The view of a job list

Jobs

https://apex.cern.ch/plc/htmlidb_devdb11/ftp=312736452403134434:NO=PT73_JOBID:5690

CERN | Celebrating 60 ... EDMS Portal EDMS Web service CERN Phonebook Mail Services

admin Logout

Electron and laser beam welding database

Home Jobs Parameters Persons Experiments Suppliers Materials Joint types Advanced

Edit job

Cancel Delete Save < >

Title * Cavité monocellule Experiment SPL Generate Report

Operator * TARDY THIERRY Creation date * 27-AUG-14

Client CALATRONI SERGIO Job number J3014084

Drawing Edmslink

Comments Assemblage d'une monocellule

1062 of 1067

Parameters

Edit	Parameter number	Machine	Joint type	CNC program	Penetration	Thickness	Diameter	Comments	Create sister parameters
	-	LEYBOLD	-	-	-	-	100	-	
	-	PTR	-	2	-	373	Soudage de l'équateur		

1 - 2

Images

Edit	Image	Comments
		Pointage avec outillage (Collier)
		-

1 - 2

Figure 6: The view of a single job

Parameters

https://apex.cern.ch/plc/htmlidb_devdb11/?p=31281:6452403134434:SAVE:NO=P81_BASICPARAMID,P81_MACHINEID,P81_JOINTTYPED:16363,2

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admin Logout

Electron and laser beam welding database

Home Jobs **Parameters** Persons Experiments Suppliers Materials Joint types Advanced Home

Edit basic parameters
Cancel Delete Save

Machine PTR Type ELECTRON Joint type
CNC Prg Penetration [mm] 2 Thickness [mm]
Parameter number Diameter [mm] 373
Comments Soudage de l'équateur

Edit electron-beam parameters

Beams

Acc Voltage [kV] 60 Beam Current [mA] 25 Focus current workpiece [mA] Focus 1 [mA] 1000
Focus 2 [mA] 455 Adv speed [mm/s] 15 Work distance [mm] 300

Beam path

Path X 20 Path Y 20 Frequency [Hz] 200 Geometry 5

Beam pulse

Frequency [Hz] Time [%]

Slope

Up Slope [mm/"] 5 Down Slope [mm/"] 5 Overlap [mm/"] 10

Tacking

Acc Voltage [kV] 60 Beam Current [mA] 25 Focus 1 [mA] 1000 Focus 2 [mA] 455
Adv Speed [mm/s] 15 Up Slope [mm/"] 5 Down Slope [mm/"] 5 Work Distance [mm/"] 300

Figure 7: The view of a single machine parameters