

WIR SCHAFFEN WISSEN - HEUTE FÜR
MORGEN



Mark Könnecke

The Instrument User Interface Challenge

- The Lay of The Land
- Survey of existing solutions
- UX Development
- Where do we want to go?
- A Suggestion
- Discussion

- A complex instrument can easily have thousands of parameters
 - Filtering
 - But we get in trouble if we hide too much
 - Some parameters are more important than others
 - The importance of parameters may vary with the use case of the instrument
- Cluttered Interfaces
- Online graphics
 - Frequent updates are a problem
 - Requirements for interaction

Latch to the Rescue



“Information may be infinite, however... The organization of information is finite as it can only be organized by LATCH: Location, Alphabet, Time, Category, or Hierarchy.”

Wurman, 1996

- Location: example: instrument components
- Alphabet: alphabetical listings
- Time: generated data files
- Category: all motors, counters, slits, whatever
- Hierarchy: tree views

- We also want to run procedures against the instrument
 - counting, driving, and scanning
 - The ones we always tend to forget:
 - Alignment
 - Experiment planning
- Flexibility in the use of the instrument
 - Each instrument is unique
 - It must be easily possible to use the instrument in a different way

UI Challenges: Diverse User Community

- The Start/Stop user
 - Different communities with different IT abilities
- The advanced user/instrument scientist
- Maintenance staff

UI Challenges: Different Interfaces

- Interaction with humans
- A machine interface for computer clients
- NEW: workflow integration
- We need to program: batch processing

- Desktops of various OS
 - Linux
 - OSX
 - Windows (to my regret)
- Mobile
 - Android
 - iOS
- Speech: chinese, swedish, Schwitzerdütsch, danish, english, Klingon,...
- Watch

