

CERN Controls Configuration Service

a challenge in usability

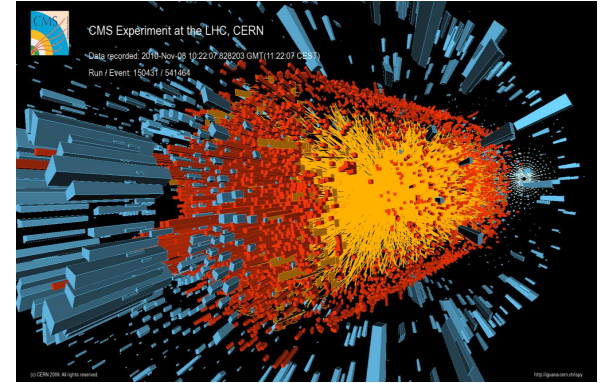
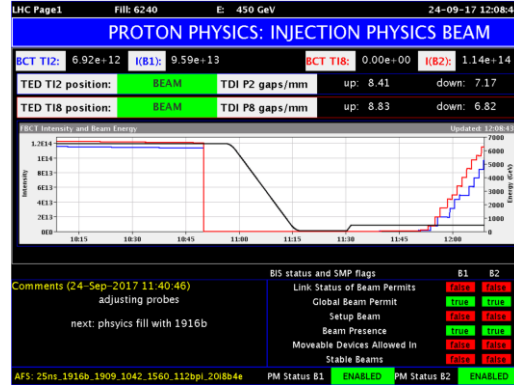
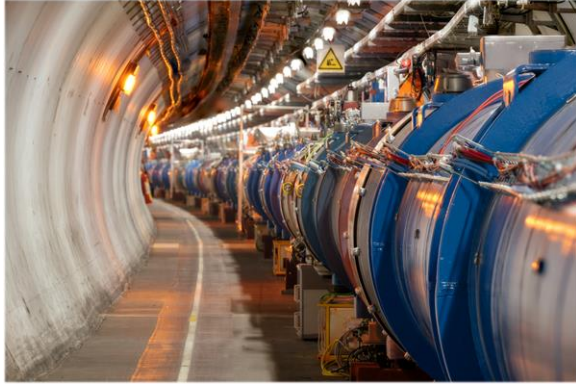


Lukasz Burdzanowski

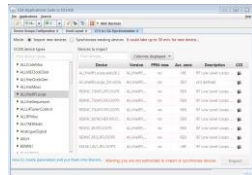
CERN European Organisation for Nuclear Research
Beams Department

ICALEPCS 2017 TUBPL01

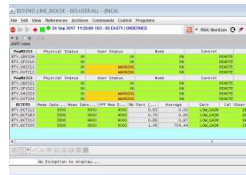
Control system applications



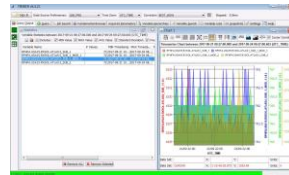
Critical, robust, performant, tailored - prerogatives of control system software applications.



