

Life cycle Management @EuXFEL

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Time line of this presentation (status quo)


- Introduction
- Requester wants to buy an instrumented chamber, completes and submits: **Component Requirement Document** (CRD and Change Request to assess risks coming from modification)
- Requester realizes it includes not supported devices, fills and submits an **Equipment Requirement Document** for each type/model of device (aka ERD and/or from now on EasyForm).
- Requester submits at least one purchase request via ERP (Infor)
- Requester inserts possibly all assets of delivered items into Inventory (xim) (Equipment categories at this time defined both in CRD and in xim)
- Conclusions and Outlook



Introduction (why we want to do this)

- We have installed scientific and industrial equipment along 6 km of tunnels and in 7 experiment locations (starting around the year 2012)
- Some of the equipment has been running ever since, with basically 100% duty cycle
- We aim to:
 - improve, develop, locate, track and maintain the devices keeping the down time to a minimum and keep historical knowledge
 - develop intervention strategies (possibly w/o interference) to exchange devices near end of life-time
 - keep track of integrated duty-time of devices and interventions (whether to repair or modify)
 - to understand which equipment has become or is going to become obsolete (and prepare for possible replacement with equivalent device(s))
 - ...

What I will cover

 Touched in this talk

Document Management

- Alfresco
- RTD
- D3 (ERP)
- EPLAN P8
- EDMS Direct

Asset Management

- XIM
- EDMS Direct
- EAM (ERP)

Product Life-cycle Management

- XIM
- EDMS Direct

Component and Equipment Requirement document(s) comparison (stored on alfresco)



This form must be used to define all requirements relevant for DAQ & Controls. It typically results in an EPLAN drawing.

Summary

Component (short)	KBS	Component (long)	KB system
Component Group	BLC	Component Group (long)	Beamline components
Instrument	SXP	Facility	SASE3
Patchpanel (optional)	YES	Hutch / Room ¹	E01
Rack (optional)		Floor (optional)	
Underlying project code	DP026	Redmine ID	Filled in by DAQ and Controls experts



This form must be used to define all requirements relevant for DAQ & CTRL.

Summary

Hint: Fill all fields as much as possible

Equipment (short) ¹	LinPS	Equipment (long) ²	Linear-Proportional Power Supply
Equipment Group ³ / XIM-Group if available	PS	Equipment Group (long) ⁴ / XIM-Group if available	Power Supply
Controller/Interface Model	HCK	Vendor XIM-vendor if available	FUG
Controller (Vendor Part Number)/ XIM-item type if available ⁵	Integrated-in-equipment	Equipment (Vendor Part Number)/ XIM-item type if available	- ??
ePlan ID	Filled in by DAQ and CTRL experts	Redmine ID	#103289

Component Requirement (many equipment and devices)

Equipment Requirement (only one type of equipment)

- The CRD template was created before first installation of equipment had been started (and it worked quite well), aim is to list what equipment and devices belong to a whole assembly which we name component
- The ERD process and associated template (soon to be replaced EasyFrom) were created as simple solution to document support-decision of new hardware equipment that is still not supported within EuXFEL and integration level in the control system, linked to Redmine for project tracking purposes

Component and Equipment Requirement document(s) comparison (cont)

Equipment overview

Equipment Type	Quantity	# IP-Addresses needed
Stepper motors	9	
Encoders	7	
Gate valves	1	
Anngle Valve	2	
Generic Valve	1	
Pressure gauges	1	
Turbo pump	2	

CRD (snapshot)

Preliminary classification checklist

Direct integration through: PLC Karabo MicroTCA ToBeClarified

Communication channels present:

IO-signals RS232/RS485 EtherCAT Ethernet (GigE) Ethernet (10G)
 USB-2 USB-3 PCIe Modbus IEEE-488 CAN

ERD (snapshot)

Component and Equipment Requirement document(s) comparison (cont)