Solution 1: the Command Line

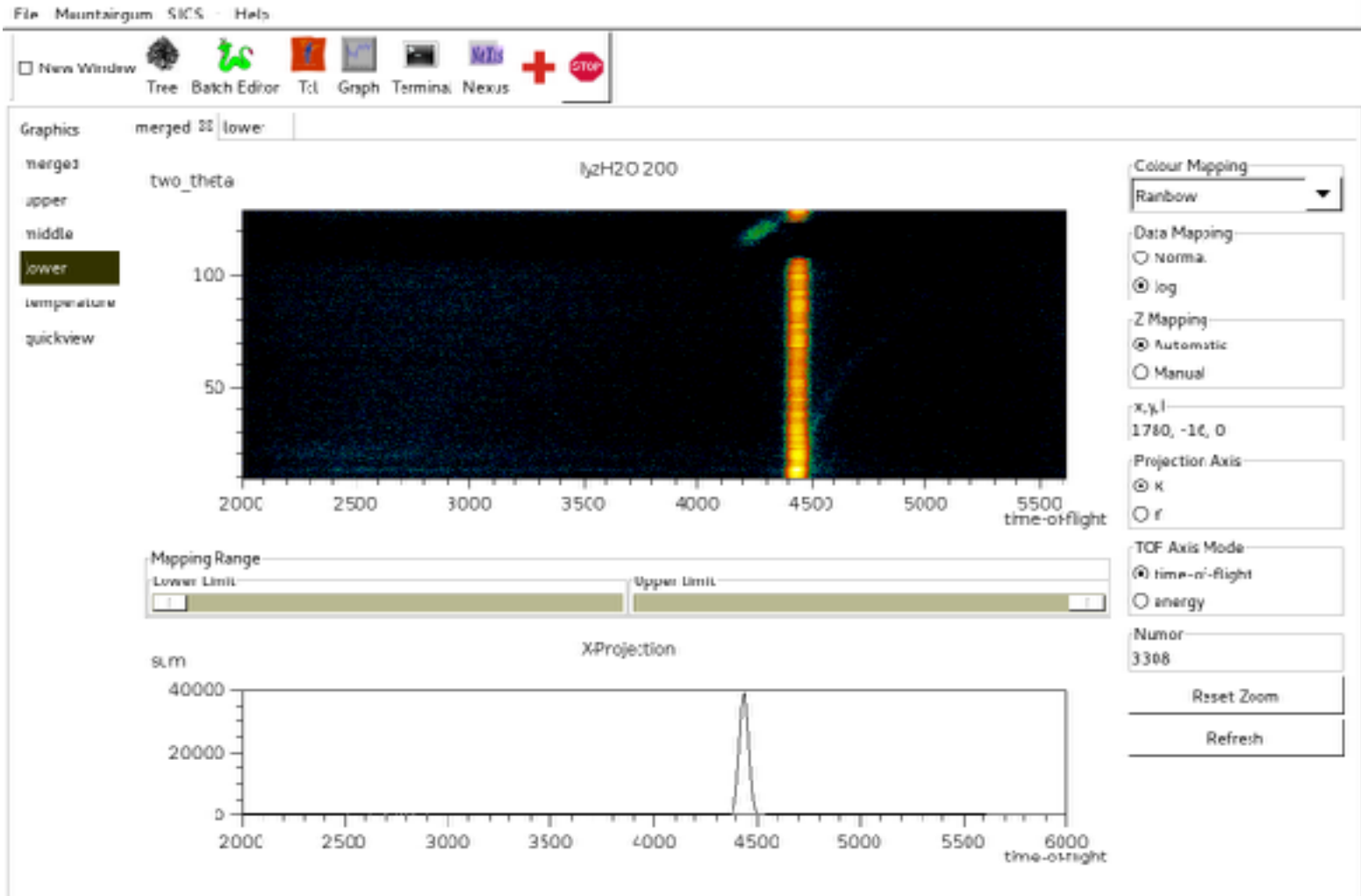
The screenshot shows a terminal window with a menu bar (File, Connect, User) and buttons (Connect, Disconnect, Authorize, Configure, Exit). The main content area displays the following text:

```

LOCAL LOCAL LOCAL
SICS Input/Output
Writing data file:
/afs/psl.ch/project/singdev/mksics/tmp/001/mosim2017n001364.dat ...
WARNING: Saving data for Linda Wuergheles, proposal 00-undefined-00
ERROR: variable temperature NOT found
NP som Counts Monitor1 Monitor2 Monitor3 Time
0 -0.300 5 15 25 35 0.1
NP som Counts Monitor1 Monitor2 Monitor3 Time
1 -0.200 5 15 25 35 0.1
NP som Counts Monitor1 Monitor2 Monitor3 Time
2 -0.100 5 15 25 35 0.1
NP som Counts Monitor1 Monitor2 Monitor3 Time
3 0.000 5 15 25 35 0.1
NP som Counts Monitor1 Monitor2 Monitor3 Time
4 0.100 5 15 25 35 0.1
NP som Counts Monitor1 Monitor2 Monitor3 Time
5 0.200 5 15 25 35 0.1
NP som Counts Monitor1 Monitor2 Monitor3 Time
6 0.300 5 15 25 35 0.1
OK
Command History
cscan som 0 .1 10 .1
cscan som 0 .1 5 .1
cscan som 0 .1 3 .1
SICS Input
Interrupt Eager to execute commands
  
```

- Surprisingly popular even in the graphical 21st century
- Why?
 - Expressive
 - Fast
 - Needed anyway: batch processing
 - Two stages in an experiment:
 - Setup: knowledgeable instrument scientist nearby
 - Experiment: only few commands required
- It can be improved:
 - Can someone remember the legendary VMS help system?

Solution 2: Specialized Online Data Display











spy@focus.psi.ch

Enter to execute command!



- Interaction is asked for:
 - Zooming
 - Changing plot characteristics: log, normal, color schemes
 - Projections
 - ...
- An instrument usually has several plots on offer
- Scientists often ask for simple data analysis in this:
 - Determining centers
 - Fitting gaussians...
 - Comparing with old data

Solution 3: Parameter Tree Displays

File Mountaingum SICS - Help

New Window
 








name	value
▼ experiment	
title	lyzH2O 200
▼ user	ABenedetto
address	0
phone	3246
email	0
datafilenumber	3308
batchpath	/home/focus/batch
▼ chopper	
▷ status	
fermi_chopper_speed	500
disk_chopper_speed	500
phase	0.1
ratio	1
▷ vacuum	
▷ beryllium_filter	
▶ monochromator	
▷ sample	
▷ counters	
▷ commands	