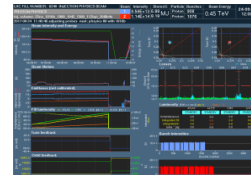
Meta-data



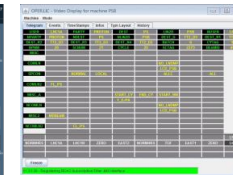
Settings



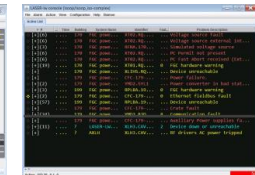
Acquisition



Monitoring



Diagnostics



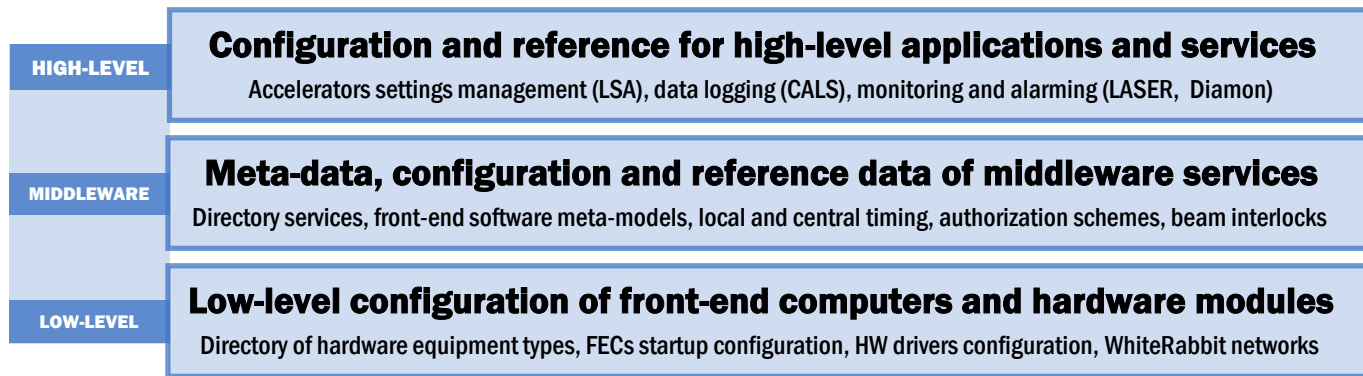
Safety

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 challenge:

- 25 years of history
- 1500 DB session per day
- 80 ^{calls}/_{sec} on Java API(s)
- 700 domain tables
- over 40k DML operations per day
- 500 distinct users of GUIs
- variety of users
- operations-critical components

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.**

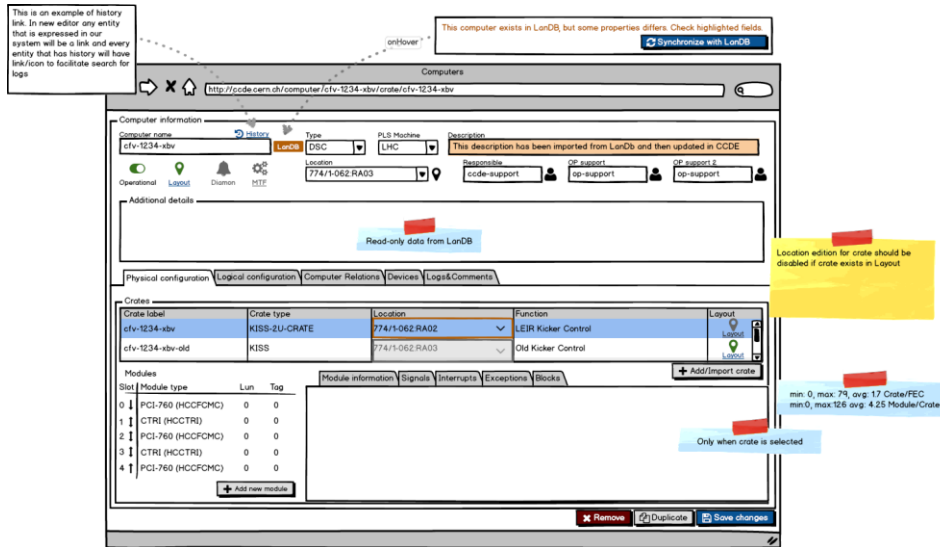
The subject of usability is formalised by dedicated ISO standards:

- 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

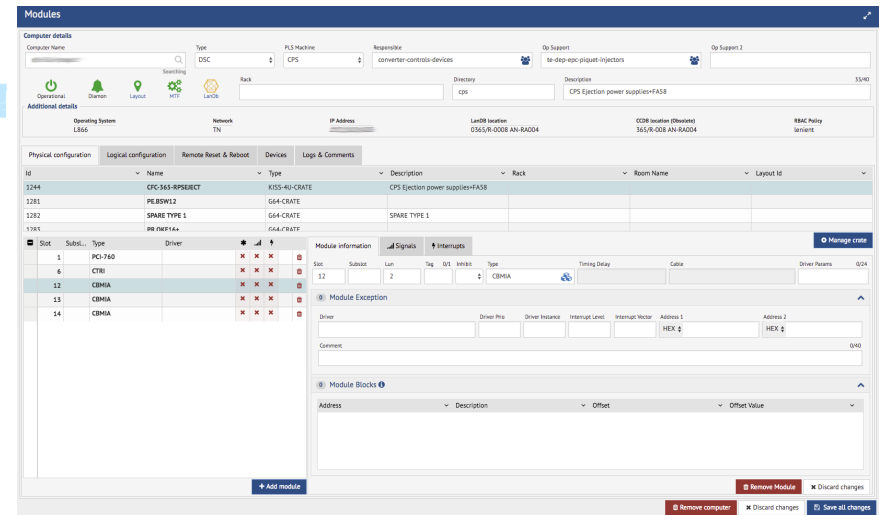
When designing and developing interfaces, not only graphical ones, the biggest challenge is always the same:

