

CERN Controls Configuration Service a challenge in usability

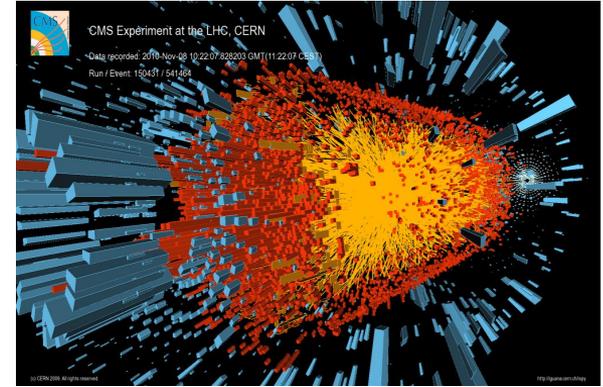
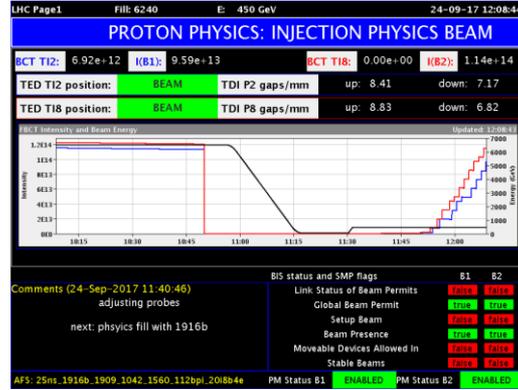


Lukasz Burdzanowski

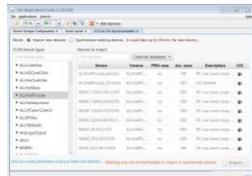
**CERN European Organisation for Nuclear Research
Beams Department**

ICALEPCS 2017 TUBPL01

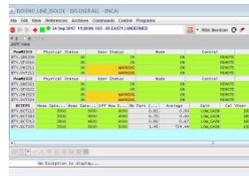
Control system applications



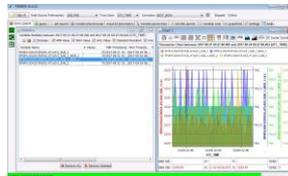
Critical, robust, performant, tailored - prerogatives of control system software applications.



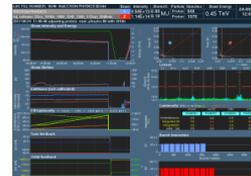
Meta-data



Settings



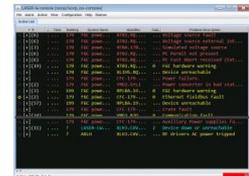
Acquisition



Monitoring



Diagnostics



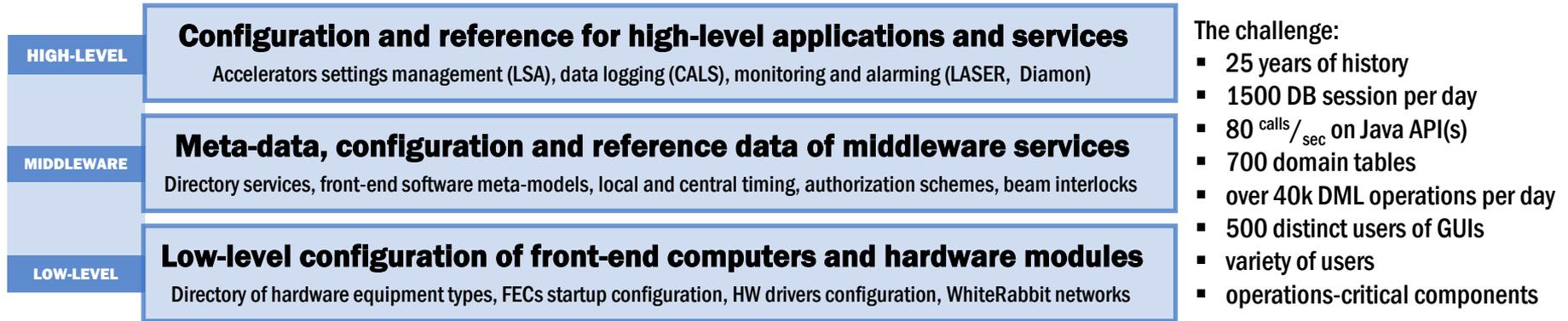
Safety

Easy to use? Intuitive and usable? Ergonomic and delivering good user experience?

