

The CONTACT Elements Data Model

A high-level overview

Patrick Simon

CONTACT Software

August 2022

energizing great minds

Table of Contents

Classes and Objects

Universal
Classification

BOMs & XBOM
Manager

Variant Management

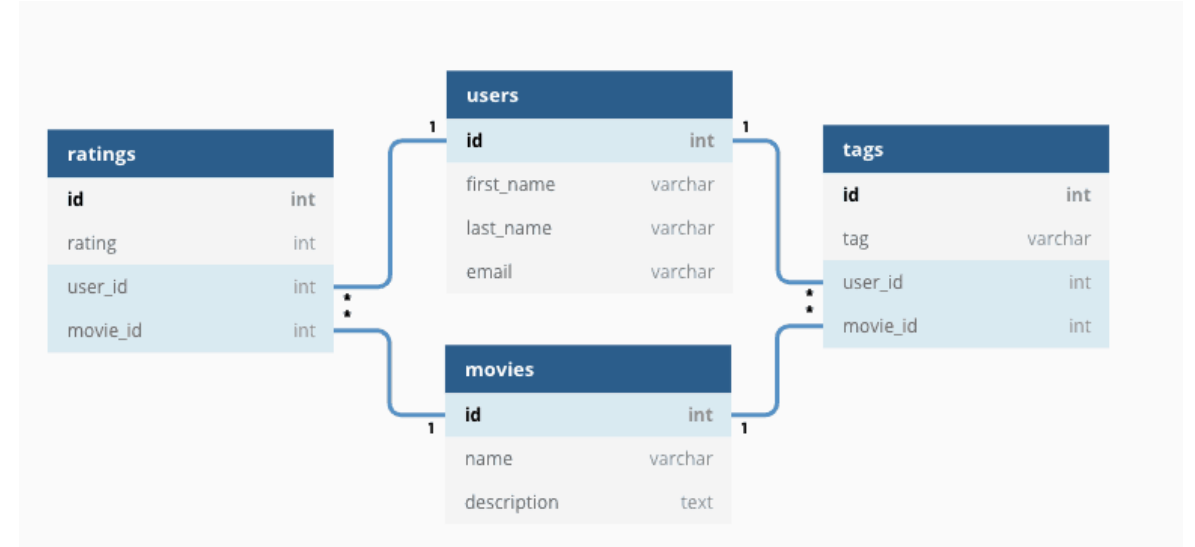
Requirements Mgmt.

Workflows



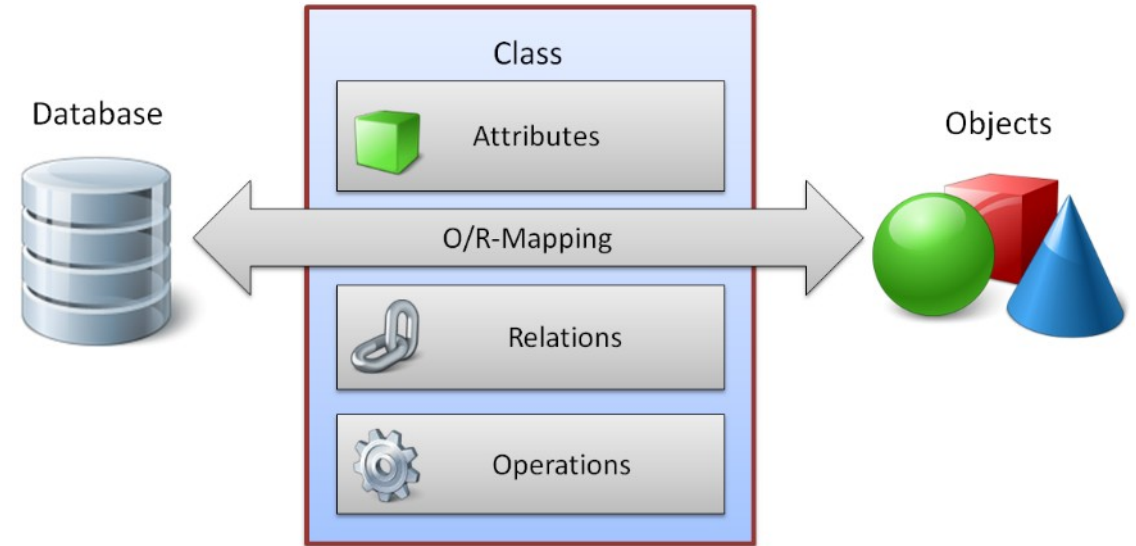
Classes and Objects: Basic Concepts for Relational Databases

- Data stored in SQL database
- Each table represents a certain object class (Person, Organization, Document, Part, ...)
- Each column represents an attribute of that class (Person: Name, Address, Phone Number, Employer, ...)
- Each row represents an object of that class
- Tables have primary keys that uniquely identify each record, and may have foreign keys that establish relationships to other tables



Classes and Objects: The Data Dictionary

- The Data Dictionary is used to define classes in CONTACT Elements
- It serves as a blueprint for each object
- It defines attributes of various types: Char, Int, Float, Date, ...
- Compiling a DD class creates a corresponding SQL database scheme
- The DD allows the definition of relationships to other classes



Classes and Objects: Operations

- Describe how the user interacts with class and its objects
- Examples: Create, Copy, Search, Show Object, Status Change, ...
- Operations are connected to the user interface and rights system
- Different input dialogs can be configured for each operation
- User Exits connect business logic to operations:
 - „Do X, Y and Z after a new document has been created.“
 - „Verify the input data before allowing a user to modify object X.“
 - „Automatically fill the author, department and project number when a new object is being created in a specific context.“
 - ...

The screenshot displays the CDB software interface. On the left, a tree view shows the hierarchy of the system, including 'document (Document)', 'Tables', 'Operations', 'Relationships (Referer)', 'Attributes', 'Constraints', 'Outlets', and 'Life Cycle Configuration'. The 'Operations' folder is highlighted with a yellow box. On the right, the 'Operations' panel is visible, showing a list of operations with their names, applicability, and labels. The panel is also highlighted with a yellow box.