#	Equipment Type	Member	Manufacturer	Model	Data Sheet	Connector Type, Pin Assignment	Comment	Standard	Control Interface Hardware	Driver class (f/w, s/w)
57	2-phase Stepper Motor	CTY	Oriental	PKP268 MD 28A-R2FL-L	https://docs.xfel.eu/share/page/site/xfelwp86/document-details?nodeRef=workspace://SpacesStore/5e1a97f0-fb07-4109-bea8-33cd18f940f5	C2	Cryostat Translation along Y (vertical)			
	Limit Switches			ESB M		2,8A 3,4V 1.23Ohm 5,6mH 400 Steps	YES	E57041/ EL5042	SD_MC2Motor	
58	Absolute Angle Encoder	CTZ	Renishaw	RL26BAT050BxxA	https://docs.xfel.eu/share/page/site/xfelwp86/document-details?nodeRef=workspace://SpacesStore/2977eae2-c1bd-4030-8340-42d349fb008b	C28	U _{max} =60VDC, I _{max} =50mA N.C.	YES		
	2-phase Stepper Motor			ESB M	PKP268 MD 28A-R2FL-L	https://docs.xfel.eu/share/page/site/xfelwp86/document-details?nodeRef=workspace://SpacesStore/5e1a97f0-fb07-4109-bea8-33cd18f940f5	C2	Cryostat Translation along Z	YES	E57041/ EL5042
58	Limit Switches	CTZ	Renishaw	RL26BAT050BxxA	https://docs.xfel.eu/share/page/site/xfelwp86/document-details?nodeRef=workspace://SpacesStore/2977eae2-c1bd-4030-8340-42d349fb008b	C28	U _{max} =60VDC, I _{max} =50mA N.C.	YES		
	Absolute Angle Encoder			ESB M	PKP268 MD 28A-R2FL-L	https://docs.xfel.eu/share/page/site/xfelwp86/document-details?nodeRef=workspace://SpacesStore/5e1a97f0-fb07-4109-bea8-33cd18f940f5	C2	Cryostat Translation along Z	YES	E57041/ EL5042

CRD (snapshot)

Note also links to datasheets and vendors' documentation (still on alfresco)

Integration interface checklist

To be filled by Data Department

<p>PLC control (write) channels: <input checked="" type="checkbox"/> IO <input type="checkbox"/> Serial <input type="checkbox"/> EtherCAT <input type="checkbox"/> Ethernet <input type="checkbox"/> Modbus <input type="checkbox"/> CAN</p> <p>PLC monitor (read) channels: <input checked="" type="checkbox"/> IO <input type="checkbox"/> Serial <input type="checkbox"/> EtherCAT <input type="checkbox"/> Ethernet <input type="checkbox"/> Modbus <input type="checkbox"/> CAN</p> <p>Non-PLC control (write) channels: <input type="checkbox"/> IO <input type="checkbox"/> Serial <input type="checkbox"/> EtherCAT <input type="checkbox"/> Ethernet <input type="checkbox"/> IEEE-488</p> <p>Non-PLC monitor (read) channels: <input type="checkbox"/> IO <input type="checkbox"/> Serial <input type="checkbox"/> EtherCAT <input type="checkbox"/> Ethernet <input type="checkbox"/> IEEE-488</p> <p>Configuration by: <input checked="" type="checkbox"/> PLC <input type="checkbox"/> Non-PLC <input type="checkbox"/> Display/Console <input type="checkbox"/> Vendor tool</p> <p>Interlock requirements: <input checked="" type="checkbox"/> PLC interlock source (Condition) <input checked="" type="checkbox"/> PLC interlock target (action)</p> <p>FW, SW and Karabo interface requirements: <input type="checkbox"/> use existing f/w and s/w: _____ <input checked="" type="checkbox"/> develop new f/w and s/w: <u>SD_FUGHCK</u> <input checked="" type="checkbox"/> EEE + CTRL pairing set up <input type="checkbox"/> new Gui widgets</p> <p>Equipment requires:</p>	<p>EEE-PLC & CTRL</p>
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ERD (snapshot) on agreement with requester(s) on what will be supported

Component and Equipment Requirement document(s) comparison (cont)

Operating modes and interlock conditions (machine protection)

Fundamentally, your system can be one of three global modes at a time: Manual, Supervised, or Safe.

Manual operation allows driving all hardware independent of each other (no interlock active, only experts can do that). In supervision mode, one or more conditions are evaluated which define the boundaries for a healthy, operational system. Once such a condition is broken (either by external factors or by bad control) the system will go to safe mode.