**Usability is not the main goal for controls applications,
yet it should not be left unconsidered.**

Controls Configuration Service at CERN

The main purpose of the CCS: **centralize** all the information relevant to the Control systems.



The CCS provides database, tools and services enabling access to the Control systems configuration data.

One of the key challenges of the CCS: diversified and vast groups of users, functions and a multitude of domains and sub-system-specific extensions.

In order to improve usability and ergonomics of the CERN Control system configuration, a new tool, the Controls Configuration Data Editor (CCDE) has been designed with the goal of providing a single and user-oriented view of all Control System configuration data.

Usability in control system applications

Qualities of usable software applications:

**low learning curve, intuitive, context-oriented,
tailored to user role and situation, reliable.**

Aspects to be considered when aiming at high usability:

**attention to visual consistency, context-oriented workflows,
concise behaviour reflecting real-life situations,
encapsulation of system complexity.**

The subject of usability is formalised by dedicated ISO standards:

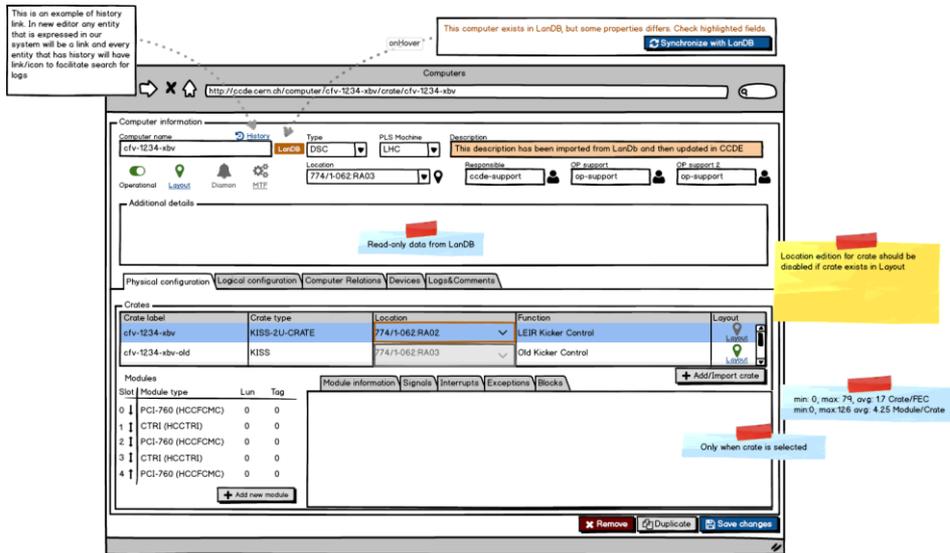
- ISO/TR 16982:2002 Ergonomics of human-system interaction: [Usability methods supporting human-centred design.](#)
- ISO 9241-210:2010 Ergonomics of human-system interaction: Part 210: [Human-centred design for interactive systems.](#)