Name	Applicability	Label
CDB_Create	Class	&New ...
cdb_create_doc_from_template	Class	Create from Template ...
CDB_CreateWithSearchConditions	Query	Create from Search Condition
CDB_SelectAndAssign	Query	Search and Assign
CDB_Search	Class	&Search ...
CDB_SearchAgain	Query	Search Again ...
CDB_ShowObject	SingleObject	Information
CDB_Modify	SingleObject	&Modify ...
CDB_Copy	SingleObject	&Copy ...
CDB_Index	SingleObject	Generate Index
CDB_Workflow	SingleObject	Status Change
CDB_View	MultipleObjects	&View
CDB_Imagination_Overview	MultipleObjects	Overview
CDB_Edit	SingleObject	Edit
CDB_PrintDocument	MultipleObjects	Print
cdbwf_ahwf_new_from_template	MultipleObjects	
CDB_SubscribeToChannel	MultipleObjects	Activities/Subscribe
CDB_UnsubscribeFromChannel	MultipleObjects	Activities/Unsubscribe

Classes and Objects: Object Lifecycle

- Describes the various states that object can be in
- Transitions can be triggered manually (by users with the correct role) or automatically during certain work or user exits
- Status changes can trigger their own follow-up processes, and determine which users have which rights for respective object
- Different lifecycles for different sub-categories of a class are possible

The screenshot displays the CDB software interface. On the left, the 'Life Cycle Configuration' tree is visible, showing a hierarchy of objects and their states. A yellow box highlights the 'document' object and its associated states: 0: Draft, 170: Blocked, 180: Obsolete, 190: Revision, and 200: Released. On the right, the 'Operations' table lists various actions and their applicability.

Name	Applicability	Label
CDB_Create	Class	&New ...
cdb_create_doc_from_template	Class	Create from Template ...
CDB_CreateWithSearchConditions	Query	Create from Search Condition
CDB_SelectAndAssign	Query	Search and Assign
CDB_Search	Class	&Search ...
CDB_SearchAgain	Query	Search Again ...
CDB_ShowObject	SingleObject	Information
CDB_Modify	SingleObject	&Modify ...
CDB_Copy	SingleObject	&Copy ...
CDB_Index	SingleObject	Generate Index
CDB_Workflow	SingleObject	Status Change
CDB_View	MultipleObjects	&View
CDB_Imagination_Overview	MultipleObjects	Overview
CDB_Edit	SingleObject	Edit
CDB_PrintDocument	MultipleObjects	Print
cdbwf_ahwf_new_from_template	MultipleObjects	
CDB_SubscribeToChannel	MultipleObjects	Activities/Subscribe
CDB_UnsubscribeFromChannel	MultipleObjects	Activities/Unsubscribe

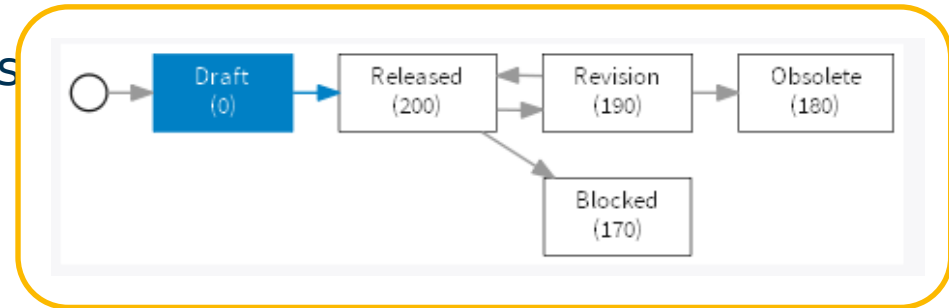


Table of Contents

Classes and Objects

Universal
Classification

BOMs & XBOM
Manager

Variant Management

Requirements Mgmt.

Workflows



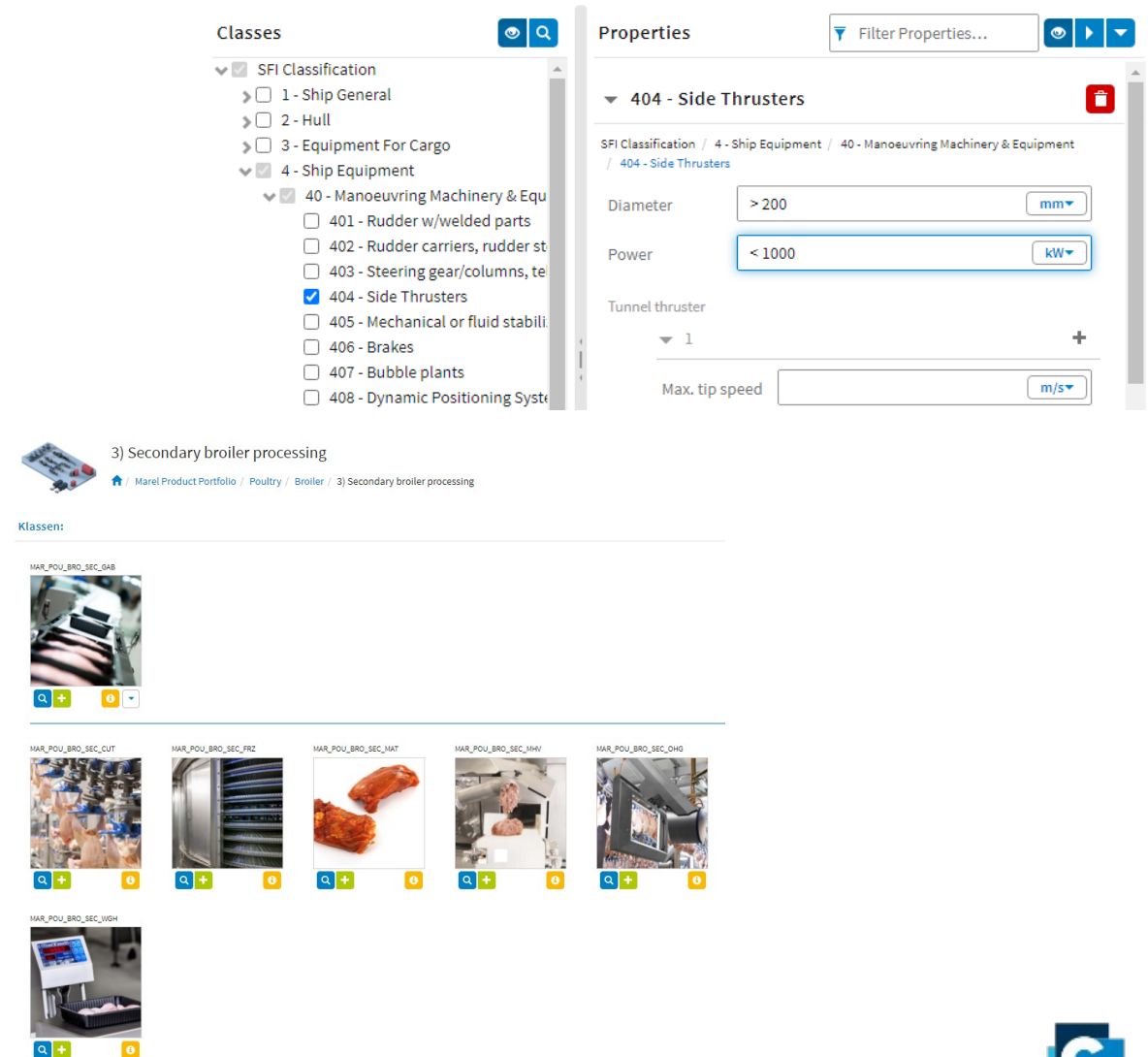
Universal Classification: Basic Concepts