ERROR: ir
 ERROR: C
 ERROR: ir
 ERROR: C
 can not g
 ERROR: ir
 ERROR: C
 ERROR: ir
 ERROR: C

Spy@focus.psi.ch
Eager to execute commands

Parameter Tree Display

LARMOR is SETUP

Run: 00003480 Shutter: CLOSED

Time: Analyser setup (9-10:30) - 0.5.6492.0

Users:

Condition 1 Name: 018 Inst. Name: 1078/2975-1115/08
 Current Total: 018 Inst. Name: 5.888.21.5
 Monitor Counts: 0 Positron: 1.1.1

JMWGAPS		BENCH		Sample		Detector		Optics		Other	
CG Gap	30.0E1	DSC	337.00225	Pt	3.22E16 g/g	DetectorPack1	0E	Pd_Tank	003.0020 m/s	Current_1	Succeeded
AHGap	35.0E1	SSV	58.00225	ConductHigh	18.6-100	DetectorPack2	0E	BeamlineA	30.400	Current_2	Succeeded
SVGap	38.988	preH08084	0.00000	Isotopes	11.99925 m/s	DetectorPack3	0E	Fl_1809	1.0000 m/s	Fl_1809	Succeeded
GGGap	39.0E4	DocLib	0.00000	CGapping	4.0 E	DetectorPack4	0E	Ap_Ap	1.0000 m/s	Current_3	Succeeded
STHGap	18.982	preH1101	0.00000	Sample	2.00000 m/s			Fl_79	1.0000 m/s	STHGap	0.000
AHGap	13.000	Mitron	200.00000	SamplePos						Isotopes	0.000
SVGap	14.000	MonitorOn		CGap	21.0 C					Isotopes	0.000
CGGap	32.0E4			CGGap	22.0 C					Fl_1809	0.000
				CGGap	23.0 C					DetectorPack1	Succeeded
				CGGap	24.0 C						
				CGGap	25.0 C						
				CGGap	26.0 C						
				CGGap	27.0 C						
				CGGap	28.0 C						
				CGGap	29.0 C						
				CGGap	30.0 C						

Currents: 1078 Sample: 1011 1.00000 MASS: 00.517102907 Stop: 0

PARAMS

- Beam Control
- LAE
- Data Browser
- Experiment Details
- IOC Log
- Inputs
- Scoping
- Synops
- Web Links

Parameter Tree:









- Resource 02: 3.000
 - Resource 01: 107.000
 - Vacuum 1
 - Chopper
 - PrepMag: 15
 - Power: 0
 - Error: 0
 - Coarse Jaws
 - HGap: 38.000
 - VGap: 35.000
 - Polariser
 - WGap: 0.004 degrees
 - ABSOLE 1
 - HGap: 36.000
 - WGap: 18.000
 - SAB 1
 - HGap: 37.000
 - WGap: 18.000
 - Monitor 3
 - Current: 0.00000
 - MWeight: 0.00000
 - Current: 0.00000
 - Sample Changer
 - sample: [input]
 - In Position: [input]
 - Sample Stack
 - X: 0.000
 - Y: 0.000
 - Z: 0.000
 - Flux: 0.000
 - Flux Log # 3.000
 - Flux: 0.000
 - Flu 2
 - HGap: 36.000
 - VGap: 35.000
 - Monitor 4
 - Current: 0.00000
 - Flux: 0.00000
 - Search Rotation
 - Range angle: [input]
 - Current angle: [input]
 - Status: unknown
 - Analyse
 - Intra: [input]
 - Angle: 0.000 degrees
 - Moving Detector
 - Count: 0.00000
 - Current: 3.000000
 - Flux: 0.00000
 - Flux Log # 3.00000
 - Flux: 0.00000

- Good at organizing parameter space
- Caveat:
 - not easy to organize commands
 - no graphics
 - you may get into deep hierarchies
 - Bad at cross cutting concerns:
 - Show me all motors?
 - Show me all motors I am allowed to scan?
- Not the silver bullet either