User interfaces: design challenge

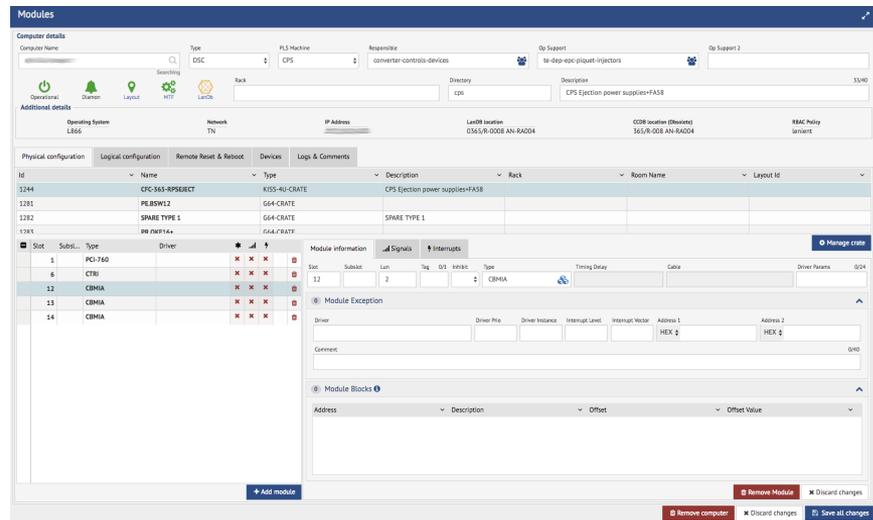
When designing and developing interfaces, not only graphical ones, the biggest challenge is always the same:

how to satisfy real needs of our users?



Wireframes based design and screen mockups are an indispensable tool to gather users feedback.

The mockups can help to describe complete real-life workflows and scenarios thus greatly reduce overall development time.



User interfaces: visual consistency

Window labels

The screenshot shows a web application interface for managing devices. The main window is titled "Devices" and contains several sections:

- Computer details:** A form with fields for Computer Name (ccdb_internal_dev), Type (DSC), PLS Machine, Responsible (Lukasz Burdzanowski), Op Support, and Op Support 2.
- Additional details:** A section with icons for Operational, Diamon, Layout, MTF, and LanDb. It includes fields for Rack (RA-FO_R047=774), Location (774/R-047), Directory, and Description (Only for CCDB data management).
- Additional details (table):** A table with columns: Operating System, Network, IP Address, LanDB location, CCDB location (Obsolete), and RBAC Policy. The CCDB location is /abc FEC NOT IN NETWORK and the RBAC Policy is lenient.
- Configuration tabs:** Physical configuration, Logical configuration, Remote Reset & Reboot, Devices, and Logs & Comments.
- Table:** A table with columns: Class N, Class Vt, Device I, Device, Description, Implem, Acceler, State, In Laser, In Lsa, In Cals, In Oasis, and Respo. It contains two rows of data for CCSTest devices.
- Footer:** A bar with buttons: Remove computer, Discard changes, and Save all changes.

Core context location

Unified icons

Context separation

Streamlined UI grids

Window labels, location and color-code of buttons, icons, UI grids behavior, fields labeling, separation of core-context from specific details: all these aspects make an UI consistent.

Buttons location and color code

User interfaces: visual consistency

Devices

Computer details

Computer Name: ccdb_internal_dev | Type: DSC | PLS Machine: | Responsible: Lukasz Burdzanowski | Op Support: | Op Support 2: |

Additional details

Class N	Class V	Device I	Device V	Description	Implem	Acceler	State	In Laser	In Lsa	In Cals	In Oasis
CCSTest	0	CCSTest			FESA2		development	×	×	×	×
CCSTest	0	NONECSTI		It's a NONE device	FESA2		development	×	×	×	×

Remove computer | Discard changes | Save all

Commonly accessed configuration data

Module Blocks

Hardware Type Information

Hardware Type: ABT_BIDISFIS_S1 | Equipment Code: | Layout: | Obsolete EQ Code (CCDB): | Description: Slave card #1 for BIDIS Fast Interlock System (1xSVEC+2xFMCSCHDIO) | 66/70

Block	Address	Offset	Description	Offset	Depth	Word	Rwmc	Name	Descri	Timel	Role	Mask
0	1	0	All registers block		0	uint64	r	INST_NAM	Installatic			
8					0	uint32	r	SYS_NAM	System na			
12					0	uint32	r	SYS_REF	System Re			
32					0	uint32	r	MASTER	Master/Sl			
20					0	uint32	r	PCB_VERS	PCB versi			
24					0	uint32	r	INTLCK_C	Interlocks			
16					0	uint32	r	HDL_CON	HDL gate			

Remove Hardware Type | Discard changes | Save all changes

Expert-level configuration

Within a single tool, the CCDE, two different groups of users: FECs users and HW experts defining dictionary of equipment types benefit from the unified UI.

