



# DEVELOPMENT WITH FOCUS ON AUTOMOTIVE SPICE AND FUNCTIONAL SAFETY @ DRÄXLMAIER

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EC12, Quality, Guidelines & Infrastructure

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A decorative graphic in the top-left corner consisting of several overlapping, colorful triangles in shades of pink, yellow, and blue.

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# AGENDA

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- Introduction
- Standards and Processes
- Usage of Integrity
- Summary and Questions

# INTRODUCTION

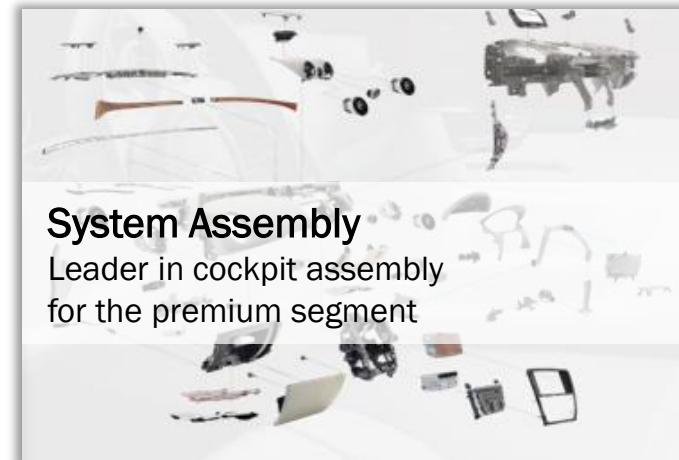
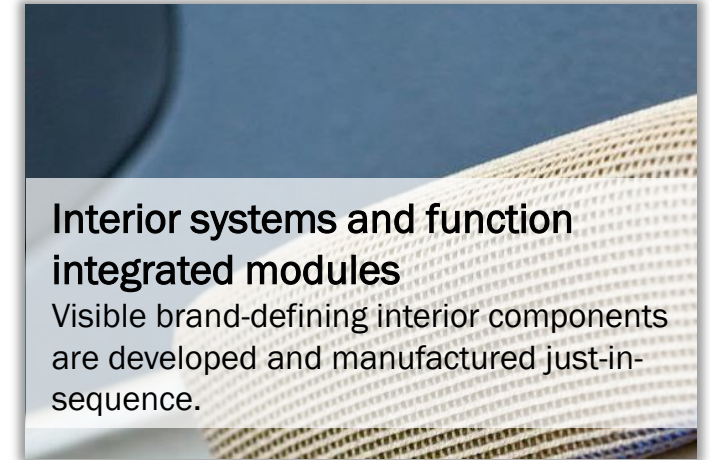
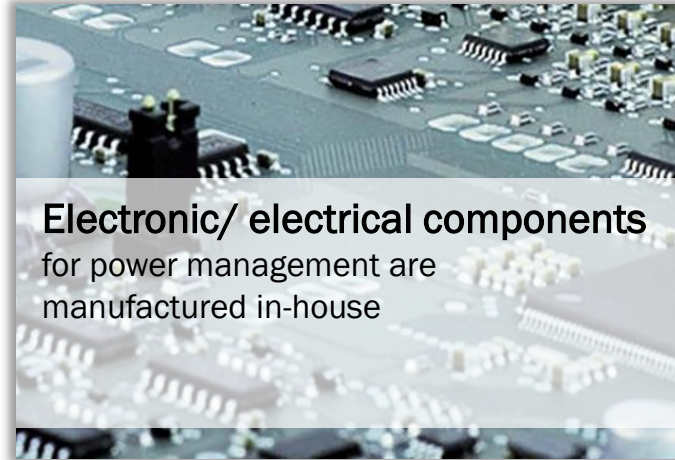
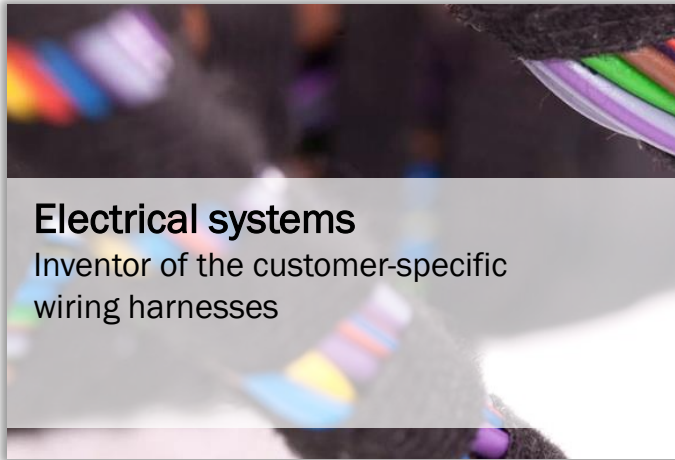
# DRÄXLMAIER AT A GLANCE



- Automotive supplier (Tier 1) focused on premium and luxury car segment
- > 60 sites in more than 20 countries worldwide
- > 55.000 employees
- Headquarter: Vilsbiburg (Germany)
- Customers: Audi, BMW, Bugatti, Cadillac, Daimler, Jaguar, Lamborghini, Land Rover, Maserati, Mini, Porsche, Tesla, Volkswagen



# DRÄXLMAIER PRODUCT AND COMPETENCE OVERVIEW



# DEPARTMENT ENGINEERING COMPONENTS



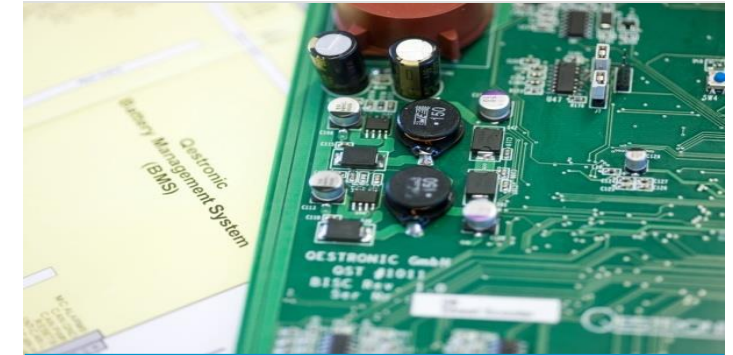
## Locations / Development Sites

- Vilsbiburg (Germany)
- Munich (Germany)
- Braunau (Austria)
- Pitesti (Romania)
- Gliwice (Poland)



## Main product segments

- Battery Systems  
(Lithium Ion, Hybrid, E-Mobility)
- Electronic and Electric Components
- Testing and Validation Equipment



## (Sub-) departments:

- Department Control
- Engineering Electronics
- Engineering Electro-Mechanics
- Engineering Electrics
- Testing and Validation
- Testing and Validation Equipment

