



Electronics and Components



System Validation Process for Instrument Clusters

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Introduction

- System Validation Process Test Definition
- System Validation Process Test Development
- System Validation Process Test Campaign
- **System Validation Process Test Follow-up & Coverage**

Conclusion



Magneti Marelli is an international Group (36.000 employees in 19 countries) committed to the **design and production of hi-tech systems and components for the automotive sector** which supplies all the most important car makers in Europe, North and South America and Asia.

Magneti Marelli Electronic Systems is dedicated to Instrument Clusters & Displays and Infotainment & Telematic Systems business areas.



Introduction - Development Process



Instrument Clusters & Displays development process is based on V-model in which is included System Validation.



System Validation Process & MBT



In the early 2000s, we have defined a **System Validation Process** using **Model Based Testing** approach, with the objective of building a complete tool chain.



Test Definition -> Requirements Library



Test cases are written in **Doors** while **Reqtify** ensure requirements traceability & changes. **Requirements library** is an xml export from Doors that will imported in **Matelo**.

SVT_PAG_09_Analoganzeigen' current 1.0 in /PAG/S	IV/SVT Germany (Formal module) - DOORS					
File Edit View Insert Link Analysis Table T	ools User Matelo Help						
	Et B Z Export						
MM - SIV test spec creation (All levels V Star Star Star Star Star Star Star Star		🗄 🌾 🎯 🛆 🕾 😤 🛃 -	∼ 22 10				
SVT_PAG_09_Analoganzeigen B-1 General Information D-2 Function Name G-3 Global	MM_BB-ID	MM_History	MM_Function	MM_input	MM_Output	_	
	Pointers_EngineSpeed_UC01 _BB01	Kl. 15 = off	display normal engine speed with valid value	set engine speed = 12312282 KL 15 = on	The engine speed is displayed by the pointer. For engine speed > max scale the pointer displays the max scale value; for engine speed = 0 the pointer should move to '0 position'.		×
-3.1.122.04 -3.1.122.05 -3.1.122.06 -3.1.122.06 -3.1.122.08	Pointers_EngineSpeed_UC01 _BB02	State produced by BB01	put the pointer position to 0	Put Kl. 15 off	Requirements S	Search requirements	
 ⇒ 3.1.1.2 Low ⊕ 3.1.1.2 Low ⊕ 3.1.1.4 OI Temperature Pointer ⊕ 3.1.1.5 Unressure Pointer ⊕ 3.1.1.5 Anzeigeverhalten bei Diagnose (\$ 	Pointers_EngineSpeed_UC01 _BB03	State produced by BB01	timeout management	GW_SVB_PAG.SVB_Mote 1 timeout on Motor_04= 1 for ≥ 500ms	Name	(32) (9) (4)	Coors baseline Baseline : 12/20/11 00:00:00 Statistics Statistics
Vsemame: bodereau Read-only mode	↓ 				Pointers_EngineSpeed_UC01 (Pointers_EngineS Pointers_EngineS Pointers_EngineS	(8) Speed_UC01_BB01 Speed_UC01_BB02 Speed_UC01_BB03	S Referenced Requirements : 583
					Pointers_EngineS Pointers_EngineS Pointers_EngineS Pointers_EngineS Pointers_EngineS ColoantTemp_UC01 Ollemen_UC01 (11) Ollemen_UC01 (12)	Speed_UC01_B804 Speed_UC01_B805 Speed_UC01_B806 Speed_UC01_B806 Speed_UC01_B807 (13)	1 Name: Pointers_EngineSpeed_UC01_BB01 1 Description: display normal engine speed 1 with valid value
					Corrise_JC01 (9) Corrise_JC01 (9)		References M14@\Version4\EngineSpeed_Pointer.mcm MTL[T01@T_CAN_V. M14@\Version4\EngineSpeed_Pointer.mcm MTL[T11@T_CAN_V. M14@\Version4\EngineSpeed_Pointer.mcm MTL[T51@T_CAN_V. M14@\Version4\EngineSpeed_Pointer.mcm MTL[T51@T_CAN_V. M14@\Version4\EngineSpeed_Pointer.mcm MTL[T51@T_CAN_V. M14@\Version4\EngineSpeed_Pointer.mcm MTL[T51@T_CAN_V. M14@\Version4\EngineSpeed_Pointer.mcm MTL[T51@T_CAN_V. M14@\Version4\EngineSpeed_Pointer.mcm MTL[T51@T_CAN_V.
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Test Development -> Test Bench Library



System Validation library is composed of basic modules that manage Setting & Measurement test steps.