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

Devices

Computer details

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

Operational Diamond Layout MTF LanDb

Rack: RA-FQ_R047=774 Location: 774/R-047 Directory: Description: Only for CCDB data management 29/40

Additional details

Operating System Network IP Address LanDB location CCDB location (Obsolete) /abc FEC NOT IN NETWORK RBAC Policy lenient

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

Class N	Class Vt	Device I	Device	Description	Implem	Acceler	State	In Laser	In Lsa	In Cals	In Oasis	Respo
CCSTest (2)												
CCSTest	0	CCSTest			FESA2		development	×	×	×	×	lburdzan
CCSTest	0	NONECCSTe		It's a NONE device	FESA2		development	×	×	×	×	lburdzan

Remove computer Discard changes 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

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Operational | Diamond | Layout | MTF | LanOb

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Operating System: | Network: | IP Address: | LanDB location: | CCDB location (Obsolete): /abc FEC NOT IN NETWORK | RBAC Policy: lenient

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

Class N	Class V	Device I	Device	Description	Implem	Acceler	State	In Laser	In Lsa	In Cals	In Oasis
CCSTest (2)											
CCSTest	0	CCSTest			FESA2		development	✗	✗	✗	✗
CCSTest	0	NONECST		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 (1xSVEEC+2xFMCSCHDIO) | 66/70

Responsible: Felipe Cordobes Dom | Owner Group: TE-ABT-EC | Module Blocks: Enabled | Category: MODULE | Input Bus: VME | Output Bus: |

VME/PCI Configuration | Module Blocks

Block	Address	Offset	Description	Offset	Depth	Word	Rwmc	Name	Description	Timel	Role	Mask
0	1	0	All registers block		0	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 versk		
					24	0	uint32	r	INTLCK_C	Interlocks		
					16	0	uint32	r	HDL_CON	HDL gaten		

Manage Module Block | Manage Module Register

Import Module Configuration from another HW Type

Upload configuration data

Hardware Type: | Import Module Configuration

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: Type: DSC PLS Machine: CPS Responsible: converter-controls-devices Op Support: te-dep-epc-pluget-injectors Op Support 2:

Operational: Diamond Layout HTP LanOb

Additional details: Operating System: L866 Network: TN IP Address: LanDB location: 0365/R-0008 AN-RA004 CCD8 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				

Module information

Slot	Subslot	Type	Driver	Signals	Interrupts
1		PCI-760			
6		CTRI			
12		CBMIA			
13		CBMIA			
14		CBMIA			

Module Exception

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

Comment:

Module Blocks

Address	Description	Offset	Offset Value

Actions:

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

The screenshot shows a hardware configuration interface. A blue callout box points to the 'Physical configuration' tab, stating: 'Physical crate layout representation facilitates use by HW experts'. Another blue callout box points to the 'Module information' tab, stating: 'Advanced configuration options are easily accessible yet hidden as used infrequently'. The interface includes a table of modules, a 'Module information' panel, and a 'Module Exception' section.

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

Slot	Subslot	Type	Driver	*	Signal	Interrupts	
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

Slot: 3, Subslot: , Lun: 0, Tag: , O/I: , Inhibit: , Type: BI_ADC36, Timing Delay: , Cable: , Driver Params: 0/24

Module Exception

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 \$2: 2>/dev/con

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	✓	✗	✗	✗	iko
	LTIM	3.4.5	cfc-351-cgsrc1.l		FESA3	LEI	development	✓	✗	✗	✗	iko
	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