# STANDARDS AND PROCESSES

# AUTOMOTIVE SPICE



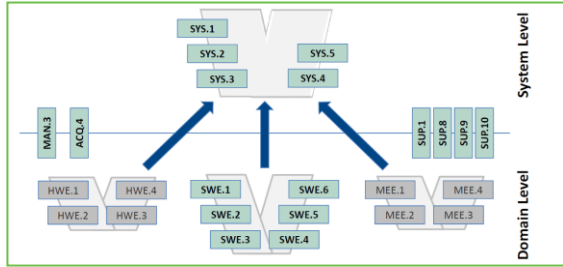
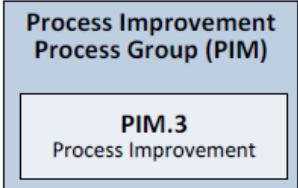
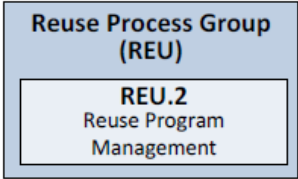
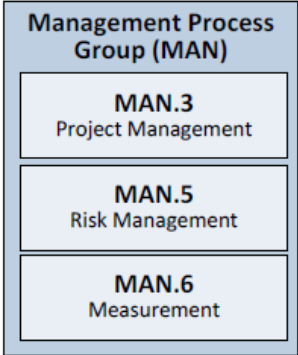
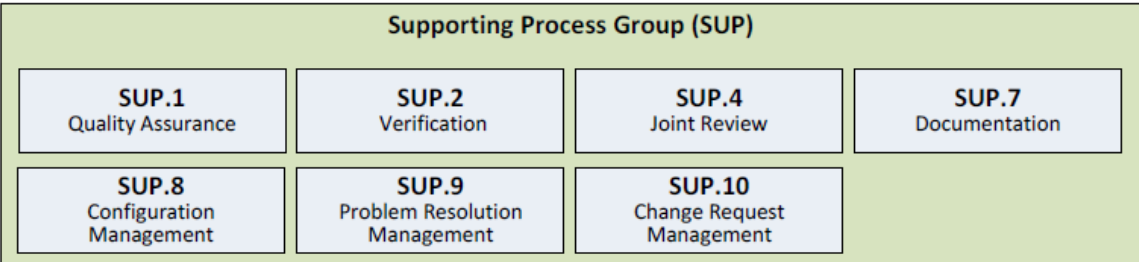
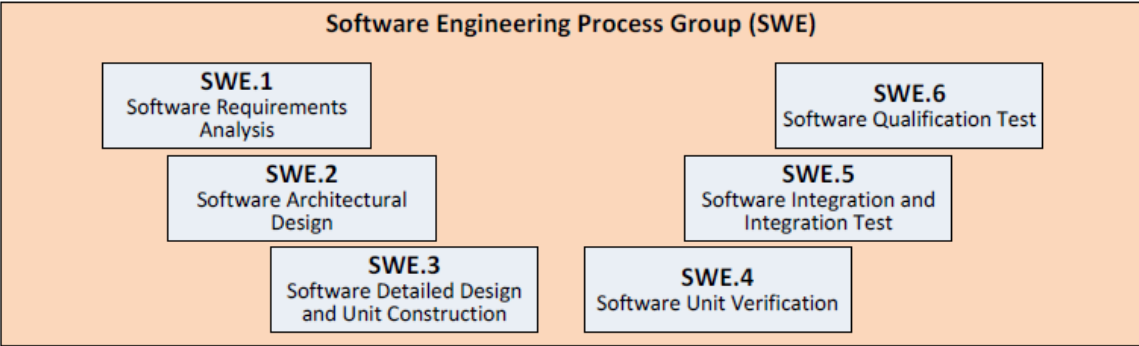
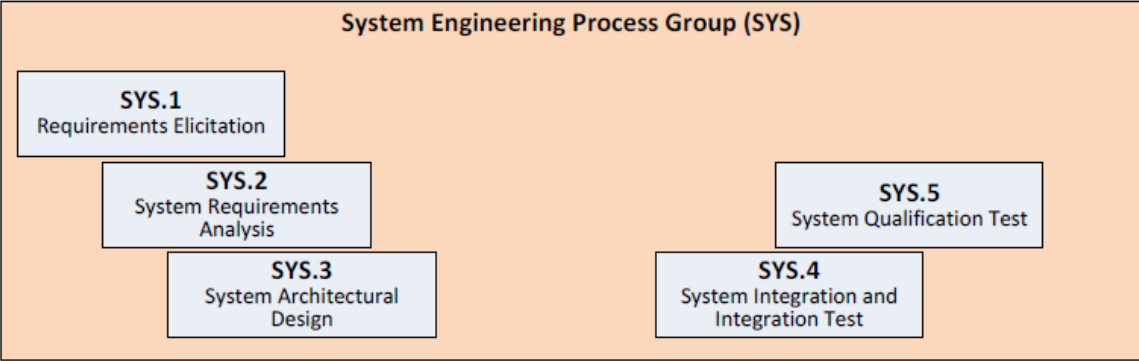
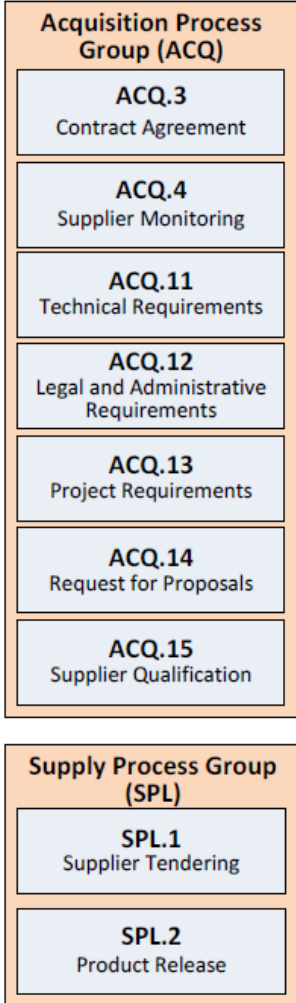
**Automotive SPICE®** is owned by **VDA** (German „Verband der Automobilindustrie“) and a domain specific variant of the international standard ISO/IEC 15504 (SPICE).

- Originally designed for **electronic / software development** in automotive industry.
- Focuses on evaluation and **continuous improvement** of development processes .
- Lists **processes** and **outputs** including their characteristics and requirements.
- Not a complete, detailed and specific engineering process though.
- Useful **guideline** to develop company specific engineering processes.
- **V-Model** approach that pays a lot of attention to **Traceability** and **Consistency**.
- German **OEMs** explicitly request Automotive SPICE from their suppliers.
- Controlled by regular **audits** and **assessment**.

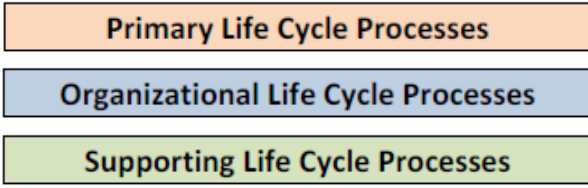




# ASPICE 3.0 PROCESS MODEL



More than software only



# ISO 26262 - FUNCTIONAL SAFETY



**ISO 26262** („Road vehicles – Functional Safety“) is an (international) ISO standard in automotive industry for **electronic and electric systems** of passenger vehicles.