- Invented between ANSTO and PSI
- Map commands and graphics data into the tree
- Use that tree as underlying model for the UI
- GumTree Swiss Edition and GumTree ANSTO Edition are built on top of this

More Shameless Advertising

File Moustaingum SICS - Help

New Window
 








name	value
datacollector	start
backpath	/home/focus
chopper	
status	
feml_chopper_speed	500
disc_chopper_speed	500
phase	0.1
ratio	1
vacuum	
beryllium_filter	
monochromator	
sample	
counters	
commands	
count	start
repeat	start
wait	start
batch	
updatestatus	start
configure_instrument	start
command_line	start

count:

mode: monitor

preset: KNNNN

Make It So Interrupt

TrigView
 Console

```

ERROR: in sea:
ERROR: Object -> temperature <- NOT found
ERROR: in sea:
ERROR: Object -> mf <- NOT found
can not get mf
ERROR: in sea:
ERROR: Object -> mf <- NOT found
ERROR: in sea:
ERROR: Object -> mf <- NOT found
    
```

spy@focus.psi.ch Eager to execute commands

Solution 5: Dashboards

File Mounting SICS Help

New Window Tree Batch Editor Tel Graph Terminal Nexus + STOP

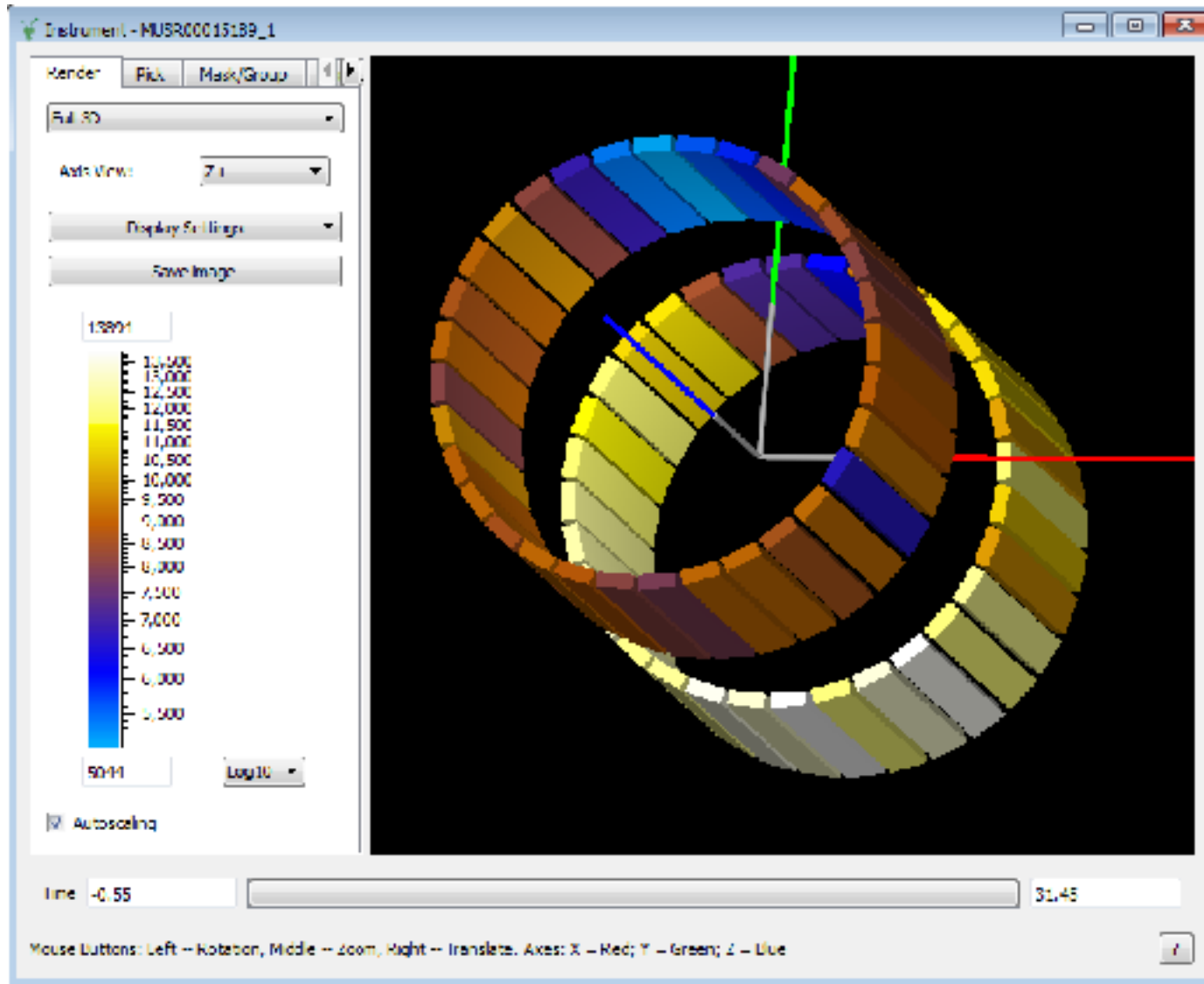
Graphics	merged	lower	quickview 33
merged	title		lyz120 200
upper	sample		MA10 slits h=14mm v=25mm double wall Al-can for liquids
middle	femispac		500
lower	diskspac		500
temperature	phase		0.13
quickview	ratio		1
	presel		55000
	monitor		30999