CRD (snapshot)

PLC Hardware Interface

From Connector	Signal Name (name as seen in vendor's manual)	EPlan Alias (member name in SD_CLASS if different)	Compatible Terminals	I/O Type
2	Status report current regulation	I_REGULATION	EL180X/ES100x	DI: 15[24]V
2	Status report voltage regulation	V_REGULATION	EL180X/ES100x	DI: 15[24]V
2	Monitor-signal current	I_MON	ES316X	AI: 0-10V
2	Slider front plate voltage potentiometer	V_SET_MON	ES316X	AI: 0-10V
2	Slider front plate current potentiometer	I_SET_MON	ES316X	AI: 0-10V
2	Polarity change	POLARITY_SET	ES262X	DO: relay
2	Set value voltage	V_SET	ES410x	AO: 0-10V

ERD (snapshot)

Equipment Requirement form(s) EasyForm

The screenshot shows a web browser window with the URL `exfformsdemo.desy.de:3000/application/34`. The page title is 'Applications / ERD Main 2.0'. The main content area is titled 'ERD Main 2.0' and contains a form for 'Equipment Request'. The form has a green header and is divided into sections: 'Equipment Details', 'Equipment Name', 'Manufacturer', and 'Manufacturer Part/Model Number'. The 'Equipment Name' field contains 'ElectFuse', 'Manufacturer' contains 'SIEMENS', and 'Manufacturer Part/Model Number' contains '6ED1052-1CC08-0BA1'. There is also a checkbox for 'Built-in Controller?'.

The screenshot shows two sections of the form. The first section is 'Preliminary classification checklist' with two sub-sections: 'Integration method:' and 'Communication channels present:'. The 'Integration method:' section has four radio buttons: 'PLC', 'Direct through Karabo', 'MicroTCA', and 'To be determined'. The 'Communication channels present:' section has ten radio buttons: 'IO-Signals', 'RS232', 'RS485/RS422', 'EtherCAT', 'Ethernet (GigE)', 'Ethernet (10G)', 'USB-2', 'PCIe', 'Modbus', 'IEEE-488', and 'CAN'. The second section is 'External experts and requesters' which contains a table with the following data:

Expert or Requester	Group	Firstname	Lastname
Expert	CTRL		

Below the table is an 'Integration Deadline' field with the value '2023-06-13'.

All needed input fields and radio buttons have been implemented

- This new tool would permit, in the future, interfacing with a DB so that users will be able to select known equipment-models via predefined menus for their components in a consistent way and with validated information.
- It offers a whole work-flow mechanism to 'approve' incoming requests (at the moment via Redmine tickets)
- Similar tool for CRD could be developed in the future

ERP (Infor)

Class	Part	Description	Long Description	UOM	Preferred Supplier
N	N10327	Motorverteiler NEMA 23 mit Lemo-Steckern		PCS	
N	N10330	PMM 12-50 S2		PCS	
N	N10332	Anbausatz Endlagenschalter		PCS	
N	N10333	Linear-Encoder assembly kit		PCS	
N	N10334	Linear-Encoder Montagesatz resolut		PCS	
N	N10335	Motorverteiler NEMA 23 für 3 Achsen		PCS	
N	N10336	Anbauverteiler 3-Achsen Renishaw Absolut		PCS	
N	N10382	34562871	MONTAGEPLATTE 460T 84TE	PCS	
N	N10383	24560184	NTS MONTAGEPLATTE	PCS	
N	N10420	AA.MC080-A2-L1064-Z32-C355a	Akustooptischer Modulator mit folgenden Spezifikationen - Material Quarz - Anstiegszeit 115ns/mm Strahldurchmesser - HF Frequenz 80MHz - Apertur 2x2mm - Wellenlängenbereich 1030nm -1080nm - HF Leistung nominell 15W - HF Kabel 35cm, SMA-Anschluss - Gehäuse in Pro 343 -	PCS	
N	N10477	Tischaufsteller	Tischaufsteller 16,6 cm x 9,8 cm 5 Sorten à 100 Stück Umfang: 1 Seite, 5 Sorten Format: 9,8 cm x 41,9 cm offen / 16,6 cm x 9,8 cm geschlossen Druck: 4/0-farbig Euroskal/ Papier: Format: 9,8 cm x 41,9 cm offen / 16,6 cm x 9,8 cm geschlossen Druck: 4/0-farbig Euroskal/ Papier:	PCS	