Test Bench library is an xml file managed by Matelo that contain step descriptions & parameters.



Statistic Model Design



Model design is based on test cases tagged with requirements.

Transitions between 2 states contains input parameters & expected results used by associated test steps.



Configuration management



All projects are managed in a **Synergy** configuration tool. Basic modules are derivate from templates.

<u>File View Actions Tools Admin H</u> elp			
PSA_B78_TEST_root-2.(🚽 😕 📴 🗊 😵 🙈 💘 🦑	🎿 Role: ccm_admin 💌		
Default Task: None	▼ Select Task		
Name	Version	Owner	Status
SA_B78_TEST_root	2.0.0	bodereau	prep
▼ m PSA_B78_TEST_root	1.2	murat	released
PSA_B78_CanMatrix	3.19.3	murat	released
PSA_B78_DynamicFunctions	1.0.1	murat	released
PSA_B78_MATELO	2.0.0	abbaoui	integrate
PSA_B78_ManualMode	3.22.2	charnace	released
PSA_B78_SV_SEQUENCE_EDITOR	1.0	murat	released
PSA_B78_SW_TOOL	2.0.0	bodereau	working
 Specifications 	1.0	murat	released
HW mini HW	1.1	bodereau	working
🕨 💼 sw	1.1	bodereau	working
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IBM Rational Synergy Project View - TESTING_PC2					×
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PSA 878 SW TOOL-2 (🚽 📄 📴 📬 🚳 🐋 🛶 🐙 🛷 🛬	Bole: com admin				
Default Task: None	▼ Select Lask				
Name	Version	Owner	Status	Type / Release / Task	1
SA_B78_SW_TOOL	2.0.0	bodereau	working	project / PSA_B78_SW_TOOL_2.0 / SECT95#7	170
▼ ■ PSA_B78_SW_TOOL	1.1	murat	released	dir / PSA_B78_SW_TOOL_1.0 / SECT95#5250	
Doc 📾	1.0	murat	released	dir / PSA_B78_SW_TOOL_1.0 / SECT95#5210	
🔻 📾 Lib	1.1	murat	released	dir / PSA_B78_SW_TOOL_1.1 / SECT95#5534	
ATSEP2	2.1	helias	released	dir / TEMPLATE_SW_TOOL_2.0 / SECT95#550	06,S
CAN_Matrix	1.3	murat	released	dir / PSA_B78_SW_TOOL_1.7 / SECT95#6261	
CAN_Server	2.0	helias	released	dir / TEMPLATE_SW_TOOL_2.0 / SECT95#462	27,S
Mutex	2.0	helias	released	dir / TEMPLATE_SW_TOOL_2.0 / SECT95#462	27,S =
🕨 🏛 PXI	2.0	helias	released	dir / TEMPLATE_SW_TOOL_2.0 / SECT95#462	27,S
Sound	2.3	bodereau	released	dir / TEMPLATE_SW_TOOL_2.0 / SECT95#462	27,S
Tools	2.2	helias	released	dir / TEMPLATE_SW_TOOL_2.0 / SECT95#513	38,S
Vision	2.0	helias	released	dir / TEMPLATE_SW_TOOL_2.0 / SECT95#462	27,S
🕨 📾 Out	2.0	bodereau	integrate	dir / PSA_B78_SW_TOOL_2.0 / SECT95#7172	
PSA_B78_SW_TOOL.cws	2.0	bodereau	integrate	asci / PSA_B78_SW_TOOL_2.0 / SECT95#717	2
PSA_B78_SW_TOOL.prj	2.0	bodereau	integrate	prj / PSA_B78_SW_TOOL_2.0 / SECT95#7172	
Public_int	1.0	murat	released	dir / PSA_B78_SW_TOOL_1.0 / SECT95#5210	
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4					