spy@focus.ps.ch Eager to execute commands

- Displays most important instrument parameters
- Instrument specific
- Configurable

- As far as I know: only seen at ISIS
- A list of blocks for showing and modifying parameters
- Configurable:
 - List of Blocks
 - Content of Blocks

Solution 6: Graphical Instrument Views



- Expensive to program
- Impresses managers and politicians
- IMHO:
 - Doubt about usefulness
 - ROI: Return On Investment?
 - Does not solve the parameter storm issue
 - No commands

Solution 7: Log and Alarm Viewers

- Often part of CLI interface
- But also separate, showing the instrument log
- Alarm Viewers: lifts potential problems out of the log message storm

Examples: medm

The screenshot displays several EPICS MEDM windows for the X10SA experiment:

- X10SA Mirror:** Shows a 3D model of the mirror with parameters: Coating (Pt), Rh, Theta (3967.00 mrad), Bender Z2 (0.30800 mm), Bender Z1 (0.30750 mm), and Height (-231.10 μm).
- X10SA Experiment Status:** A large window listing various system parameters such as Ring Current, U19 Gap, FE Shutter, and various motor positions (Goniometers, Sample, Detector, etc.).
- X10SA-ID PLC-IO:** A control window for the ID system showing a 'GAP DONE' indicator, a 'STOP' button, and 'REMOTE' control options.
- X10SA ID Encoders:** A window showing the status of upstream and downstream encoders, including their positions (37998 μm and 38000 μm) and connection/referencing status.

- Is what you get when you leave the EPICS people alone
- Interfaces ONLY to EPICS PV
- Succeeds at confusing users
- To be programmed for each instrument
- Changes require programming to accomplish

Solution 9: Search

- When you used google you know how it works
- Has never been tried in the context of instruments
- Has been marketed for a while as the next big thing in user interfaces

Solution 10: Workflows

- Organise operation of instrument in workflows
 - Much like a wizard with branches
- User is guided along these workflows
- Has never been tried in the context of instruments

Solution 11: Instrument Specific UI

1

2

3

4

The screenshot displays a complex software interface for instrument control, organized into several functional areas:

- Top Bar:** Contains menu options like 'File', 'Instrumentation', and 'Help', along with a status indicator for 'Export mode'.
- Left Panel:** A hierarchical tree view showing the system configuration, including components like 'Falkgroup - 2', 'sp42H1 - 6', and 'LIMACON 200 - 2'. It includes controls for 'Show' and 'Control'.
- Sample Control Panel:** Features a 'Sample control' section with parameters for 'Offset', 'Kappa', and 'Phi'. Below it is a 'Sample view' showing a dark image with a bright spot and a 'Sample distance' slider.
- Data Collection Panel:** Includes a 'Collection method' section with 'Characteristics' (Number of images, Exposure time, Oscillation area) and 'Observation' (Voltage consistency, X-rays for resolution storage, Detached SLD, Indexes item).
- System Status Panel (Right):** Displays real-time data such as 'Energy' (12.5 kV), 'Current' (1.408 mA), 'Resolution' (Current: 1.800 A, Minima: 1), and 'Temperature' (Current: 20.17%). It also includes 'Safety status' and 'Fast status' indicators.
- Bottom Panel:** Shows a log of system events with timestamps and messages.