- Allows the classification of all objects in the system for additional description, or separation or grouping
- Extends the data model, but only where needed
- Highly flexible
 - One UC class can be used for multiple data dictionary classes
 - Does not modify the database schema
 - Can be administrated by certain user groups

The screenshot displays the 'Classification' software interface. On the left, a 'Classes' tree shows a hierarchy starting with 'SFI Classification', followed by '4 - Ship Equipment', and then '40 - Manoeuvring Machinery & Equipment'. Under '40', the class '404 - Side Thrusters' is selected. On the right, the 'Properties' panel shows configuration for the selected class. It includes fields for 'Diameter' (900.00 mm), 'Power' (1.21 kW), and a 'Tunnel thruster' section with a dropdown set to '1'. Below this, there are fields for 'Max. tip speed' (50 m/s), 'Rating approx.' (120 kW), 'Min. diameter' (1000 mm), 'Input rpm' (223 rpm), 'Drive', and 'Pitch'. At the bottom, a 'Frequency converter' section is visible with a dropdown set to '1' and fields for 'Min. Ingress ...' and 'Insulation cl...' (set to 'IP44').

Universal Classification: Classes and Properties

- Any object can be classified with one or multiple Universal Classification classes
- Each UC class has a list of pre-defined class properties, for which an object can have its own property values
- The classified search allows users to find objects belonging to certain UC classes, and with specific property values within these classes
- The object plan allows for easy navigation and search based on the UC structure



Universal Classification: Rules, Formulas and Constraints

- Universal Classification brings certain features out of the box that would usually need to be customized through user exits:
- Rules: set certain class properties to mandatory/optional and editable/read-only based on other property values
- Formulas: automatically fill property values based on other property values
- Constraints: restrict users from assigning specific property values or combinations

The screenshot displays the 'Class Overview' window of the Universal Classification software. The left sidebar shows a hierarchical tree of classes, with '40 - Manoeuvring Machinery & Equipment' expanded. The main area is divided into two panes. The top pane, 'Property Values', shows the 'Power (SFI_404_SFI_404_POW)' property. The bottom pane, 'Formula Editor', shows a formula being edited: 'SFI_404_SFI_404_DIA > 100'. The 'List of Formulas' pane on the left shows a formula 'If SFI_404_SFI_404...'. The 'Checking of Formulas' pane on the right shows the '404 - Side Thrusters' class with various properties like Diameter, Power, Tunnel thruster, Max. ti..., Rating..., Min. d..., Input..., Drive, and Pitch. The interface includes a top navigation bar with tabs for Class Overview, Data Sheet, Properties, Property Groups, Table columns, Applicability, Subclasses, Images, Constraineditor, and Doc. The bottom of the window shows a status bar with the ID 'ia-a561-000c29fd00ac#'. Buttons for 'Save', 'Cancel', and 'Validate' are visible at the bottom right.

Table of Contents

Classes and Objects

Universal
Classification

**BOMs & XBOM
Manager**

Variant Management

Requirements Mgmt.

Workflows



BOMs and XBOM Manager: Basic Concepts

- The Bill of Material (BOM) is a key component of CONTACT Element's Virtual Product module
- It describes the structure of a whole product or one of its various sub-

eBOM reflects how the product has been designed

Engineering BOM (eBOM)					
Search...					
	Description	Pred...	Operati...	Component No.	Index Qu...
	Conveyor Belt System 4VAR			9507328	
	10: Frame			9507205	1
	20: Lateral Guide Rail			9507206	2
	30: Pulley	»X		9507207	75
	50: Support			9507330	2
	60: Fence	»X		9507331	2
	70: Wireway			9507212	1
	80: Roller Conveyor Drive System	»X		9507203	1
	10: Hexagon Socket Screw			9507202	4

mBOM reflects the stages involved in assembly

Manufacturing BOM (mBOM)					
	Acti... Description	Pred...	Operations	Component No.	Index Qu...
	Conveyor Belt System 4VAR			9508508	
	1: Conveying			9508509	1
	2: Frame			9508510	1
	10: Frame			9507205	1
	20: Support			9507330	2
	30: Support			9507343	4
	40: Mounting Frame			9508127	1
	70: Wireway			9507212	1
	110: Control Cabinet			9508111	1

Takes into account logistical parts, pseudo-parts, logistical units; integration of lubricants, shipping protection, ...