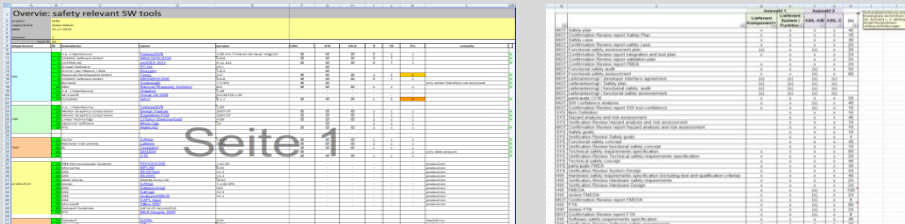
- Focus is to ensure functional safety and thus **safety of passengers**.
- May lead to **severe juridical consequences** if not applied in safety relevant projects .
- Defines required **activities** and **outputs** as well as **specific methods** for engineering, testing and production (as well as acquisition and supplier processes) .
- Not isolated of normal engineering, testing and production processes but rather an **enhancement** of those.
- Pays a lot of attention to **Traceability** and **Consistency** (as well).
- Its process model matches very well to **Automotive SPICE**.

**ASIL** (Automotive Safety Integrity Level) is used as a term for **risk classification** and refers to **severity, exposure** and **controllability**.

It determines the **specific activities** and **methods** that need to be applied.

## Functional Safety Management

Planning, coordination and tracking of all activities and outputs related to functional safety.



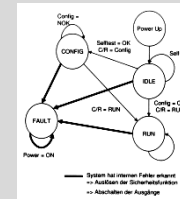
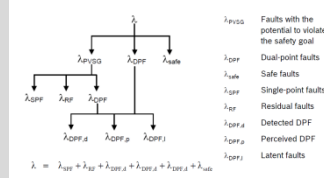
### Special outputs

- Safety plan
- Tool qualification
- Supplier qualification (safety aspects)

## Functional Safety Engineering

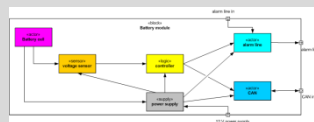
Expertise for analysis and design methods related to functional safety.

HW fault classification flow diagram



Coding and Modelling Guidelines

Method	ASIL A	ASIL B	ASIL C	ASIL D
1a Enforcing low complexity	++	++	++	++
1b Usage of language subsets	++	++	++	++
1c Enforcing strict typisation	++	++	++	++
1d Usage of defensive implementation techniques	0	+	++	++
1e Usage of established design rules	+	+	0	++
1f Usage of unambiguous graphical models	+	++	++	++
1g Usage of style guides	+	++	++	++
1h Usage of naming conventions	++	++	++	++

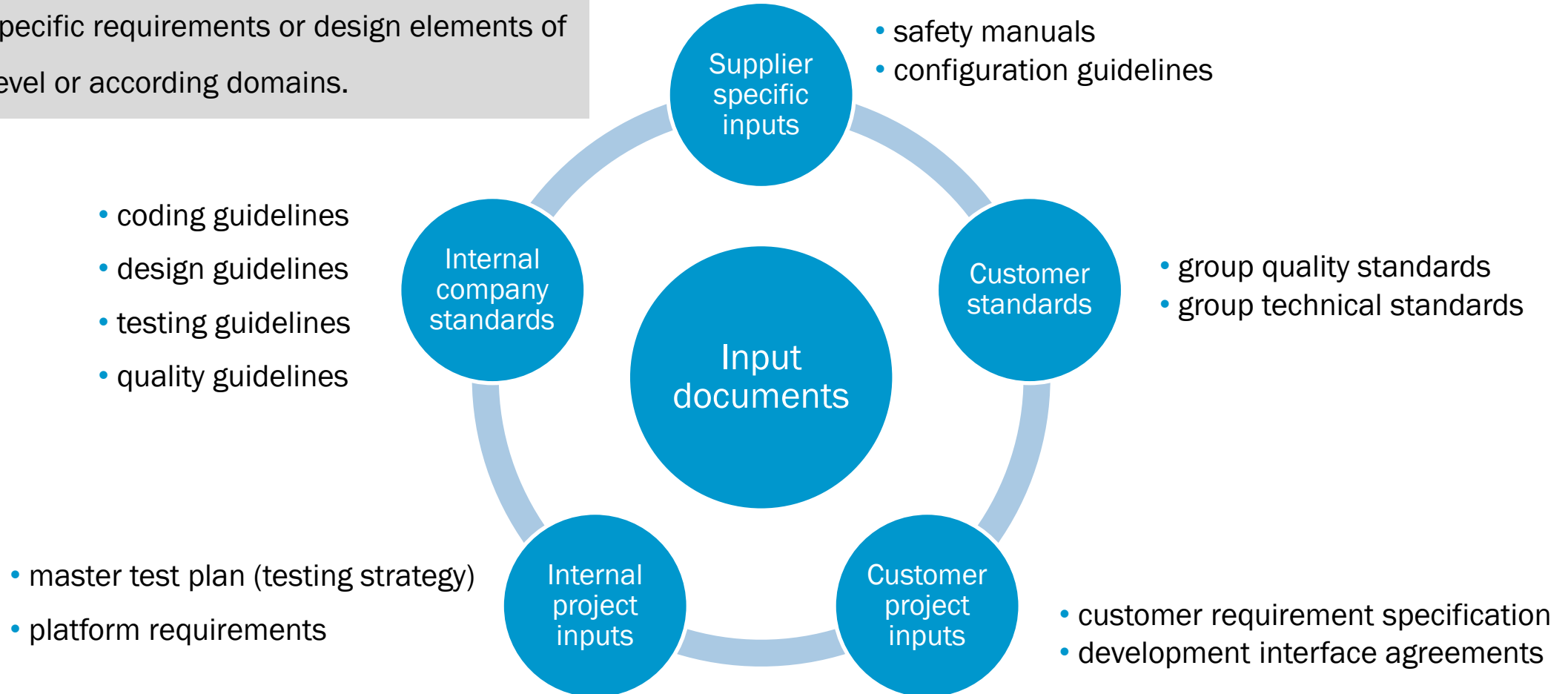


### Special outputs

- FMEA
- FMEDA
- FTA

# SOURCES OF INPUT DOCUMENTS

**Input documents** need to be decomposed to project specific requirements or design elements of system level or according domains.



# THE VALUE OF TRACEABILITY



## Reporting and Proofs of Conformity

- Customer Reports and Audits
- Management Reports
- Quality Assurance and Test Reports
- Project KPIs

## Typical change rate (in early samples)

~20 % change and addition in requirements, design and test cases

→ Thousands of changes per sample



## Quality and Efficiency

- Consistency in constantly changing, huge and complex systems
- Increased quality, efficiency and reusability
- Improved planning and controlling

## Typical project data volume

- 20.000 requirements + design elements
- 15.000 test cases
- 500 defects (mainly internal testing)
- 500 change requests

# USAGE OF INTEGRITY

# SCOPE OF INTEGRITY

Integrity **is used for** specifications, documentation, ensuring traceability and consistency, tracking and reporting.