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PSA_B78_MATELO-2.0.1 🚽 😕 💱 🗊 🐝 🔊 🧐 😼 🐙 🖉	🌮 🎫 Role: developer 📼		
Default Task: None	▼ Select Task		
Name	Version	Owner	Status
SA_B78_MATELO	2.0.1	bodereau	working
V 💼 PSA_B78_MATELO	1.1	murat	released
CompletionDictionary.ini	2.4	abbaoui	integrate
PSA_B78_MATELO.prt	2.5.8	abbaoui	integrate
Reports	1.1	murat	released
▼ ■ TestSuites	1.4	murat	released
▶ 💼 B78_HL	2.1	bodereau	integrate
▶ 🕅 B78_LL	2.0	abbaoui	integrate
Sequencer.seq	2.0_B78_1.0	murat	released
Template.seq	1.2	murat	released
Utils	4.7.6	abbaoui	released
Utils	4.7.6	abbaoui	released
Version1	2.10	abbaoui	released

Test bench setup



Test equipment setup consists in :

- I/O setup from customer connector description
- Vision training for pattern matching & OCR
- Sound training







Test campaign -> Generation



A test campaign is perform at each delivery to the customer.

Test sequences are **generated** from the **statistic model** with several profiles.

Testor - D:\ccm_wa\Porsche_P9x1_Matelo-2.0.1\Porsche_P9x1_Matelo\F	Porsche_P9x1.prt
<u>File View Management H</u> elp	
Usage Model Edition Test Suite Generation Report Management	
Model version : Version4	Required Sub-Chain Generation
Profile : 981	
Profile Type : Usage	Chain
Algorithm Selection	
Algorithm	
Algorithm User Oriented	
User Oriented	
Parameter Defir User Uriented (Limit Cases)	
Minimum (Arcs Coverage)	E Warnings mcm
Test Cours Numbers	
	Warnings DriverAssistance mcm
Maximum Test Step Number :	Warrings_salety.incm
	Warnings_Furtherinito.mcm
D	Warnings_BLMHinten.mcm
Decreasing rate :	I III Warnings RI MVorn mem
	<u>G</u> enerate <u>Select All</u> <u>Unselect All</u>
Equivalence Class Handing	Requirements Cumulated Coverage
Equivalence class francing . Random	Computer and View
Simulation :	
Test Suite Coverage : 🔽	
U	

Test campaign -> Execution & Analysis



Test campaign will be executed and test reports analyzed to check issues.



Sub chain : warnings_chassis_childpr	oorcateri
27 - T_KL15	
Status:	Done
CAN Klemmen_Status.ZA1_ZAS_Kl_15	: 1.000 / 0x01
28 - T_Requirement	
Status:	Done
Requirement : Warnings_Chassis_Chil	dProofCatch_UC01_BB01
28 - T_CAN_WriteCode	
Status:	Done
CAN TSG_FT_1.FT_Kisi_Fehler : 1.000 nicht m)	/ 0x01 (Kindersicherungsfunktion
28 - S_Warning_State	
Status:	Failed
Expected frequency : 600 Hz - Measu Expected text : Sécurité-¶enfants !¶D Displayed text : Sécurité-¶enfants!¶D To see picture, <u>click here</u>	red frequency : 601 Hz ysfonct. ysfonct.
29 - T_Requirement	
Status:	Done
Requirement : Warnings_Chassis_Chil	dProofCatch_UC01_BB03
29 - T_KL15	
Status:	Done
CAN Klemmen_Status.ZA1_ZAS_Kl_15	: 0.000 / 0x00
29 - S_Warning_State	
Status:	Passed
Expected sound : no sound - Measured Expected text : Displayed text :	d sound : no sound

Requirements and a set of the se	Passed	Failed
Warnings_Chassis_ChildProofCatch_UC01_BB01	0	1
Warnings_Chassis_ChildProofCatch_UC01_BB02	1	0
Warnings_Chassis_ChildProofCatch_UC01_BB03	2	0
Warnings_Chassis_ChildProofCatch_UC01_BB04	1	1
Warnings_Chassis_ChildProofCatch_UC01_BB05	2	0
Warnings_Chassis_ChildProofCatch_UC01_BB06	1	1

Test Follow-up & Coverage

Issues are added in a **Synergy Change** database to ensure follow-up, And results are returned into **Doors** via a dxl script.