BOMs and XBOM Manager: Features of the XBOM Manager

- The XBOM Manager offers side-by-side comparison between eBOMs, mBOMs, other BOM types
- Automatic calculation of quantity differences
- Highlighting of matching positions (and components in 3D model)
- Easy and intuitive creation and maintenance of derived BOMs

The screenshot displays the XBOM Manager interface with the following components:

- Top Bar:** CONTACT Elements logo, search bar, and navigation icons.
- Left Panel:** Tree view showing the hierarchy of the Engineering BOM (eBOM) for part 9507210.
- Center Panel:** Side-by-side comparison of the Engineering BOM (eBOM) and Manufacturing BOM (mBOM) for part 9507210. The eBOM table lists components like Pipe Installation, Conveyor Belt System, Frame, Lateral Guide Rail, Pulley, Fence, Roller Conveyor Drive System, Hexagon Socket Screw, Electric Motor 7,5 kW, Adapter, Wireway, Support, Middle support, and pallet. The mBOM table lists components like Conveyor Belt System Small, Side Panel, Pulley, Conveyor Belt, Frame, Roller Conveyor Drive System, Hexagon Socket Screw, Electric Motor 7,5 kW, Adapter, Steel Grating Staircase, Modular Unit with Pressure R..., Modular Unit with Floor, Railing, Pipe Bend, and Pipe Bend.
- Bottom Left:** 3D model of the conveyor system assembly.
- Bottom Right:** Table of Quantity Differences (13) comparing eBOM and mBOM quantities.

Part No.	Index	Structure Level	Name	Category	eBOM	mBOM	Differences
9507210	3	Electric Motor 7,5 kW	Assembly/mechatronic	5	6	-1	
9507203	2	Roller Conveyor Drive System	Assembly	5	6	-1	
9508078	2	Support	Single Part	16	20	-4	
9508143	1	Conveyor Belt System	Assembly	4	5	-1	
9507207	2	Pulley	Single Part	300	375	-75	
9507211	3	Adapter	Single Part	5	6	-1	
9507202	2	Hexagon Socket Screw	External Single Part	246	252	-6	
9507212	2	Wireway	External Single Part	4	5	-1	
9507206	2	Lateral Guide Rail	Single Part	8	10	-2	
9507205	2	Frame	Single Part	4	5	-1	
9507209	2	Fence	Single Part	8	10	-2	
9508079	2	Middle support	Single Part	8	10	-2	
9507673	1	pallet	Logistical Assembly	5	10	-5	

Table of Contents

Classes and Objects

Universal
Classification

BOMs & XBOM
Manager

Variant Management

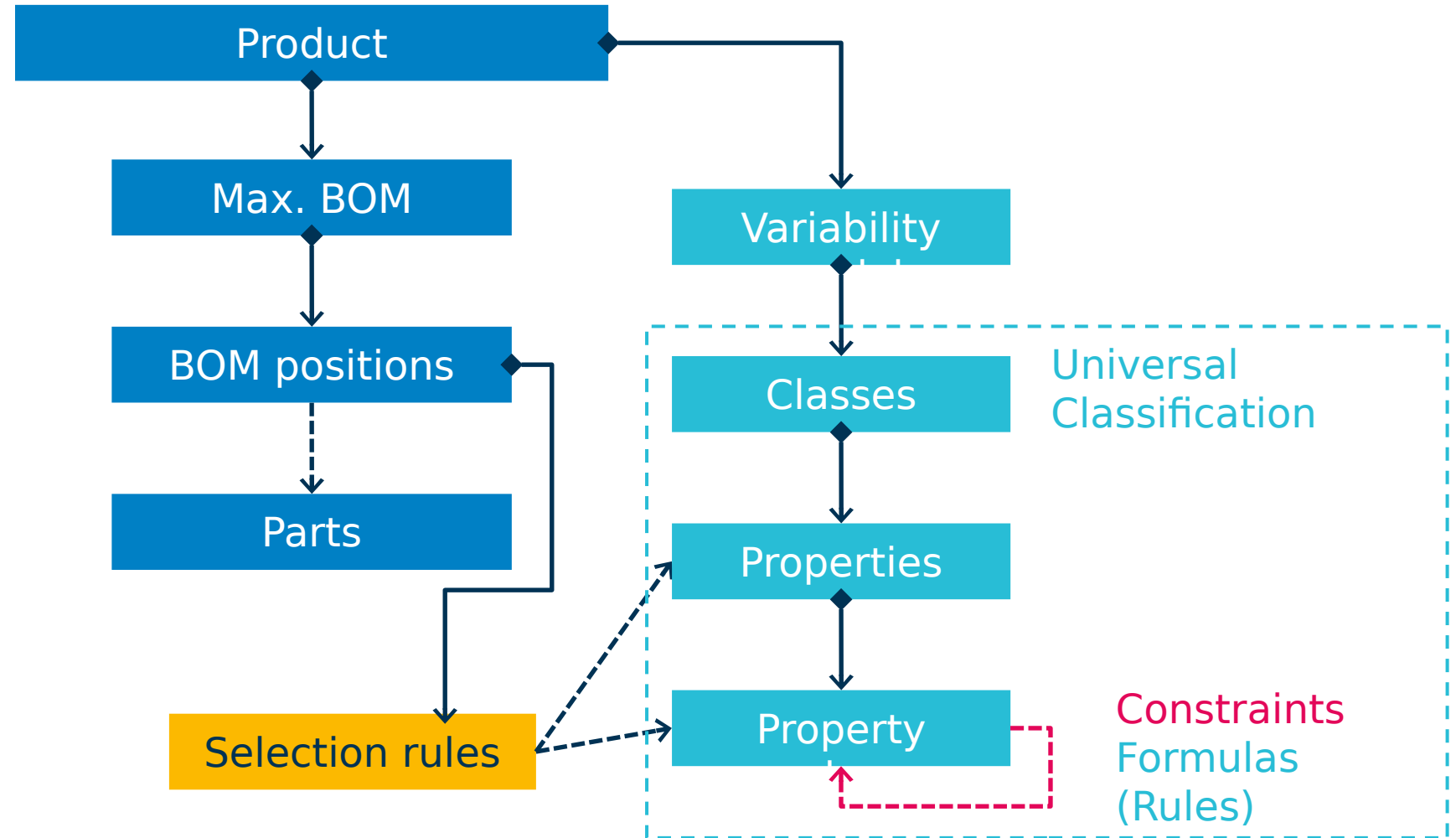
Requirements Mgmt.