Instrument Specific UI

- Bespoke UI for a type of instrument
- Works for well standardized experimental procedures
- Limits you when doing non standard things
 - Often reduces this limit by clutter
- Dagobert Duck funding required



Batch Editing 1: Text Editors

- Emacs, Vim, TextEdit, ...
- Users need to know syntax
- Should (MUST?) be accompanied by a simulation mode at the instrument
 - Otherwise your batch program dies 3 minutes after you left for the weekend
- Good news: NICOS does simulation

Batch Editing 2: Block Programming Language

The image shows a block programming environment with a left sidebar containing categories: Logic, Loops, Math, Text, Lists, Color, Variables, and Functions. The main workspace contains a sequence of blocks: a 'set Count to 1' block, a 'repeat while' block with a condition 'Count <= 3', a 'do' block containing a 'print "Hello World!"' block and a 'set Count to' block with a 'Count + 1' block. A trash can icon is visible at the bottom right of the workspace.

Language: JavaScript ⚙

```
var Count;  
  
Count = 1;  
while (Count <= 3) {  
  window.alert('Hello World!');  
  Count = Count + 1;  
}
```

- You select items from a toolbox
- Simple logic possible
- Only seen so far in NOMAD from ILL

Batch Editing 3: Spreadsheets

The screenshot shows the OpenOffice Calc application window. The spreadsheet contains the following data:

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	sample	msh	flipper	flipper	moeller								
2	199_Q	p0	on	on	50								
3	199_Q	p0	off	off	50								
4	199_609_24h	p1	on	on	50								
5	199_609_24h	p1	off	off	50								
6	199_609_1h	p2	on	on	50								
7	199_609_1h	p2	off	off	50								
8	199_609_4h	p3	on	on	50								
9	199_609_4h	p3	off	off	50								
10	199_659_24h	p4	on	on	50								
11	199_659_24h	p4	off	off	50								
12	199_659_1h	p5	on	on	50								
13	199_659_1h	p5	off	off	50								
14	199_659_4h	p6	on	on	50								
15	199_659_4h	p6	off	off	50								
16	EB	p7	on	on	50								
17	EB	p7	off	off	50								
18													
19													
20													
21													
22													
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24													
25													
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30													
31													
32													
33													
34													
35													

- Primarily loved by SANS community
- Looking at the workflow from a higher level of abstraction:
 - Instrument scientist provides template
 - User fills in the details
- Old user batch files are templates too!!
 - ESS should manage them

UI Challenges: Recapitulation

- Lots of diverse data
- Need for action
- Instrument control is programming
- Diverse user community
- Many platforms
- Timeline: 20-30 years