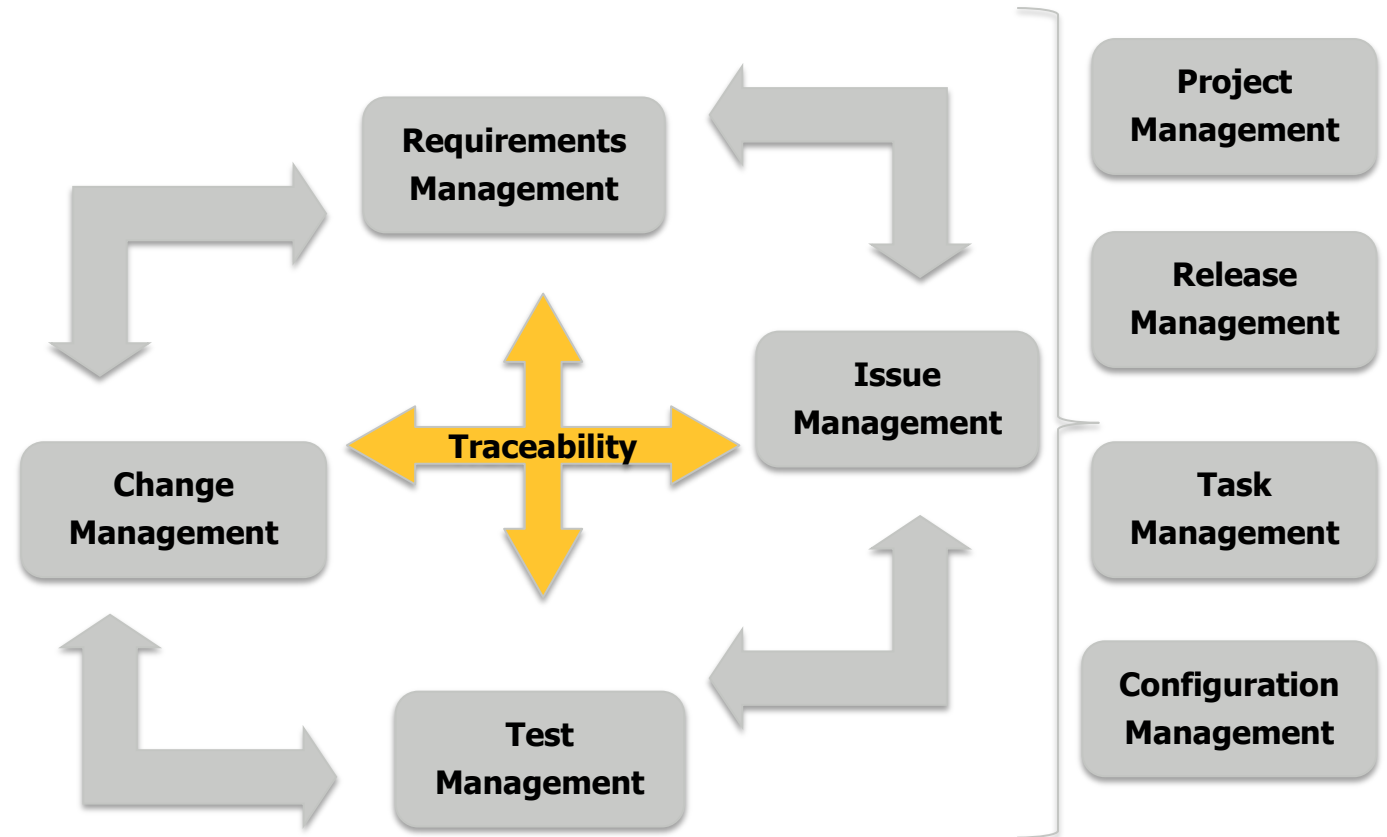
Integrity **is not used** for project planning, modeling, coding, test execution or functional safety analysis.

There are **integrations** for those aspects though.

## Design is more than just modeling

Typical design elements in Integrity:

- System architecture specification
- Interface specifications
- List of technical functions
- Explanations for supplier part selection



# DOCUMENTS IN INTEGRITY



Integrity is the **only** system for specifying or managing **requirements** and **test cases**. Considering **design** specification Integrity is not the only system but still very important.

ID	Type	Summary	State	All Content Count	Project
88578	Hardware Requirement Document	BG744_LBB Hardwarespezifikation	Open	529	/P/2005_LBB
149749	Hardware Requirement Document	BG744_LBB_EMS Lastenheft	Open	164	/P/2005_LBB
9456	Input Document	BG744_LBB Lastenheft	Restricted	1,313	/P/2005_LBB
195338	Input Document	BG744_LBB Mitgeltende Unterlage VW LIN Konzernlastenheft V2.0	Open	583	/P/2005_LBB
458388	Input Document	Bauelemente_Vernetzungsschnittstelle	Open	41	/P/2005_LBB
24201	Mechanic Requirement Document	BG744_LBB Elektromechanik Spezifikation	Restricted	637	/P/2005_LBB
114526	Mechanic Requirement Document	BG744_LBB Technical Specification Battery Cell	Open	259	/P/2005_LBB
263417	Mechanic Requirement Document	BG744_LBB Komponentenspezifikation Trennelement	Open	70	/P/2005_LBB
87319	Software Requirement Document	BG744_LBB Softwarespezifikation BZE	Open	432	/P/2005_LBB
94219	Software Requirement Document	BG744_LBB Softwareanforderungsspezifikation	Open	511	/P/2005_LBB
370160	Subsystem Architecture Document	BG744_LBB Hardwarearchitektur	Open	131	/P/2005_LBB
423210	Subsystem Architecture Document	BG744_LBB Mechanikarchitektur	In Review	15	/P/2005_LBB
21649	System Architecture Document	BG744_LBB Systemarchitekturspezifikation	Restricted	475	/P/2005_LBB
50392	System Architecture Document	BG744_LBB Batteriezustandserkennung Spezifikation	Open	0	/P/2005_LBB
121831	System Architecture Document	BG744_LBB Hardware Software Interface	Open	262	/P/2005_LBB
253426	System Architecture Document	BG744_LBB Produktbeschreibung	Restricted	170	/P/2005_LBB
295211	System Architecture Document	BG744_LBB Product Description	Restricted	165	/P/2005_LBB
350808	System Architecture Document	BG744_LBB Mustermappe	Restricted	56	/P/2005_LBB
18324	System Requirement Document	BG744_LBB Systemanforderungsspezifikation	Open	2,112	/P/2005_LBB
77749	Test Suite	BG744_LBB EMV Testspezifikation	Open	76	/P/2005_LBB
118566	Test Suite	BG744_LBB Qualifizierungsspezifikation	Open	272	/P/2005_LBB
118643	Test Suite	BG744_LBB Systemtestspezifikation	Open	938	/P/2005_LBB
121352	Test Suite	BG744_LBB Qualifizierungsspezifikation BMS	Open	243	/P/2005_LBB
129126	Test Suite	BG744_LBB HW-Testspezifikation	Open	267	/P/2005_LBB
151273	Test Suite	BG744_LBB SW-Integrations testspezifikation/ SW-Testspez BZE Online	Open	119	/P/2005_LBB
170191	Test Suite	BG744_LBB Testspezifikation Offline Modul Test (nicht durchführbar)	Open	35	/P/2005_LBB
170250	Test Suite	BG744_LBB Testspezifikation Offline System Test (nicht durchführbar)	Open	34	/P/2005_LBB
206120	Test Suite	BG744_LBB Testspezifikation BZE Offline Bordnetz Test (nicht durchführbar)	Open	35	/P/2005_LBB

- customer requirement specification
- development interface agreements
- customer group standards
- product description
- system requirement specification
- system architecture specification
- component requirement specifications
- component design specifications
- software requirement specifications
- software design specifications
- hardware requirement specifications
- hardware design specifications
- hardware software interface specification
- mechanical requirement specifications
- mechanical design specifications
- supplier safety manuals
- system test suites
- component test suites
- software test suites
- hardware test suites
- ...