Core concepts of the UI remain consistent across different views and domains.

Context oriented workflow: expert vs common UIs

Modules

Computer details

Computer Name: [Search] Type: DSC PLS Machine: CPS Responsible: converter-controls-devices Op Support: te-dep-epc-pliquet-injectors Op Support 2: [Search]

Operational Diamond Layout HTP LanIDb

Additional details

Operating System: L866 Network: TN IP Address: [Search] LanDB location: 0365/R-0008 AN-RA004 CCD location (Obsolete): 365/R-008 AN-RA004 RBAC Policy: lenient

Physical configuration Logical configuration Remote Reset & Reboot Devices Logs & Comments

Id	Name	Type	Description	Rack	Room Name	Layout Id
1244	CFC-365-RPSEJECT	KISS-4U-CRATE	CPS Ejection power supplies+FA58			
1281	PEBSW12	G64-CRATE				
1282	SPARE TYPE 1	G64-CRATE	SPARE TYPE 1			
1283	DRIVE16+	G64-CRATE				

Slot Subslot Type Driver

1		PCI-760		x	x	x	x
6		CTRI		x	x	x	x
12		CBMIA		x	x	x	x
13		CBMIA		x	x	x	x
14		CBMIA		x	x	x	x

Module information Signals Interrupts

Slot Subslot Lun Tag O/1 Inhibit Type Timing Delay Cable Driver Params

12		2				CBMIA			Q/24
----	--	---	--	--	--	-------	--	--	------

Module Exception

Driver Driver Prio Driver Instance Interrupt Level Interrupt Vector Address 1 Address 2

Comment

Module Blocks

Address	Description	Offset	Offset Value
---------	-------------	--------	--------------

+ Add module Remove Module Discard changes Remove computer Discard changes Save all changes

Immediate access to **advanced information** is essential for expert users.

The UI design represents the **natural flow**: FEC HW configuration > startup sequence > operations..

Context oriented workflow: expert vs common UIs

Physical configuration

Physical crate layout representation facilitates use by HW experts

Id	Description	Rack	Room Name	Layout Id
713	VME	Instrumentation: SEMGRID		

Slot	Subslot	Type	Driver	*
1		MEN-A20		×	×	×	
1	0	CTRP		×	✓	×	
3		BI_ADC36		×	×	×	
4		BI_ADC36		×	×	×	
5		BI_ADC36		×	×	×	
6		BI_ADC36		×	×	×	
7		BI_ADC36		×	×	×	
8		BI_ADC36		×	×	×	
9		TVME200		×	×	×	
9	0	IPOCTAL		×	×	×	

Module information | Signals | Interrupts

Advanced configuration options are easily accessible yet hidden as used infrequently

Slot	Subslot	Lun	Tag	0/1	Inhibit	Type	Timing Delay	Cable	Driver Params	0/24
3		0				BI_ADC36				

0 Module Exception

1 Module Blocks

Address	Description	Offset	Offset Value
1			0

+ Add module

Remove Module Discard changes

Immediate access to **advanced information** is essential for expert users.

The UI design represents the **natural flow**: FEC HW configuration > startup sequence > operations..

Context oriented workflow: expert vs common UIs

Physical configuration | Logical configuration | Remote Reset & Reboot | Devices | Logs & Comments

Computer family

Copy sequence

Layout of the screen remains unchanged when switching domain of presented data

Seq	Program	Parameters	Prio	Inh
1	TIMSERVICE			
4	adjust_irq_priorities			
6	SLEEP	P1:3	-3	
8	LDCONFIG	P1:/nfs/cs-ccr-nfs6/vol29,		
110	SLEEP	P1:3	-3	
120	FESA_M	P1:LTIM P2:2>/dev/con	50	
130	SLEEP	P1:3	-3	
140	FESA_M	P1:BOSEMCTRL	25	✓
145	FESA3_M	P1:BOSEMCTRL_DU		
150	SLEEP	P1:3	-3	
160	FESA_M	P1:BEMCPS P2:2>/dev/con	50	✓
170	FESA3_M	P1:BEMCPS_DU	50	
180	FESA3_M	P1:LTIM_DU		✓