Workflows

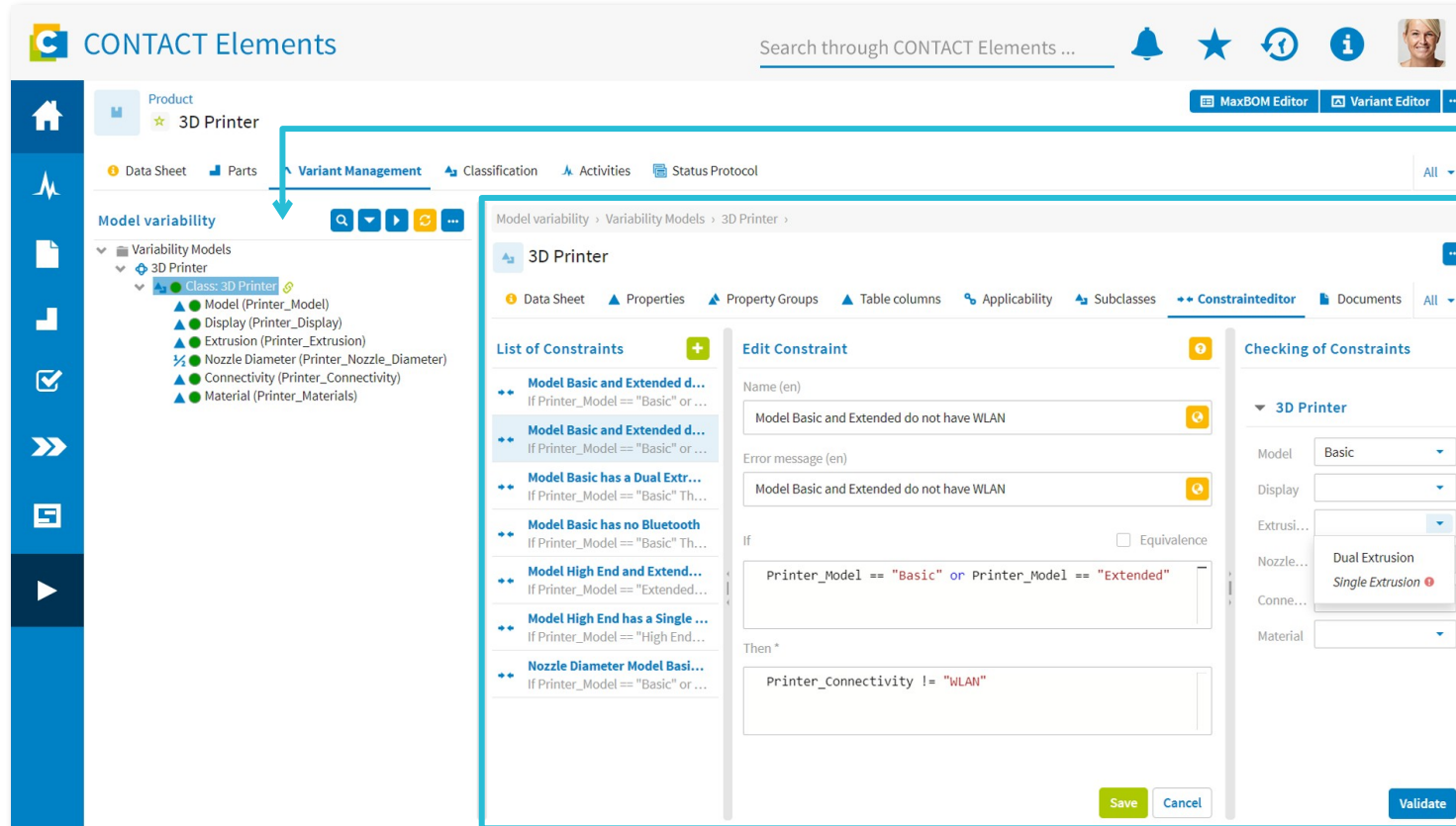


Variant Management: Basic Concepts

- Variant Management combines the worlds of BOM Management and Universal Classification
- A product's maximum BOM contains all possible parts and assemblies
- A UC-based variability model describes the variant space
- Selection rules define which of these variable parts are instantiated for