Part	Description	Supplier	Supplier desc	Supplier Part Desc.	Catalog Reference	Preferred Supplier
X00000288	Montageplatte mit Hutschiene	B10000311	Beckhoff Automation GmbH&Co.KG	Montageplatte mit Hutschiene	C0000-10503	<input checked="" type="checkbox"/>
X00000560	Stainless steel table	B10000135	Connect 2 cleanrooms Ltd.	Stainless steel table	SSTUS1	<input checked="" type="checkbox"/>
X00000668	Dell Urban Rucksack 15	B10000732	Dell GmbH (intern)	Dell Urban Rucksack 15	460-BCBC	<input checked="" type="checkbox"/>
X00000661	Dell Notebook Power Bank Plus	B10000732	Dell GmbH (intern)	Dell Notebook Power Bank Plus	451-BBMV	<input checked="" type="checkbox"/>
X00000774	nXDS10 Scroll-Pumpe	B10000041	Edwards GmbH	nXDS10 Scroll-Pumpe	A73601983	<input checked="" type="checkbox"/>
X00000791	Rotguss-Reduzierstück Nr. 3241	B10000537	EPG Hanse KG	Rotguss-Reduzierstück Nr. 3241	32415025	<input checked="" type="checkbox"/>
X00000819	Standardrohrschelle CLIC Top 4	B10000537	EPG Hanse KG	Standardrohrschelle CLIC Top 4	CCLRST46	<input checked="" type="checkbox"/>
X00000841	SHT 25m Kupferrohr als Stange	B10000537	EPG Hanse KG	SHT 25m Kupferrohr als Stange	CUSRAL15H	<input checked="" type="checkbox"/>
X00000858	Frostschutzband 7 Meter mit I-	B10000537	EPG Hanse KG	Frostschutzband 7 Meter mit I-	GCHBS77	<input checked="" type="checkbox"/>
X00000014	Raise3D N2 series Spare Parts	B10000575	3Dimensionals	Raise3D N2 series Spare Parts	PACRA00012	<input checked="" type="checkbox"/>
X00000147	RG 174 AU LSNH / 10,00 m	B10000250	Arnotec GmbH	RG 174 AU LSNH / 10,00 m	127128626227801000	<input checked="" type="checkbox"/>
X00000152	RG 174 AU LSNH / 2,00 m	B10000250	Arnotec GmbH	RG 174 AU LSNH / 2,00 m	260280C9C627800200	<input checked="" type="checkbox"/>
X00000156	RG 174 AU LSNH / 10,00 m	B10000250	Arnotec GmbH	RG 174 AU LSNH / 10,00 m	278278C9C627801000	<input checked="" type="checkbox"/>
X00000295	Überstromschutzklemme 24 V DC,	B10000311	Beckhoff Automation GmbH&Co.KG	Überstromschutzklemme 24 V DC,	EL9227-5500	<input checked="" type="checkbox"/>
X00000302	16-Kanal-Digital-Eingang 24 V	B10000311	Beckhoff Automation GmbH&Co.KG	16-Kanal-Digital-Eingang 24 V	EPP1809-0021	<input checked="" type="checkbox"/>

ERP parts (extract)

- Introduced almost 1 year ago
- Only used by procurement/finance so far.
- Data being entered purely having in mind financial issues: example from the 'description' of the equipment type cannot be recognized at all
- Equipment tagged as 'Asset YES' is inserted *automatically* into xim (since 1-month no human intervention is needed to specify type)

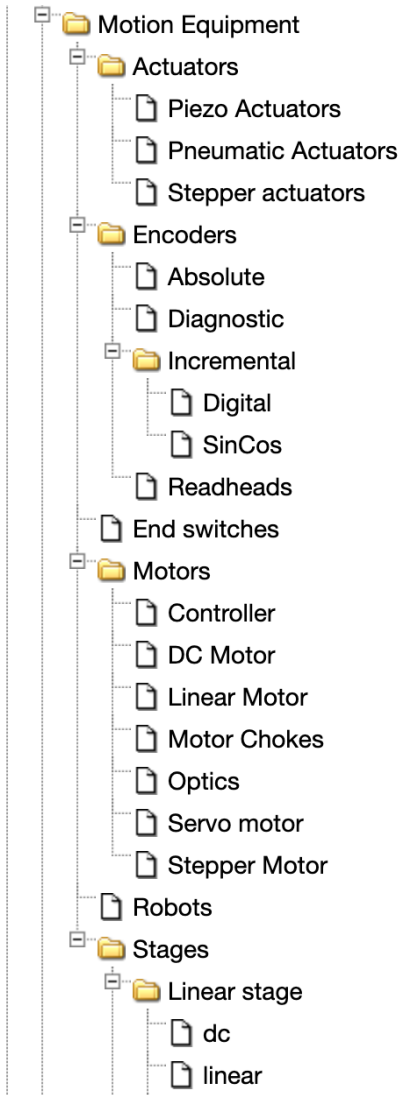
ERP Supplier Part Numbers (extract)