# CUSTOMER REQUIREMENT SPECIFICATION



ID	Customer ID	Section	Category	Text	State	Customer State	Supplier Comment	Customer Comment
3467		1.2.2	Customer Requirement	Dieses BT-LAH beschreibt Leistungen, Anforderungen, Prüf- und Erprobungsbedingungen, die das zu entwickelnde Produkt und der Auftragnehmer erfüllen müssen.	Accepted	Accepted		
3469		1.2.3	Customer Requirement	Da es sich um eine Neuentwicklung handelt, können sich aus technischen Notwendigkeiten Änderungen im Lastenheft ergeben. Näheres ist unter 2.2 Zielsetzung beschrieben.	Partially Accepted	Accepted	29.08.2013: Änderungen am Lastenheft unterliegen dem Änderungsmanagement und müssen über Änderungsanträge CRs (Change Requests) eingeführt werden. 13.08.2013: Änderungen und Auswirkungen auf Termin und Kosten müssen abgestimmt werden;	
3471		2	Heading	Allgemeine Projektvorgaben	Accepted	Accepted		
3473		2.1	Heading	Kurzbeschreibung des Entwicklungsumfanges	Accepted	Accepted		

Customer requirements are not only reviewed but also clarified and agreed.

Customer requirement specifications are regularly updated and exchanged.

# SYSTEM REQUIREMENT SPECIFICATION

The screenshot shows a software interface for system requirement management. On the left is an 'Outline' pane with a tree view of requirements. The main area displays a table of requirements, with one selected. Below the table is a 'Details' pane showing metadata for the selected requirement. Three blue callout boxes with arrows point to specific features: 'Review Status' points to a state transition diagram; 'Traceability' points to a table showing the decomposition of a requirement into more detailed ones; 'Functional Safety Classification' points to a dropdown menu for selecting safety levels like ASIL A, ASIL B, etc.

**Review Status**

```
graph LR; Unspecified --> Open; Open --> Defined; Open --> ToBeReworked[To be Reworked]; Open --> Verified; Defined --> Reviewed; ToBeReworked --> Open; ToBeReworked --> Verified; Reviewed --> Verified;
```

**Traceability**

ID	Do...	Re...	Ca...	Type	Proj...	Sig...	Text	ID	Do...	Re...	Ca...	Type	Pro...	Si...	ID	Do...	Rel...	Cate...	Type	Proj...	Sig...	Text
3456							Jul... Die LBB wi...	88				Hardwa...	Ap...	11				S...	No...	Überpr...		
								94				Softwar...	No...	11				S...	No...	Überpr...		
								94				Softwar...	Oc...	11				S...	No...	Überpr...		

**Functional Safety Classification**

- QM
- ASIL A
- ASIL B
- ASIL C
- ASIL D
- QM (A)
- ASIL A (A)
- QM (B)
- ASIL A (B)
- ASIL A (B)
- Functional Safety Level
- QM

System requirements are thoroughly analyzed, decomposed and validated.

System requirement specifications are regularly updated and reviewed.

# TEST SUITE



The screenshot displays a test suite editor interface. On the left, an 'Outline' pane shows a hierarchical tree of test cases. The main area contains a table with columns: ID, Sec..., Category, Test Summary, Precondition, Trace Status, Text, Expected Results, and State. A search bar at the top says 'Show items containing where'. Below the table, a 'Test Results' window is overlaid, showing a detailed view of a test case. This window includes a 'Test Summary' section with a 'Test Case Details of 26.03.2014 17:02:48' and a 'Test Summary' section with a 'Test Case Details of 26.03.2014 17:02:48'. The test case details include a 'Precondition' section, a 'Text' section, and an 'Expected Results' section. The test case is titled '4.1.3 I = +300A;T = ...' and is associated with 'System ... TC5'. The test case details include a 'Precondition' section, a 'Text' section, and an 'Expected Results' section. The test case details include a 'Precondition' section, a 'Text' section, and an 'Expected Results' section.

ID	Sec...	Category	Test Summary	Precondition	Trace Status	Text	Expected Results	State
26968	4.1.2	System ...	TC1	3,2V je Zellpackspannung; Transportlock = inaktiv; TE - Status = closed; Debug-CAN/ LIN - Kommunikation aktiv; Alarm = OFF;	↑ upstream	I = +10A; T = n Norm UZell Mess	gemeß.	Defined
26977	4.1.3	System ...	TC5	3,2V je Zellpackspannung; Transportlock = inaktiv; TE - Status = closed; Debug-CAN/ LIN - Kommunikation aktiv; Alarm = OFF;	none	I = + T = l Norm UZell Mess		
81408	4.1.4	System ...	TC13	3,2V je Zellpackspannung; Transportlock = inaktiv; TE - Status = closed; Debug-CAN/ LIN - Kommunikation aktiv; Alarm = OFF;	none	I = + T = l Norm UZell Mess		
81411	4.1.5	System ...	TC14	3,2V je Zellpackspannung; Transportlock = inaktiv; TE - Status = closed; Debug-CAN/ LIN - Kommunikation aktiv; Alarm = OFF;	none	I = + T = l Norm UZell Mess		
81415	4.1.6	System ...	TC15	3,2V je Zellpackspannung; Transportlock = inaktiv; TE - Status = closed; Debug-CAN/ LIN -	none	I = + T = h Norm UZell Mess		