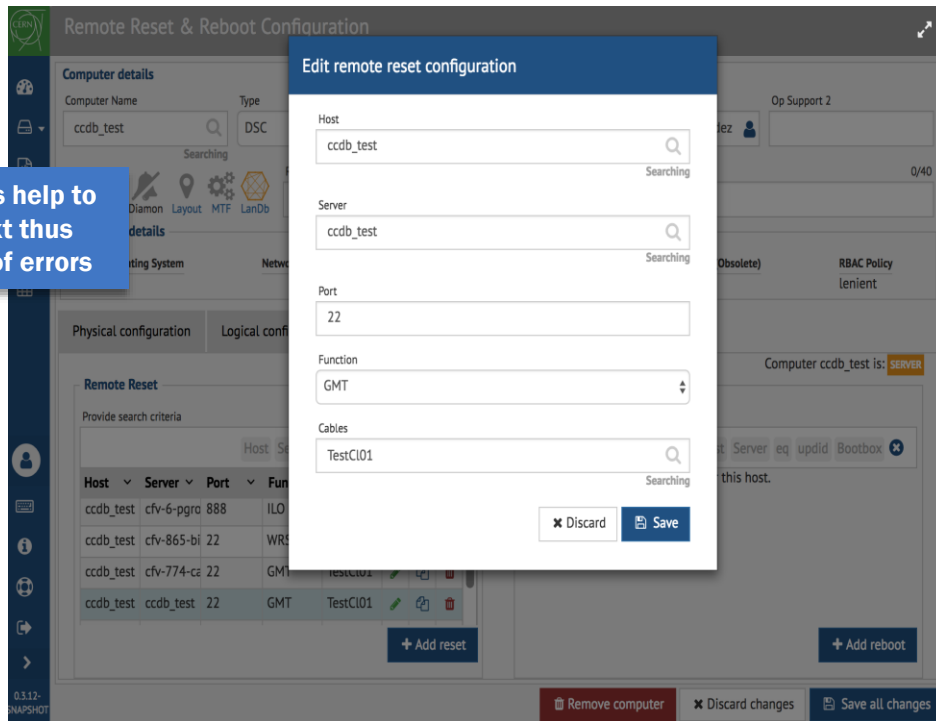
Easily accessible overview of devices is commonly used by all users and serves as an entry point to domain of “Devices”

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	Accelerator	State	In Laser	In Lsa	In Cals	In Oasis
DMN.CLIC.CFC-351-CG5SRC1		expert	✗	✗	✗	✗
IIX.AQNLO-CG5SRC1	LN3	operational	✓	✗	✗	✗
cfc-351-cgsrc1.LTIM	LEI	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 (CALS)
- 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
ABT_BEC
Searching

Equipment Code
HCMKCBC
Layout

Responsible
Nicolas Magnin

Owner Group
TE-ABT-EC
Module Blocks
Enabled

Integration between separate Controls services: LHC Layout

Classifications

Hierarchy

- HOME
- HOME1
- HOME2
- HOME3
- HOME4
- HOME5
- HOME6
- HOME7
- HOME8
- HOME9
- HOME10
- HOME11
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- HOME98
- HOME99
- HOME100

Type identification

ID: 181044 (parent convention: HC)

Code: HCMKCBC

Name: HCMKCBC

Description: Beam Energy Controller (BEC)

Dimensions: width 0.02 [m], height 0.23 [m], depth 0.14 [m]

Responsible: Nicolas Magnin

Owner: CERN LHC

Elements: Functional positions

Parent hierarchy

Hierarchy	ID	Description
HOME	181044	Beam Energy Controller (BEC)
HOME1	180649	Configurable devices (Devices which might be replaced)
HOME2	118820	Control Electronic domain
HOME3	118820	Control Electronic domain
HOME4	118820	Control Electronic domain
HOME5	118820	Control Electronic domain
HOME6	118820	Control Electronic domain
HOME7	118820	Control Electronic domain
HOME8	118820	Control Electronic domain
HOME9	118820	Control Electronic domain
HOME10	118820	Control Electronic domain
HOME11	118820	Control Electronic domain
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HOME98	118820	Control Electronic domain
HOME99	118820	Control Electronic domain
HOME100	118820	Control Electronic domain

CERN Beams Department

Lukasz Burdzanowski | ICALEPCS2017 | TUBPL01

13

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.**