Inventory (xim)

QRcode	Name / Aliases	Category	Item type	Location	Owner group	Contact person	Assigned person
Filter	Filter	Filter	Filter	Filter	Filter	Filter	Filter
56914	EL2809-40963	Digital Output	Beckhoff GmbH EL2809				
56913	EL2809-40962	Digital Output	Beckhoff GmbH EL2809				
56912	EL2809-40961	Digital Output	Beckhoff GmbH EL2809				
56911	EL2809-40973	Digital Output	Beckhoff GmbH EL2809				
56910	EL2809-40972	Digital Output	Beckhoff GmbH EL2809				
56909	EL2809-40971	Digital Output	Beckhoff GmbH EL2809				
56908	EL2809-40970	Digital Output	Beckhoff GmbH EL2809				

Random snapshot of components items

- xim is a tool, developed and maintained in-house, for inventory purposes (mainly asset management)
- It used to be 'voluntary' (large percentage of equipment not inserted at all or not properly completed)
- Some higher level features or configuration capabilities could be needed to exploit this tool for life-cycle management



Equipment categories (extract)

Inventory (xim)

Hardware > Motion Equipment > Encoders > Absolute

Name: Absolute
DB Status: Active
Office network BL: No
Part of: [Hardware](#) > [Motion Equipment](#) > [Encoders](#)
Creation date: Wed Jan 1 04:00:00 2014 (CET)
Description:

Subcategories

No elements associated.

Item types

- Fritz Kübler 8.F3683.2113.C762 (Biss-C 17Bit ST/16Bit MT) (4 items)
- Fritz Kübler 8.F3683.2123.G762 (Gray 17Bit ST/ 16Bit MT) (11 items)
- NEWALL MEASUREMENT SYSTEMS LTD SGH-AS (1 item)
- Renishaw RL26BAT050B30A (3 items)
- Renishaw RL32BAT001B30A (1 item)
- Renishaw RL32BAT005B50A (4 items)
- Renishaw RL32BAT050B30F (7 items)
- Renishaw RL32BVE001D30V (for UHV) (No items)

Models (Types) of absolute encoders: some are not listed SSI/LVDTs/EnDat.

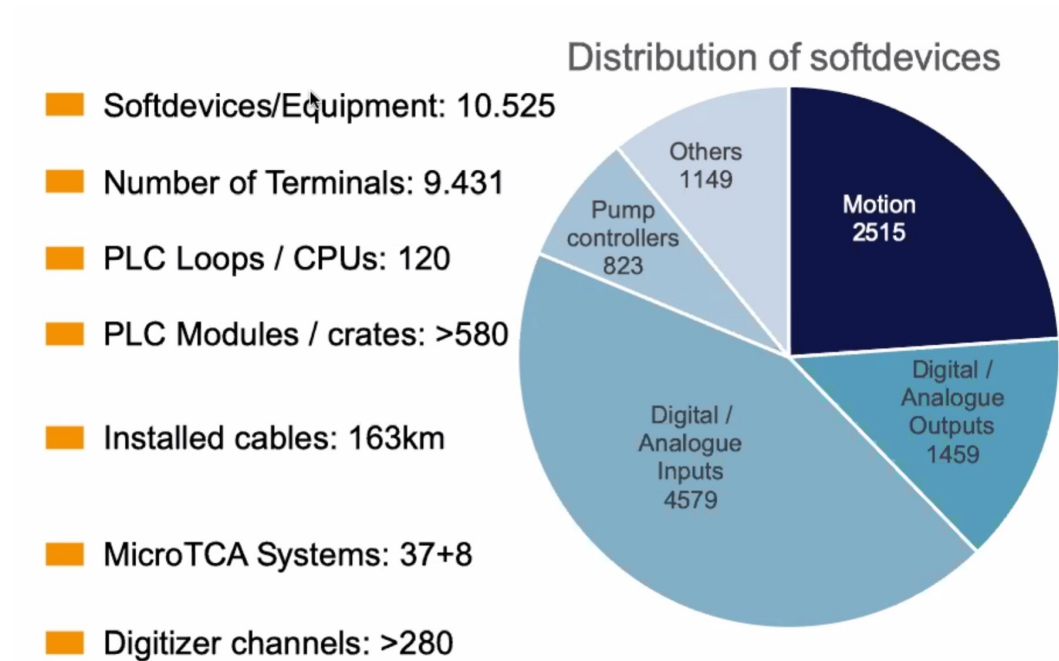
BTW I expect to be able to **count ~200 to 250** Biss-C encoders