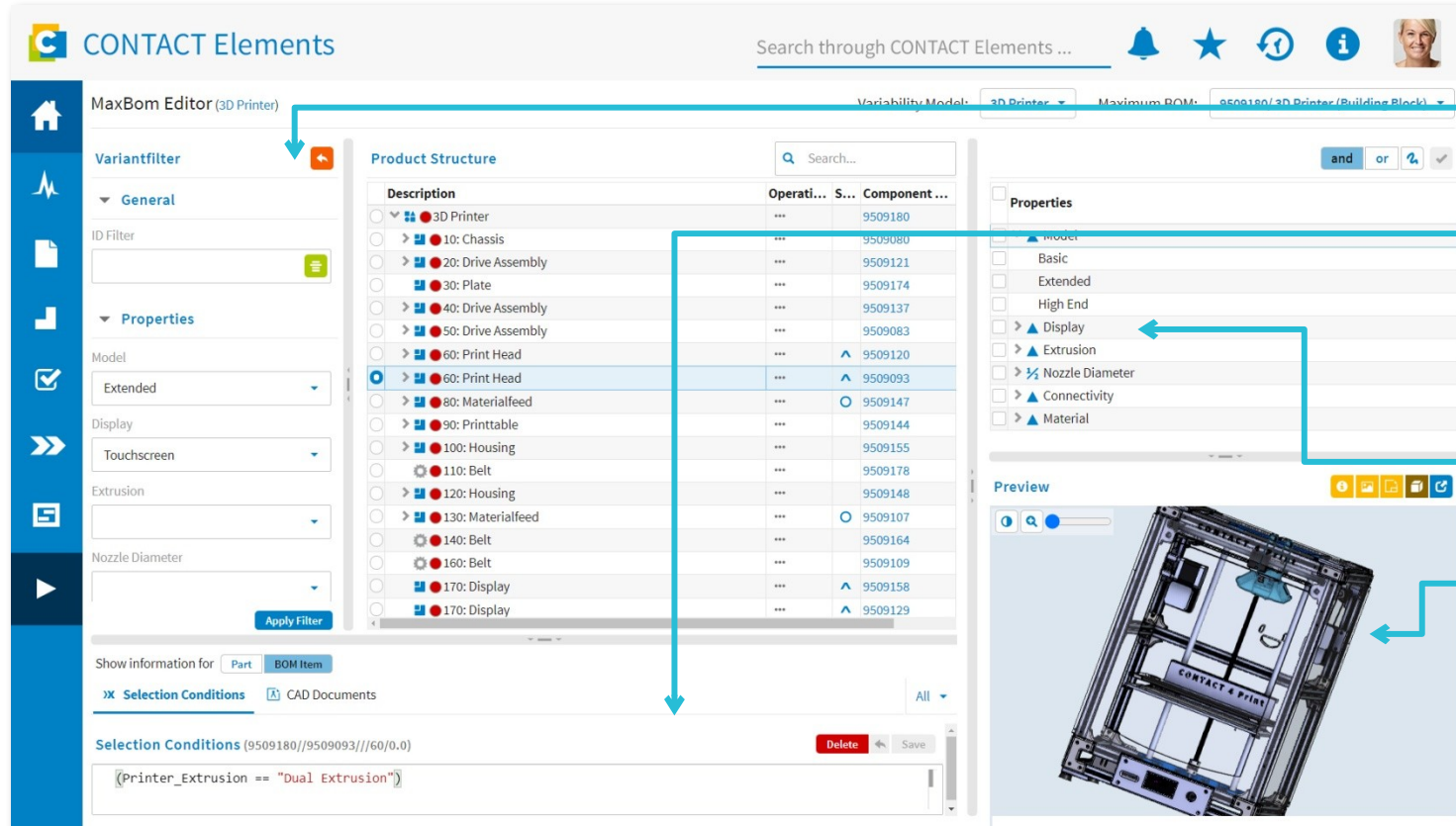


Variant Management: Variability Model



- 1 Create properties and their values
- 2 Easily define and validate constraints in the Constraint Editor

Variant Management: MaxBOM Editor



- 1 Variant filter for validating regulation of the maximum BOM
- 2 Definition of the selection conditions via text input with auto-completion ...
- 3 ... or with a few clicks
- 4 Visual support thanks to the integration of 3D preview

Variant Management: Variant Editor

CONTACT Elements

Search through CONTACT Elements ...

Variant Editor (3D Printer)

Variability Model: 3D Printer Maximum BOM: 9509180/ 3D Printer (Building Block)

Variantfilter

General

ID Filter

Only show incomplete variants

Status

Unsaved Valid Invalid

Properties

Model: High End

Display: Touchscreen

Extrusion: Single Extrusion

Nozzle Diameter

Apply Filter

72 Variants - 1 Selected

Variantfilter active

Enter Filter Text Here

S.. ID	Name	N...	O...	Model	Connectivity
1	High End PVA	0	...	High End	WLAN
2	High End PP	1	...	High End	WLAN
11	High End PVA USB	0	...	High End	USB
12	High End PLA LAN	0	...	High End	LAN
13	High End PVA Bluetooth	0	...	High End	Bluetooth
14	High End PLA	0	...	High End	Bluetooth
			...	High End	WLAN
			...	High End	WLAN
			...	High End	WLAN
			...	High End	WLAN
			...	High End	USB
			...	High End	USB
			...	High End	USB
			...	High End	USB
			...	High End	USB
			...	High End	LAN
			...	High End	LAN
			...	High End	LAN
			...	High End	LAN

Instantia...

Part No. Index

9509191

Violated Constraints (0)

No violated Constraints

Load More Entries

- 1 Filter options for quickly limiting the variant space
- 2 Overview of a variant's instantiated parts
- 3 Entire variant space as a result of properties and constraints, variants can be saved, named, and instantiated from this view