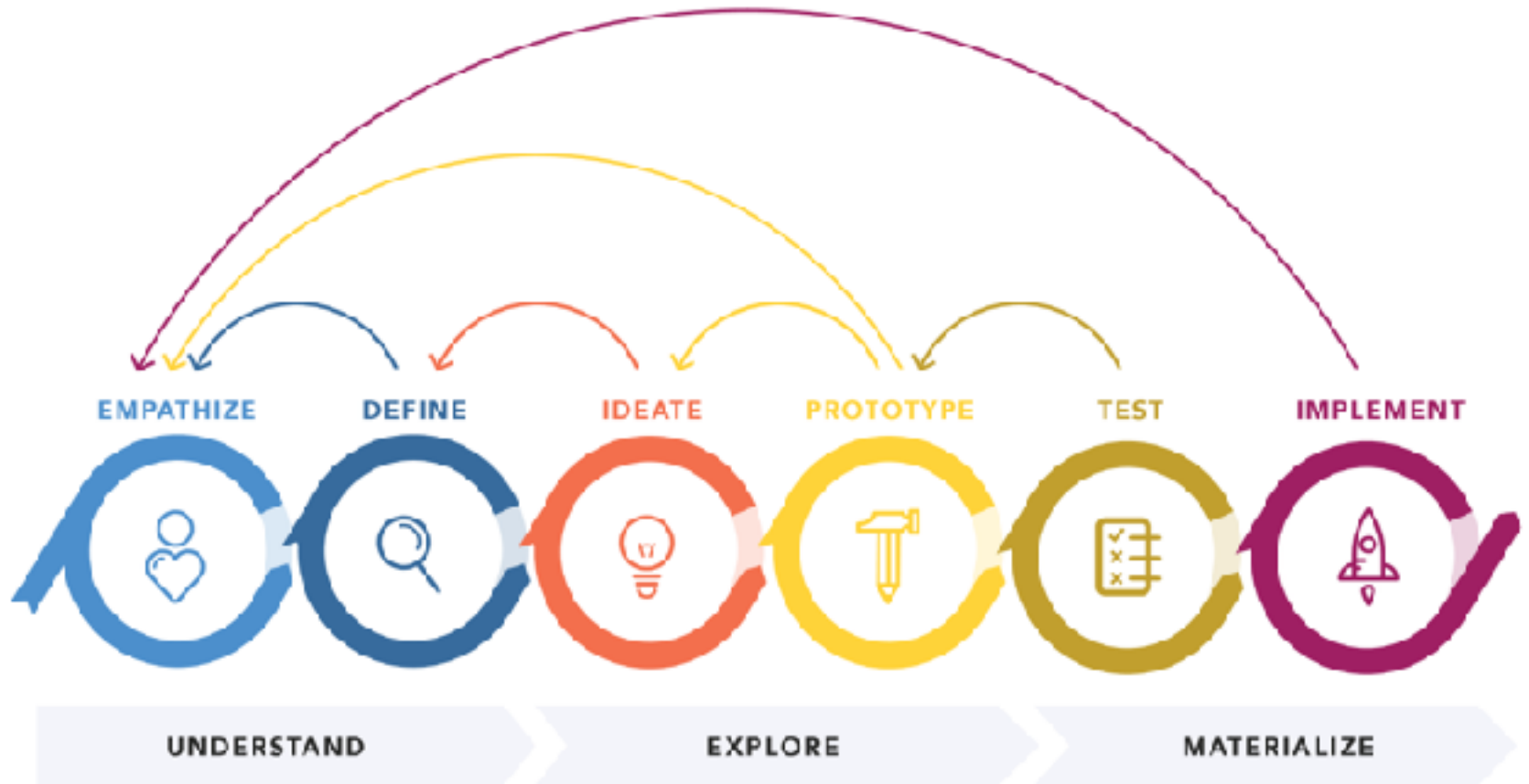
Which UI pattern do we want?

- One of the shown ones?
 - Monolith or separate components?
 - Do we try search?
 - What about a phone like screen with various apps?
 - Has someone got a better idea?
 - Your suggestion here...
-
- We need a process to decide this

Which Technical Basis?

- We already considered WWW
 - Do we wish to reconsider? Graphics can be an issue.
- Javascript on the client side is unavoidable
 - Which of the ever increasing list of frameworks?
 - How do we go about evaluating them?
- Backend
 - If we already have to do javascript we could do node.js
 - Else: python
 - Which of the python WWW frameworks?
 - How do we decide?
 - Else: ??????
- Distribution of tasks between javascript client and backend