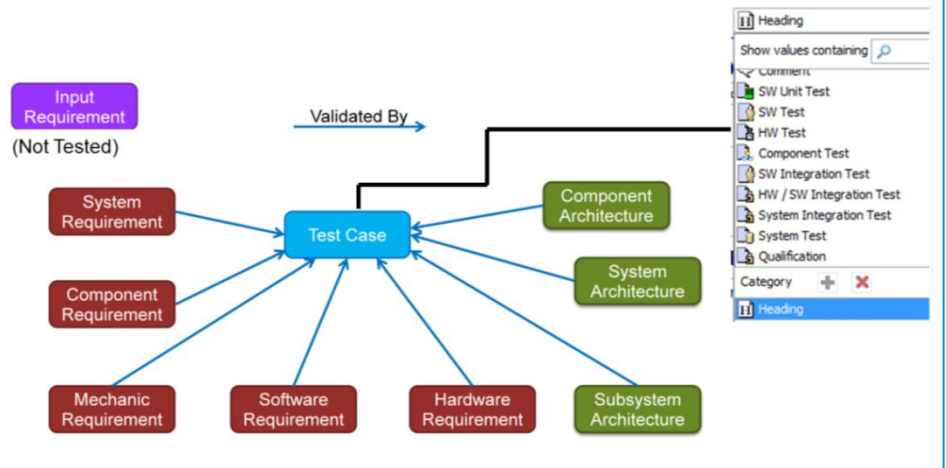
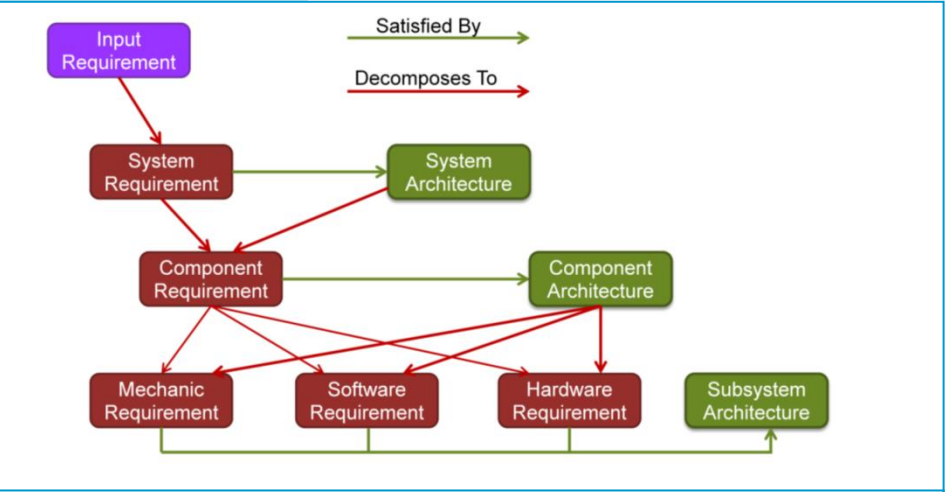
Test suites are exported for specific testing tools (e.g. Tessa, CANoe, ...).

Test results data from these testing tools is imported again for full traceability and coverage reports.

# DOCUMENT TYPES



Position	Name	Image	Show Workflow	Change Packages	Description
0	MKS Solution				This type ho
1	Project		✓		Represents
2	Input Document		✓		Solutions us
3	Input		✓		Input docu
4	Shared Input		✓		Shared cont
5	System Requirement Document		✓		Solutions us
6	System Requirement		✓		Requiremen
7	Shared System Requirement		✓		Shared cont
8	System Architecture Document		✓		Solutions us
9	System Architecture		✓		Specification
10	Shared System Architecture		✓		Shared cont
11	Component Requirement Document		✓		Solutions us
12	Component Requirement		✓		Requiremen
13	Shared Component Requirement		✓		Shared cont
14	Component Architecture Document		✓		Solutions us
15	Component Architecture		✓		Specification
16	Shared Component Architecture		✓		Shared cont
17	Test Suite		✓		Solutions us
18	Test Case		✓		Test suites
19	Shared Test Case		✓		Shared cont
20	Test Step		✓		A specific pr
21	Test Session		✓		Process iter
22	Test Plan		✓		Describes th
23	Test Objective		✓		Captures a
24	Test Group		✓		Document r
25	Defect		✓		Authorizes
26	Work Item		✓	✓	Container fo
27	Change Request		✓		Request ch
28	Task		✓	✓	Authorize d
29	Library		✓		A container
30	SI Change Package		✓	✓	This type is
31	Model		✓		Solutions us
32	Model Element		✓		Models cont
33	Shared Model Element		✓		Shared cont
34	Simulation		✓		An item typ
35	Product		✓		A long-lived
36	Portfolio		✓		Tracks a gro
37	Release		✓		Type to cre
38	Software Requirement Document		✓		Solutions us
39	Software Requirement		✓		Requiremen
40	Shared Software Requirement		✓		Shared cont
41	Hardware Requirement Document		✓		Solutions us
42	Hardware Requirement		✓		Requiremen
43	Shared Hardware Requirement		✓		Shared cont
44	Mechanic Requirement Document		✓		Solutions us
45	Mechanic Requirement		✓		Requiremen
46	Shared Mechanic Requirement		✓		Shared cont
47	Subsystem Architecture Document		✓		Solutions us
48	Subsystem Architecture		✓		Specification
49	Shared Subsystem Architecture		✓		Shared cont
50	Integrity Ticket		✓		Request ch



Separate document types exist for specific domains according to **ASPICE**.

Requirements are tested by **Qualification Tests**.

Design is tested by **Integration Tests**.

# DOCUMENT TEMPLATES



The screenshot displays the Integrity software interface. On the left, an 'Outline' pane shows a hierarchical structure of document sections. The main window shows a document template with the following content:

**<Entwicklungsgegenstand>  
Systemanforderungsspezifikation**

**Versionshistorie**

Version	Status	Datum	Bemerkung	Autor/Ersteller
	Entwurf	tt.mm.201x	Ersterstellung	Max Mustermann

Below the table, there are instructions in German: "Freigaben sind in der Versionshistorie beim entsprechenden Versionsstand im Status zu vermerken, unter Autor/Ersteller sind die freigebenden Projektmitarbeiter anzugeben." This is followed by a table with the same structure as the one above, containing the following data:

Version	Status	Datum	Bemerkung	Autor/Ersteller
1.0	Freigabe	19.11.2013	Ersterstellung	.
2.0	Freigabe	26.02.2015	Überarbeitung	.
3.0	Freigabe	18.02.2016	Überarbeitung	.

Further instructions include: "Änderungen zu Version 2.0: - Gliederung angepasst; - Filling Instructions angepasst; - Kapitel anderer Disziplinen entfernt (Test, Qualität, Produktion, Logistik)".

Another instruction states: "Geben Sie den Zweck dieses Dokuments an, z.B. 'Dieses Dokument beschreibt die Geräteanforderungen an <Entwicklungsgegenstand>. Die Anforderungen sind aus dem <OEM-Lastenheft> sowie den mitgeltenden Unterlagen abgeleitet.'" followed by a note: "Führen Sie hier alle mitgeltenden Unterlagen und Referenzen ein."

Another instruction says: "Jede Mitgeltenden Unterlage wird als einzelne IDs aufgeführt. Bsp: [laufende Nummer] <Dokumentnummer> <Dokumentname/Dokumententitel> - <Datum und/od. Version> - <opt. Bemerkung/Einschränkungen>". An example follows: "[1] VVW80000 - Elektrische und elektronische Komponenten in Kraftfahrzeugen bis 3,5 t Allgemeine Anforderungen, Prüfbedingungen und Prüfungen - Ausgabe 2013-06 - Einschränkung: nur Kapitel 1 bis 6 gültig".