Table of Contents

Classes and Objects

Universal
Classification

BOMs & XBOM
Manager

Variant Management

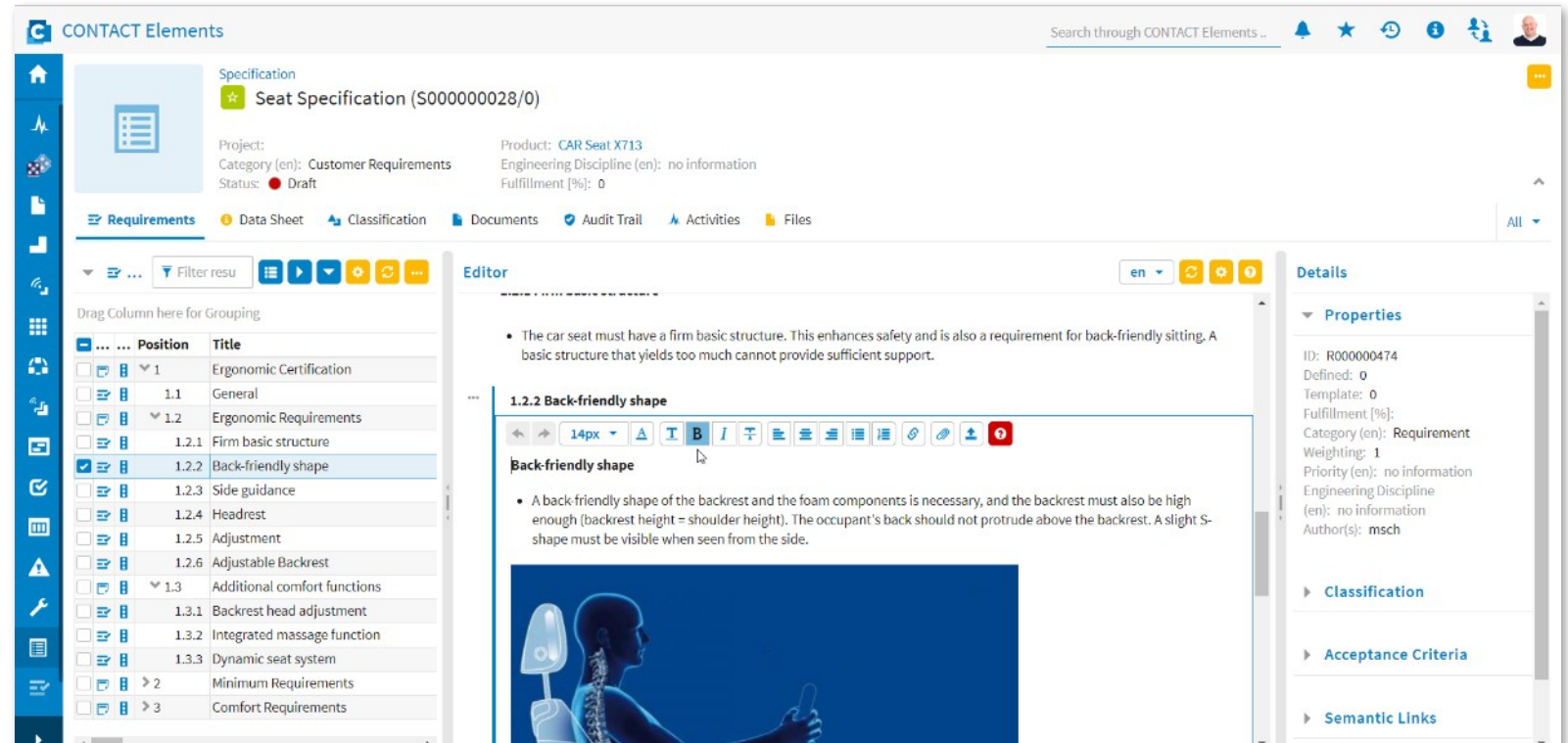
Requirements Mgmt.

Workflows



Requirements Management: Basic Concepts

- Create and edit web-based specifications, their requirements and acceptance criteria
- Add layouts and image information
- Classification and evaluation of requirements
- Link requirements to acceptance criteria



Requirements Management: Baselining

The screenshot displays the CONTACT Elements web application interface for requirements management. The main window is titled "Spezifikationsvergleich" (Specification Comparison). It shows a comparison between two versions of a requirement set: Version A (ReqIF Import Baseline) and Version B (Seat Specification). The interface includes a left sidebar with a tree view of requirements, a main comparison area with two versions (A and B) selected, and a detailed view of a selected difference. The comparison area shows a table of requirements with columns for position, object description, and ID. The detailed view shows a description of a selected difference, including a diagram of a car seat.

Position	Objektbeschreibung	ID
1	Ergonomische Zertifizierung (R000000197/0)	R0000
1.1	Allgemein (R000000198/0)	R0000
1.2	Anforderungen zur Ergonomie (R000000199/0)	R0000
1.2.1	Feste Grundstruktur (R000000200/0)	R0000
1.2.1.1	Wirbelsäulengerechte Ausformung (R000000201/0)	R0000
1.2.1.1.1	Seitenführung am Sitzkissen (R000000202/0)	R0000
1.2.1.1.1.1	Kopfstütze (R000000203/0)	R0000
1.2.1.1.1.1.1	Einstellbarkeit (R000000204/0)	R0000
1.2.1.1.1.1.1.1	Einstellbare Rückenlehne (R000000205/0)	R0000
1.2.1.1.1.1.1.1.1	Zusatzfunktionen für mehr Komfort (R000000206/0)	R0000
1.2.1.1.1.1.1.1.1.1	Mindestanforderungen (R000000210/0)	R0000
1.2.1.1.1.1.1.1.1.1.1	Komfortanforderungen (R000000219/0)	R0000

Comparison between a baseline and the current configuration

Overview of differences between compared configurations

Detailed view of a selected difference



Specification

★ Standard PCT Specification (S000000046/0)

Specification [S]
Test Specification

Project: PCT Development, Testing and Industrialization

Category (en): Test Specification

Status: ● Draft

Product: Personal Car Tyre

Engineering Discipline (en): Mechanical Engineering

Fulfillment [%]:

[Requirements](#) [Data Sheet](#) [Classification](#) [Documents](#) [Audit Trail](#) [Activities](#) [Files](#)

▼ Re... Enter Fi...

Editor

Drag Column Headers Here to Group

	R..	F..	Position	Title
<input type="checkbox"/>			1	General Information
<input type="checkbox"/>			2	D-Spec
<input type="checkbox"/>			3	Processing
<input type="checkbox"/>			▼ 4	Test Specification
<input type="checkbox"/>			4.1	Outdoor Testing
<input type="checkbox"/>			▼ 4.2	Indoor Testing
<input checked="" type="checkbox"/>			4.2.1	High Speed Test
<input type="checkbox"/>			4.2.2	Endurance Test
<input type="checkbox"/>			► 5	Production Tool Specifications
<input type="checkbox"/>			▼ 6	Bill Of Materials
<input type="checkbox"/>			► 6.1	Vulcanized Tyre

Requirement [R]

Test Case

A testing request defines the testing to be performed on an article

which (a part of) an article is made. This article could undergo a preparation or ageing before testing. Preparation and ageing other than the default are specified by the requester.