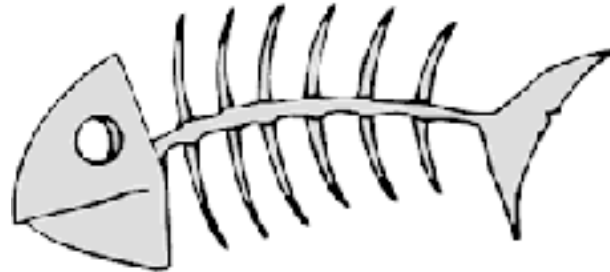
UX Design Process



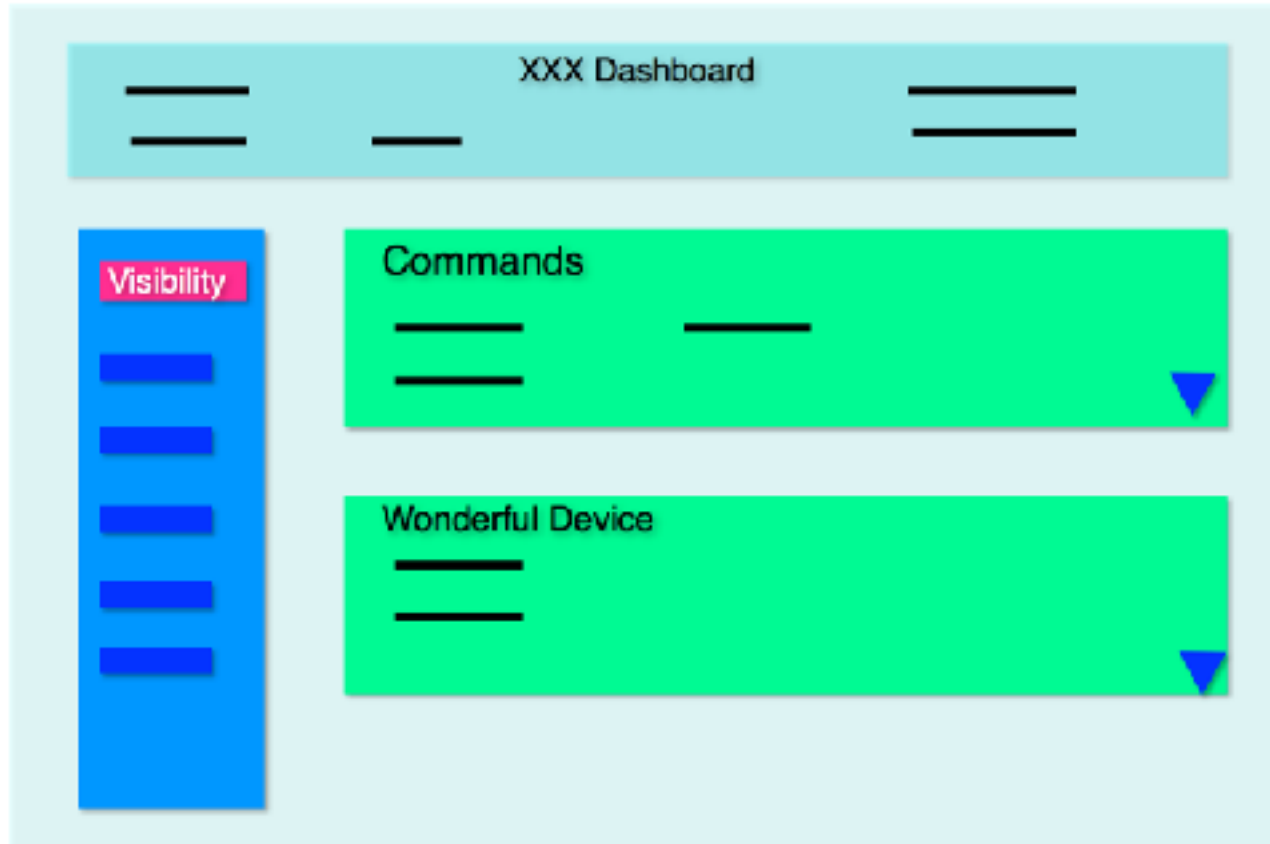
DESIGN THINKING 101 NNGROUP.COM

UX Design Process?

- Do we follow some or all steps of a UX design process?
- IMHO: Recommended
 - Saves money and time in the long run
 - We still have the time to do it



- Command Line Interface
- Online Data Display (Mantid?)
- Some text editor (emacs) for batch files



- Visibility Control, Meta data: How to display?
- Graphics is one the fields
- Block Programming for Batch Files

- Which pattern do we want?
- Has anyone a better suggestion?
- How do we arrive at a decision?
- How do we decide on a technical basis?
- Do we intend to follow UX development methodology?
- BTW: How much screen real estate will there be at ESS Instruments?