+ Add program

Edit program

Program: FESA_M | Sequence: 120 | Priority: 50 | Inhibit:

Parameters: \$1: LTIM x \$2: 2>/dev/con x \$3 \$4 x

Start Parameters quick lookup

```
# Start real-time and CMW server for FESA 2 class $1  
$P ./LTIM_M 2>/dev/con $3$4 &
```

Program details

Name	Description	RT Class	Responsible
FESA_M	FESA Server and Real-time for class \$1		

Source Directory	Source File	Destination Directory	Destination File
/dsc/local/bin	\$1_M	/dsc/local/bin	\$1_M

Owner	Group	Mask	Default prio	Clic
root	root	555	25	true

Done

Immediate access to **advanced information** is essential for expert users.

The UI design represents the **natural flow**: FEC HW configuration > startup sequence > operations..

Context oriented workflow: expert vs common UIs

Physical configuration		Logical configuration		Remote Reset & Reboot		Devices		Logs & Comments			
Class Name	Class Versio	Device Nam	Description	Implementz	Accelerator	State	In Laser	In Lsa	In Cals	In Oasis	Responsit
DMN_DSC_WIT											
DMN_DSC_WIT	0	DMN.CLIC.CFC-		VIRTUAL		expert	✗	✗	✗	✗	diamon-suppor
LTIM (2)											
LTIM	3.4.5	IIX.AQNLO-CGS	Last injection acquisition interr	FESA3	LN3	operational	✓	✗	✗	✗	ikozsar
LTIM	3.4.5	cfc-351-cgsrc1.l		FESA3	LEI	development	✓	✗	✗	✗	ikozsar
NL3SRCGEN (2)											
NL3SRCGEN	10.0.1	IP.NSRCGEN	Linac3 Ion Source	FESA3	LN3	operational	✓	✓	✓	✗	scrivens
NL3SRCGEN	10.0.1	GD_DECFAE4C	Linac3 Ion Source Global	FESA3	LN3	development	✓	✗	✗	✗	scrivens

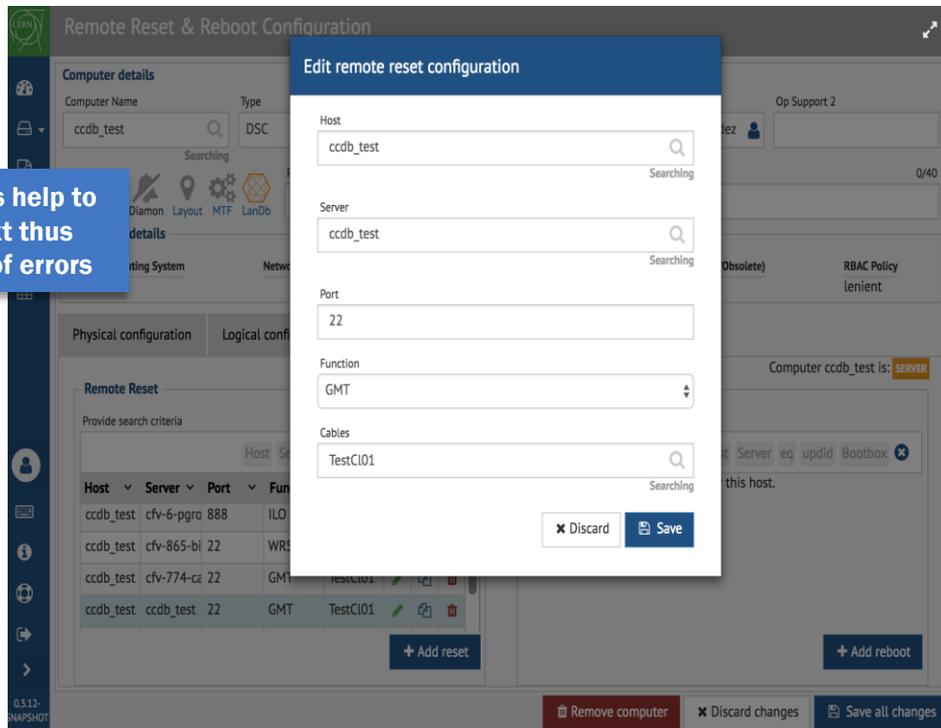
Easily accessible overview of devices is commonly used by all users and serves as an entry point to domain of “Devices”

Immediate access to **advanced information** is essential for expert users.