- Many devices has been received in bulk and either no inventory was performed on the ensemble, its subcomponent or this information is inaccurate or incomplete
- It requires human collaboration to keep information reliable.
- For more information on this tool please contact M. Manetti and/or A. Frank (both present at this Workshop)

Abbreviated name (prefix)	Identifier	Category	Manufacturer	Model	Version	Warranty (Months)	Item Type	Contact person	Num. items
Filter	Filter	Filter	Filter	Filter	Filter	Filter	Any	Filter	
C6920	---	Control Cabinet PCs	Beckhoff GmbH	C6920	0030	12	Serialized item	Nicola Coppola	25
C6920-0030	---	Control Cabinet PCs	Beckhoff GmbH	C6920-0030		12	Serialized item	Nicola Coppola	7
C6920	---	Control Cabinet PCs	Beckhoff GmbH	C6920-0050		12	Serialized item	Nicola Coppola	205
C6920-0060	---	Control Cabinet PCs	Beckhoff GmbH	C6920-0060		12	Serialized item	Nicola Coppola	2
C6920-0070	---	Control Cabinet PCs	Beckhoff GmbH	C6920-0070		12	Serialized item	Nicola Coppola	2
C6925	---	Industrial PC	Beckhoff GmbH	C6925		12	Serialized item	Nicola Coppola	0

Another case IPCs running PLCs (this is instead complete)

First look into what is there: equipment types extracted from CRD(s)

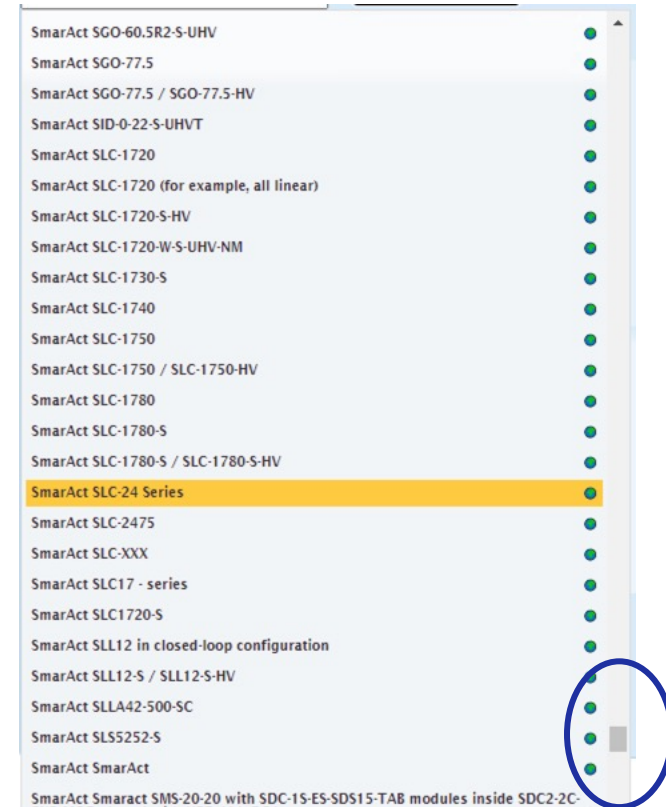
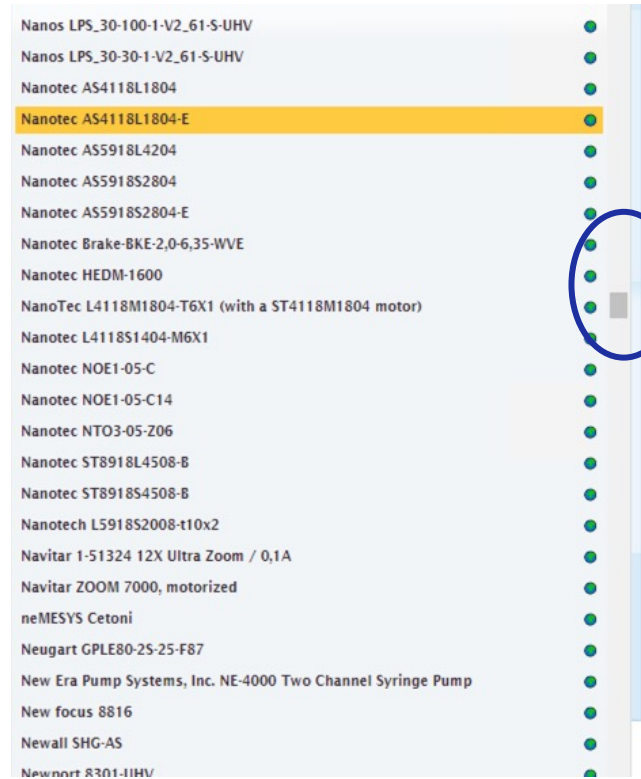