Testing is also performed as routine production control. In this case production articles are tested with a certain frequency in order to monitor the production quality.

1. All testing requests are stored and handled in the LIMS system.

2. Tests can only be performed on certain article types. When a request is created for a test on a certain article type, only tests can be selected that are valid for that article type.

3. The LIMS automatically creates requests from the control plan, when tests are within the scope of LIMS.

4. The LIMS allows easy entry of test results for production control (preferably without the need of creating a request)

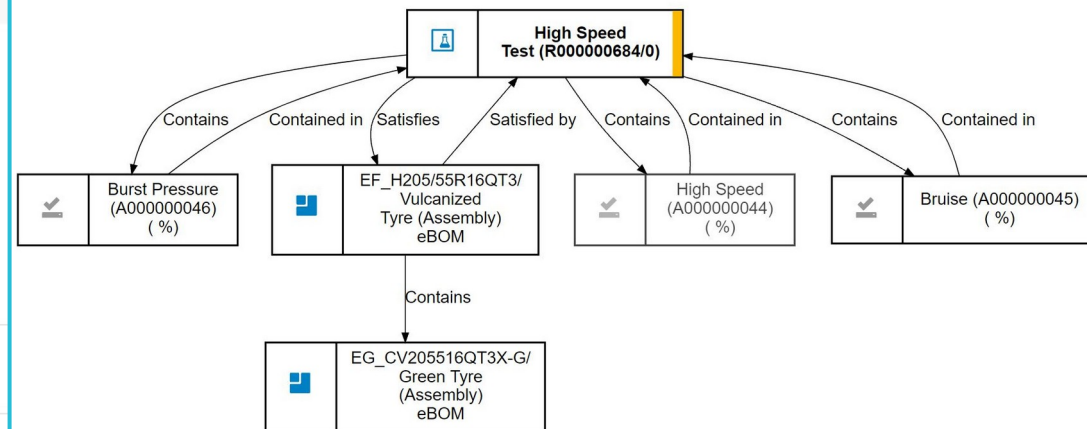
5. Requesting a standard test is possible with only a single code. Default values in preparation, aging, conditions and testing are used.

6. It is easy to request a test with ageing, preparation, test conditions and other settings than the default. The results of these results should not be mixed with results with the standard settings.

4.2.1 High Speed Test

High Speed Test

4.2.2 Endurance Test



Acceptance

Criteria [A]

<input type="checkbox"/>		High Speed
<input type="checkbox"/>		Bruise
<input type="checkbox"/>		Burst Pressure

Test Result [TR]

Testruns (1)

Drag Column Headers Here to Group

S..	Status	F..	ID	Titel
<input type="radio"/>	Waiting		TR00000007	High Speed Test

Table of Contents

Classes and Objects

Universal
Classification

BOMs & XBOM
Manager

Variant Management

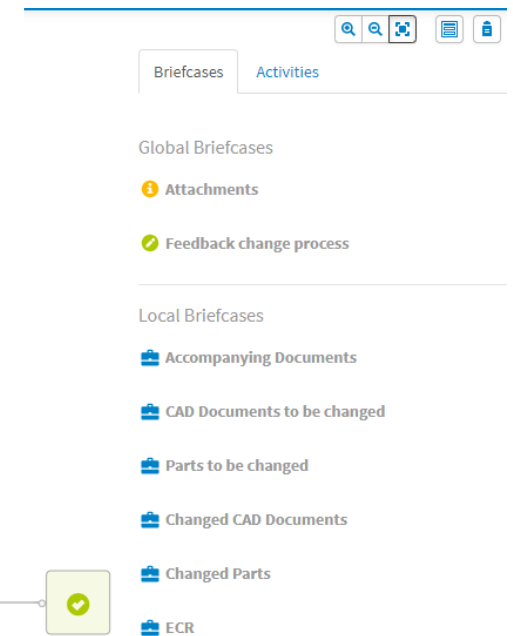
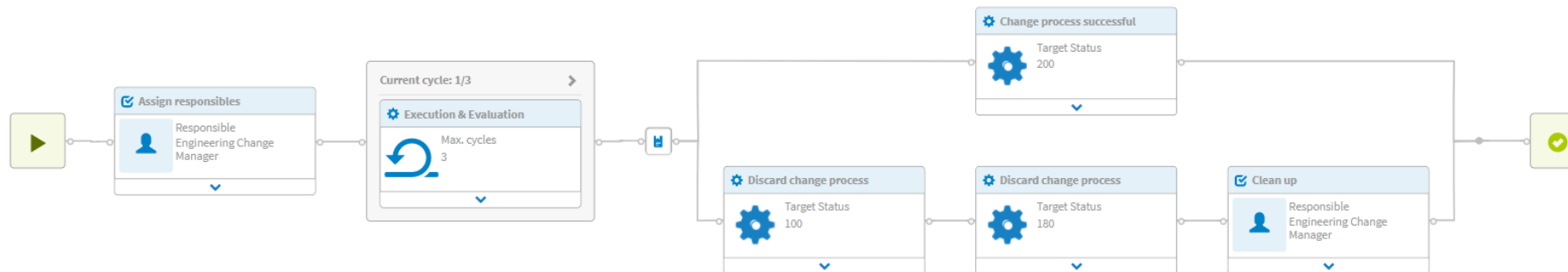
Requirements Mgmt.

Workflows



Workflows: Basic Concepts

- Workflows are used to model business processes in CONTACT Elements
- They can contain (among others):
 - Standardized tasks (Review, Approval)
 - Notification of users/user groups
 - Status changes
 - Forms that need to be filled out
- Workflow Designer: graphical interface
- Workflow Tasks show up in „My Tasks“



Questions



Thank You!

www.contact-software.com

*energizing great
minds*