The UI design represents the **natural flow**: FEC HW configuration > startup sequence > operations..

Context oriented workflow: expert vs common UIs

Modal windows and dialogues help to focus on a particular context thus helping to reduce likelihood of errors



Immediate access to **advanced information** is essential for expert users.

The UI design represents the **natural flow**: FEC HW configuration > startup sequence > operations..

CCS: taming system complexity

Device Name	Accelera	State	In Laser	In Lsa	In Cals	In Oasis
DMN.CLIC.CFC-351-CGSR1		expert	✗	✗	✗	✗
IIX.AQNLO-CGSR1	LN3	operational	✓	✗	✗	✗
cfc-351-cgsr1.LTIM	LE1	development	✓	✗	✗	✗
IPNSRCGEN	LN3	operational	✓	✓	✓	✗
GD_DECFAE4C	LN3	development	✓	✗	✗	✗

Configuration and reference for high-level applications and services

- State of a device in control system
- Relation to alarms system (LASER)
- Presence in accelerator settings management system (LSA)
- Source of data acquisition for data logging service (CAL5)
- Part of Open Analogue Signal Information System (OASIS)

End-users benefit from integration between control system components but are not exposed to its complexity.

Hardware Type

Hardware Type Information

Hardware Type: Searching

Equipment Code: Layout

Responsible: Module Blocks

Owner Group: Enabled

Classifications

Search:

Classifications

- Hierarchy
- Machines
- Electrical
- Civil works
- WorldIP

Hardware Type Hierarchy:

- POWER SUPPLY
- PCB DRIVERS
- RF-GUN INTERFACES
- VME
- RF CONTROL COMPONENTS
- RANGES HARDWARE
- RF ADDITION MONITORS
- CONNECT PC
- HAZ
- RF CONTROL COMPONENTS
- QPS ELECTRONICS
- COLLIMATOR CONTROL ELECTRON
- SAFE MACHINE PARAMETERS SYST
- WORLDIP DEVICES
- TRINKING DEVICES
- END CONTROL DEVICES
- INTERLOCK CHANGE MONITORS
- END PIN ELEMENTS

Main

Type identification

ID: 1835944 (naming convention: HC)

Code: HCMKCBC

Name: HCMKCBC

Description: Beam Energy Controller (BEC)

Streamlined: width 5.02 [mm], height 0.23 [mm], depth 0.16 [mm]

Responsible: Etienne Carlier

Owner: CERN Users

Elements: Functional positions

Parent Hierarchy

Hierarchy	ID	Description
HCMKCBC	1835944	Beam Energy Controller (BEC)
---CONFIGURABLE DEVICES	580649	Configurable devices (Devices which might...
---CONTROL ELECTRONIC DOMAIN	118820	Control Electronic domain
---HARDWARE ELEMENTS	5920388	Hardware Elements
---NEW LAYOUT	5920372	New Layout Classes
---CONFIGURABLE DEVICES	580649	Configurable devices (Devices which might...
---CONNECTABLE ELEMENTS	5920159	Connectable Elements
---NEW LAYOUT	5920372	New Layout Classes
---CONFIGURABLE DEVICES	580649	Configurable devices (Devices which might...
---SCALABLE ELEMENTS	5920124	Scalable Elements
---NEW LAYOUT	5920372	New Layout Classes

25 Items shown

Integration between separate Controls services: LHC Layout

Conclusions

CMS Experiment at the LHC, CERN

Increased user satisfaction, less stress at work, higher work efficiency, lowered user support...

... Is what easy to use, intuitive and ergonomic UIs can bring. Design and development of ergonomic user interfaces is a challenge and an opportunity.

Reliable, efficient and easy to learn: ergonomic user interfaces.