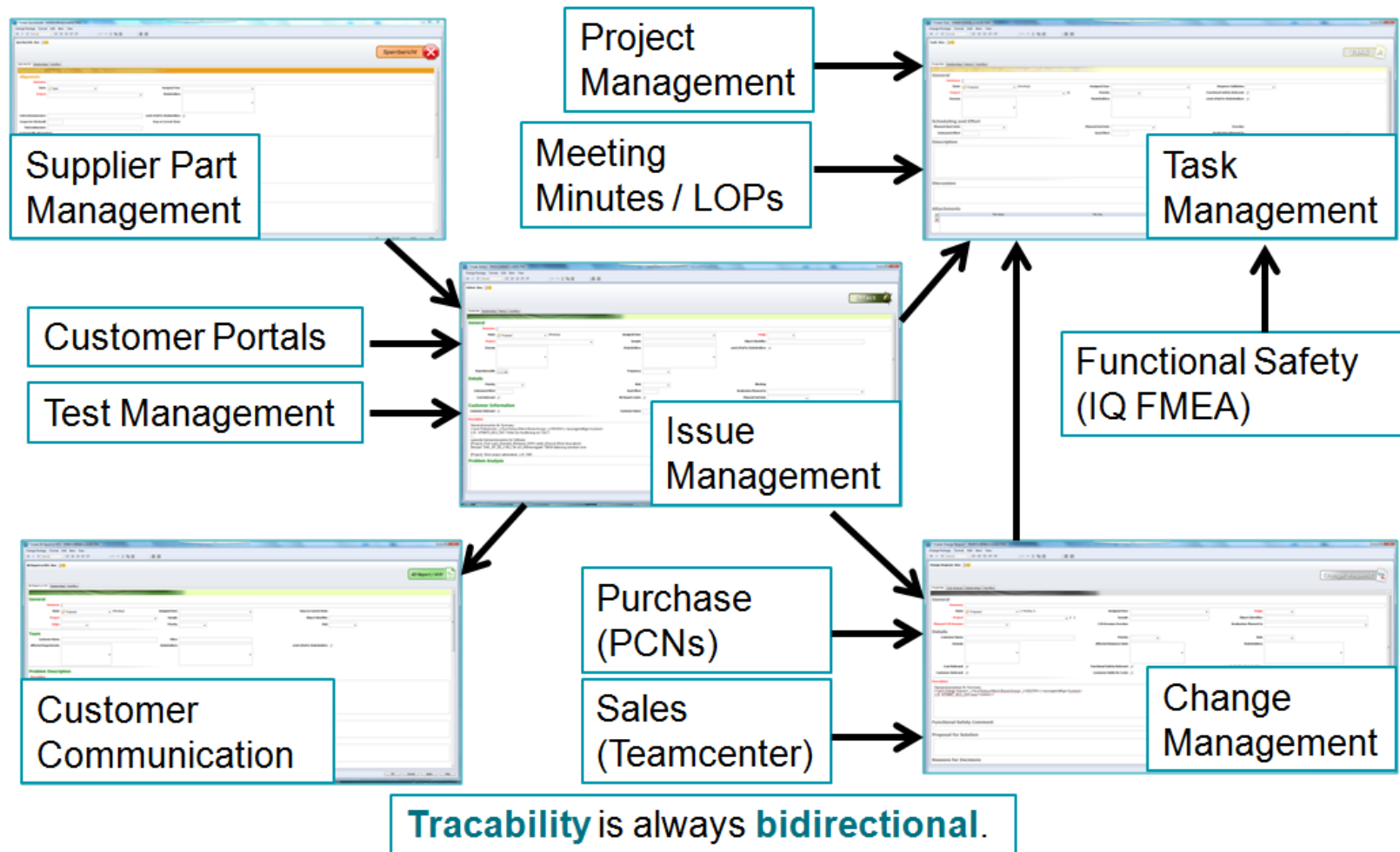
The final instruction says: "Befüllen Sie die Tabelle mit den Definitionen, Begriffen und Abkürzungen."

An inset window shows a list of templates with IDs and names, such as "17927 - DA-07.088-051 ASPICE\_Template\_S10-Testspezifikation\_de".

Templates exist for all common Integrity Documents.

Standardization of heading structures and filling instructions increases quality in specification and documentation.

# PROCESS ITEM FLOW



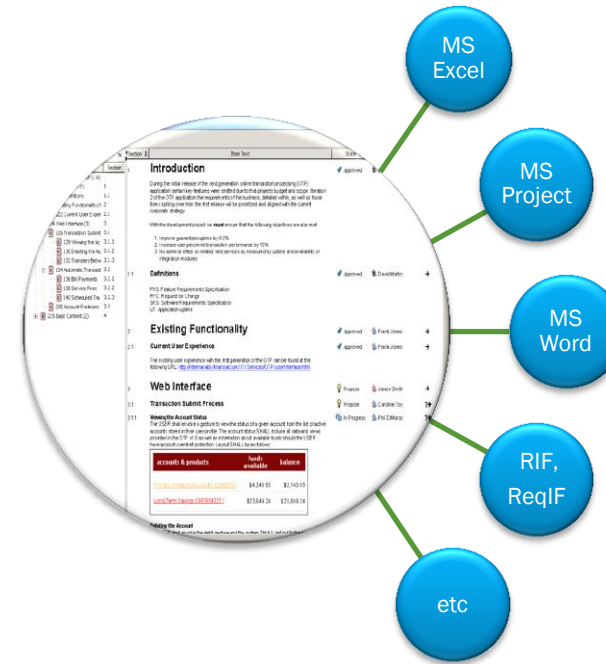
Process Items ensure traceability and historization of all important development activities.

Notifications are triggered and progress can be easily tracked.

# INTEGRATIONS

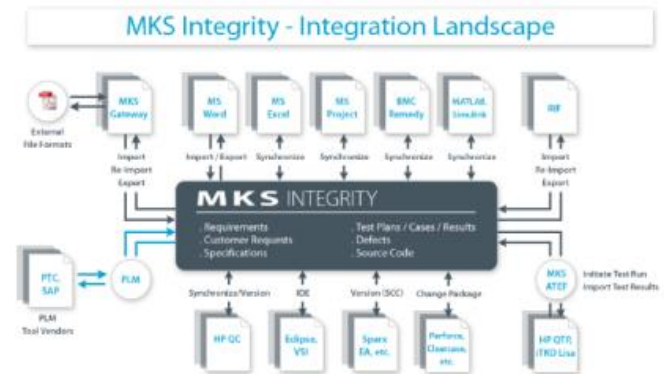
## Existing integrations:

- Excel (IQ-FMEA, Defects, ...)
- Word (Documents)
- MS Project (Task Management)
- RIF, ReqIF (DOORS, other RMS)
- KPIT Medini (Requirements Documents)
- Rhapsody (Requirements Documents, Test Suites)
- Matlab Simulink (Tracability to Model)
- Test Data Import (Tessy, CanOE, ...)
- Eclipse / Visual Studio (Tasks, Defects, Source Code)