Change Request Information		Save	Printer Friendly View	
Validation			Mare In	ío
Transitions: Conclude Rework				
CR ID:	SEST04#392		Status: df_sw_validation	
Synopsis:	Wrong shiftlock text			
Description:	When K_MSG_0051 text is provided, "	'parado" is displayed is spanish language while	"Parado" is expected in EventMap v35.	
Submitter:	Bodereau, Olivier (bodereau)	Subr	nitter's Real Name: Olivier Bodereau	
Submitter's Email Address:	Olivier.Bodereau@mmarelli-se.com			
Assignee:	Mayer, Michael (mayer)			
QA Contact:	marko			
CCB Manager:	Holienka, Peter (holienka)			
Current Phase:	Software Testing		Origin Phase:	
Found by:	Internal Testing Defect		Reported by: Test Team Fr	
Customer Defect ID:			OPL Nr.:	
Customer Contact:				
Functional unit:	Alarm		Severity: C	
Complexity:				
MM Product Name:			Priority:	
Product Version:	All			
SW Release:				

Sub chain : BCMVornKessy				
48 - T_CAN_WriteCode				
Status:		Done		
Nodule Time: 0.032 s				
CAN GW_SVB_PAG.SVB_BCM1 : 1 /	0x01	(SG_verbau	it)	
49 - T_CAN_WriteCode				
Status:		Done		
Module Time:		0.03	2 s	
CAN Klemmen Status 01.ZAS KI 1	5:1	/ 0x01 (ein)		
80 - T Requirement				
Status:		Done		
Module Time:		0.00	2 6	
Requirement : BCMVorg Kessy 10	01 B	R14.		
80 - T CAN WriteValue		0117		
		Deer		
Status:		Done		
Module Time:		0.064	1 S	
CAN Kessy_02.FBS_Prio_Warn_04 :	1/0	x01 (Kombi	Prio Warnu	ing FBS
80 - S_Warning_State			_	
Status:		Faile	d	
Issues:		1816		
Module Time:		6.27	7 s	
 Pictogram : Schluessel_gelb Expected state : On - Displaye Text : W_FBS_4 Expected text : イグニッションキー Displayed text : イグニッション・ Acknowledge : none 	d stai /¶スイ ર	te:On ッチ部を¶まず 部を¶まず左へ to:Off	左へ回す へ回す <u>->> se</u>	e picture
P2 - T. Poquiromont	d sta	te : Off		
		Dono		
Status:		Done		
Module Time:		0.00	15	
Requirement : BCMVorn_Kessy_00	.01_8	801;		
82 - T_CAN_WIIteValue				
Status:		Done		
Module Time:		0.062	2 s	
CAN Kessy_02.FBS_Prio_Warn_04 :	0/0	x00		
82 - S_Warning_State				
Status:		Pass	ed	
Module Time:		2.03	7 s	
Warn: 1D: 75 Expected value : no value - Dis Expected sound : No sound Measured sound : No sound Pictogram : Schluessel_geb Expected state : Off - Displaye Text : Expected text : no text - Displaye Acknowledge : none Expected state : Off - Displaye	playe d sta ayed d sta	te : Off te : Off text : no te te : Off	o value xt	
D	1	n 1	F 1 1	
requirements		rassed	ганец	issues
BCMVom_Kessy_UC01_BB01		19	0	

Test coverage can be evaluated by Matelo and Reqtify :

- □ Static coverage based on requirements present in statistic model
- Dynamic coverage based on requirements present in test sequences

equirements	Passed	Failed	Issues
MVom_Kessy_UC01_BB01	19	0	
MVom_Kessy_UC01_BB02	5	0	
MVom_Kessy_UC01_BB03	5	0	
MVom_Kessy_UC01_BB06	1	0	
MVom_Kessy_UC01_BB07	1	0	
MVom_Kessy_UC01_BB08	1	0	
MVom_Kessy_UC01_BB09	2	0	
MVom_Kessy_UC01_BB10	1	0	
MVom_Kessy_UC01_BB11	1	0	
MVom_Kessy_UC01_BB13	1	0	
MVom_Kessy_UC01_BB14	0	2	1816

Conclusion



Instrument clusters are more and more complex and evolving, and number of validations is very consistent.

This process has enabled us to reduce the duration of test campaigns thanks to :

- □ the generation and execution of automatic tests
- □ the aid in the analysis and bug tracking

Then it was possible to spend more time on model design, which gave us :

- □ an increasing of test coverage
- □ a better traceability of requirements