With help of S. Hauf from CTRL Group: database was created

- 500 CRDs parsed containing equipment lists
- 3417 entries created of which:
 - 1226 *unique* recognized models
 - 414 *unique* recognized types
 - 355 *unique* recognized vendors

Status as of 6/2020 (equipment belonging to 3rd port of SASE3 missing from the numbers)

Equipment types extracted back from CRD(s)



Screen-shots of examples of sections of the data present

Please note the extensive list of equipment many present only once

: How to further validate and possibly join this data into xim

Some words on the data

- This information quality is some what limited (this is not an issue for the ‘generation’ of the control system as humans have read the information and created proper EPLAN P8 documentation), but:
 - Most of devices installed in Tunnels are not described in CRDs (we have non-reviewed lists with instance names and equipment category)
 - Oldest CRDs list only certain types of equipment (the newer the CRDs the more complete and consistent data contained within these)
 - Devices which are not ‘controlled’ are not listed (SASE1 installations do not contain any fast-component)
 - Equipment type(s) listed might not correspond with what was delivered or how it was later modified
 - Not all sub-items of equipment part are listed (gearing, end-switches, real sensor and not just sensor type)
 - **No indication** of HW/FW **version** of the installed equipment (or delivery date/integrated duty)

Some words on the data (cont)

■ ...:

- Equipment input was not validated for typos (many models are listed multiple times with different casing or level of verbosity), for example many equipment appears in all the following ways:
 - ▶ Vendor-name Model
 - ▶ vEndor-name MODEL
 - ▶ Vendor-name Product family-name Model
 - ▶ Vendor-name Product family-name
 - ▶
- Mismatch are present (due to incomplete data present in CRDs) so equipment might have vendors or types which are not consistent.
- **All issues are present which are related to the fact that the entered data are ‘free text’ and experience of person who entered it**
- One possible improvement could be gained by joining data from CRDs, EPLAN P8 and xim

What we are missing

- Tool for planning and document maintenance works and interventions
- Documentation of failures of equipment and the respective class
- Tool linking information among tools
- Database of supported devices:
 - which a requester is able to *interrogate* and use to select equipment when designing a new component or when discussing with external vendor
 - which enables cross-linking information xim and other tools

Conclusion and Outlook

- Although with limitations we have plenty of in-house or internally used tools (xim, ERP, CRDs ERDs, e-logbooks, Redmine, EPLAN P8 ...) each could be possibly used to perform certain type of actions
- The aim is to identify if we could 'join' these tools or replace some of these to be able to gather data in a more global way and not in unique and predefined *points of view*.
- I am here to learn from you and to build bridges to be able to cooperate with you
 - Understand from you how and for what type of equipment you perform life-cycle management(s)
 - How do you receive end-of-production statements from vendors
 - Also on how to overcome the 'we are too small we cannot move the industry' feeling