## Under construction:

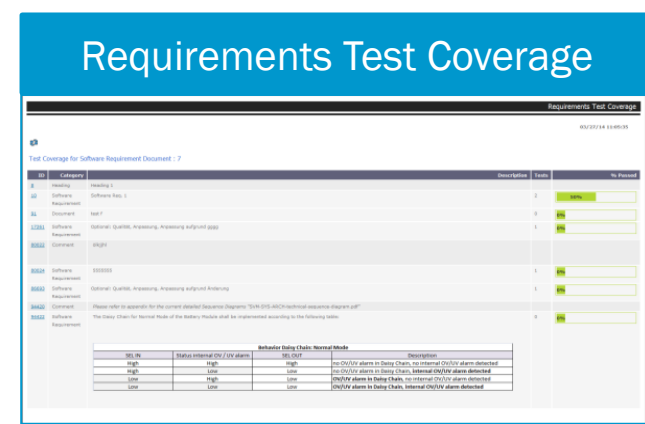
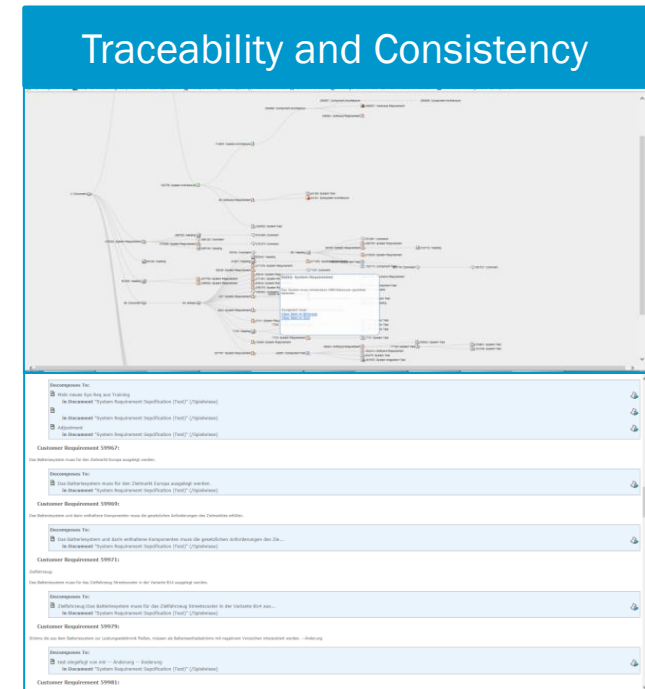
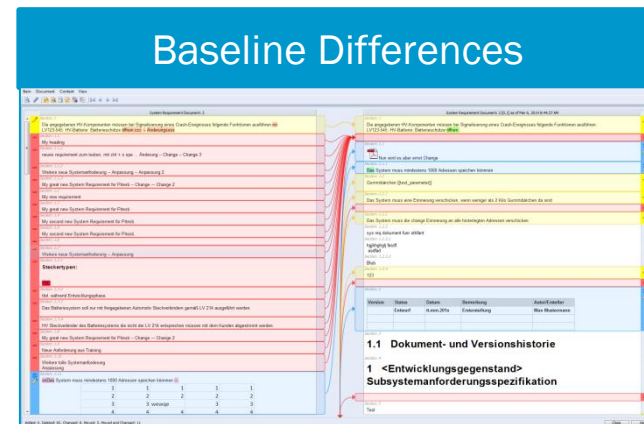
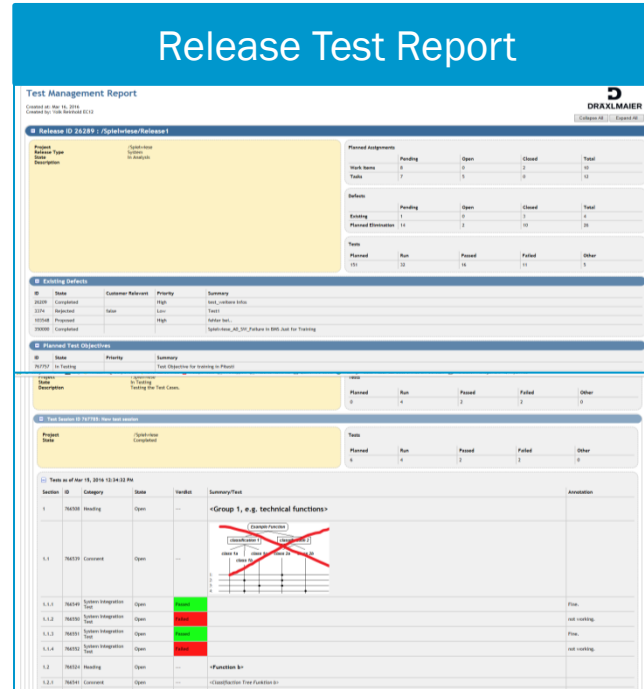
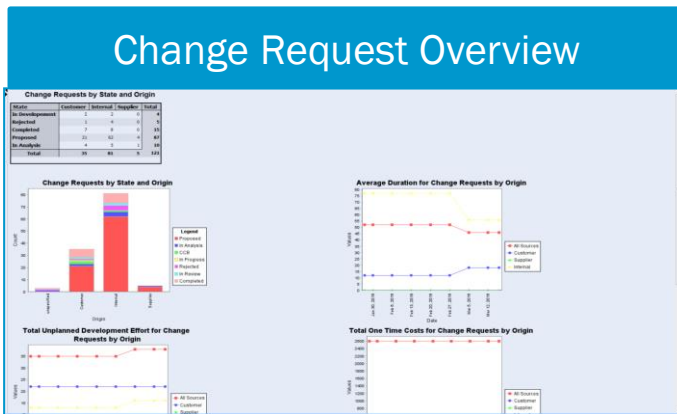
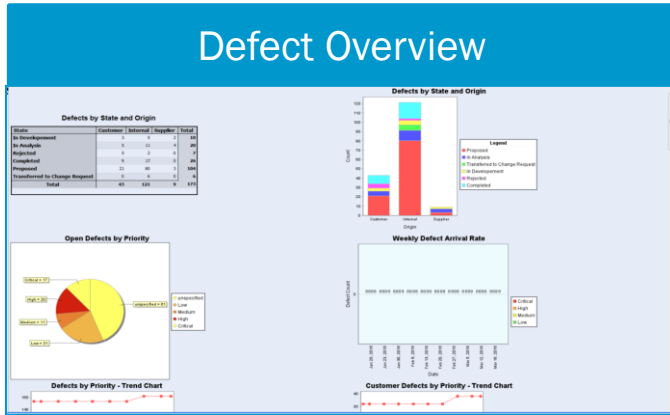
- PLM TeamCenter (Change Requests)
- Tortoise SI (Integrity Source and Windows Explorer)
- Customer Portals (KPMWeb, PFIFF, ...)







# DASHBOARDS, REPORTS



# SUMMARY AND QUESTIONS

# SUMMARY



- **DRÄXLMAIER** is a Tier 1 Supplier in **automotive industry**.

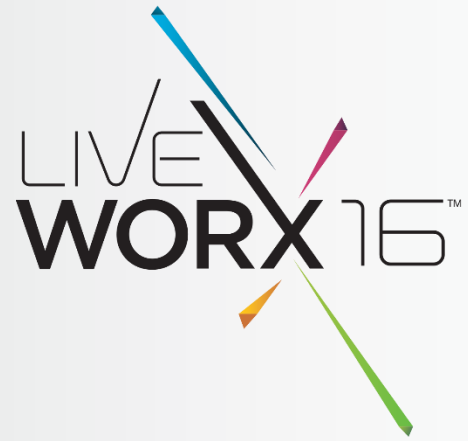
Our products include **electronics, electrics** and **mechanical parts**.

- We need to apply according **industry standards** and are regularly audited.

**Tracability** and **Consistency** are of high importance in our processes.

- We use **Integrity** to implement most of our development processes

Integrity helps us to manage **complexity** and deliver appropriate **quality**.



# QUESTIONS ?

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# THANK YOU FOR YOUR ATTENTION!

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The image features several colorful geometric shapes, including triangles and lines in shades of blue, green, yellow, orange, pink, and purple, scattered across the background. A large, multi-colored geometric shape is prominent on the right side.

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