



System Validation Process for Instrument Clusters

Thursday 24th October

Olivier BODEREAU

R&D – Instrument Clusters & Displays
System Validation Referent

Electronic Systems

- 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.

Porsche 911

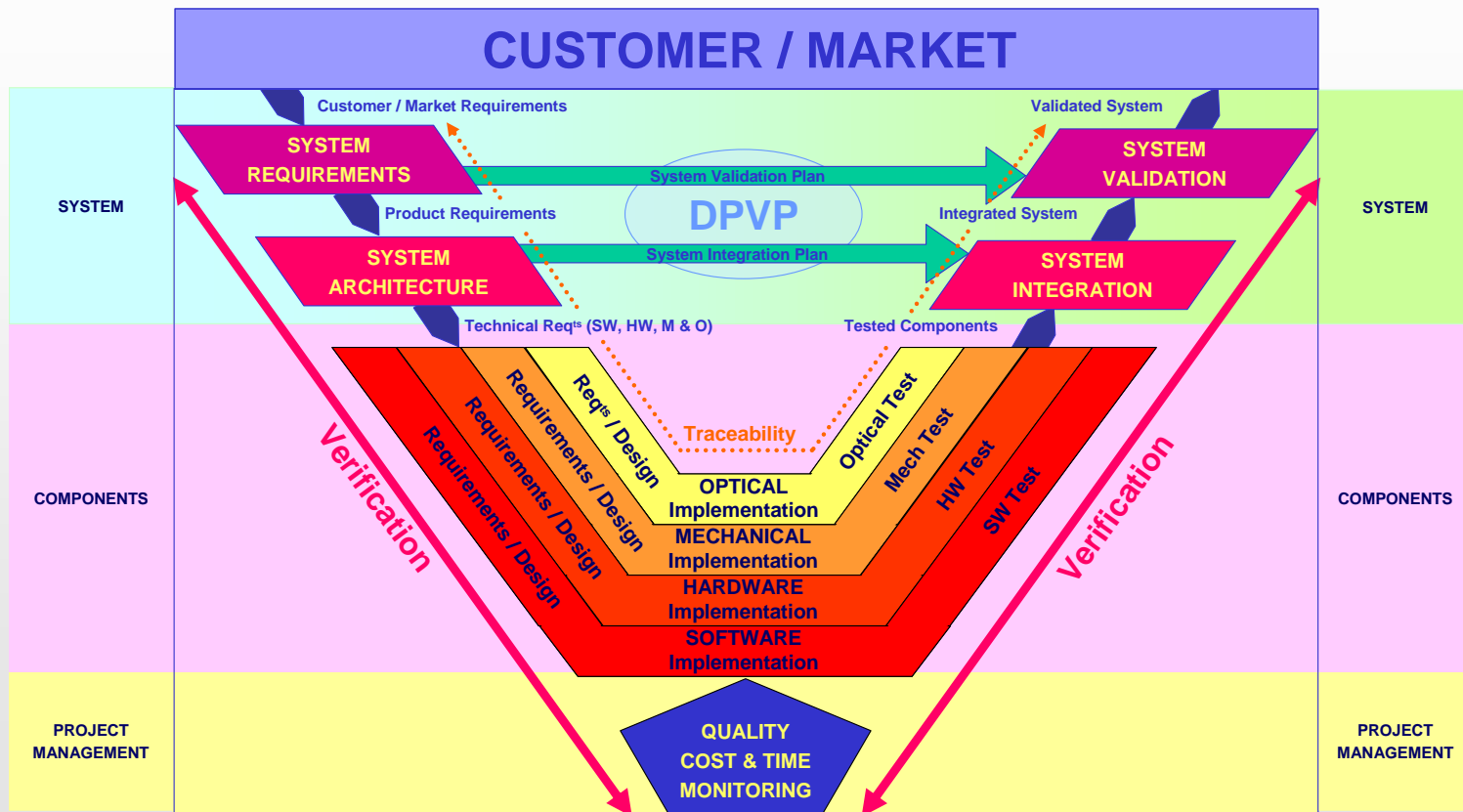


Fiat 500

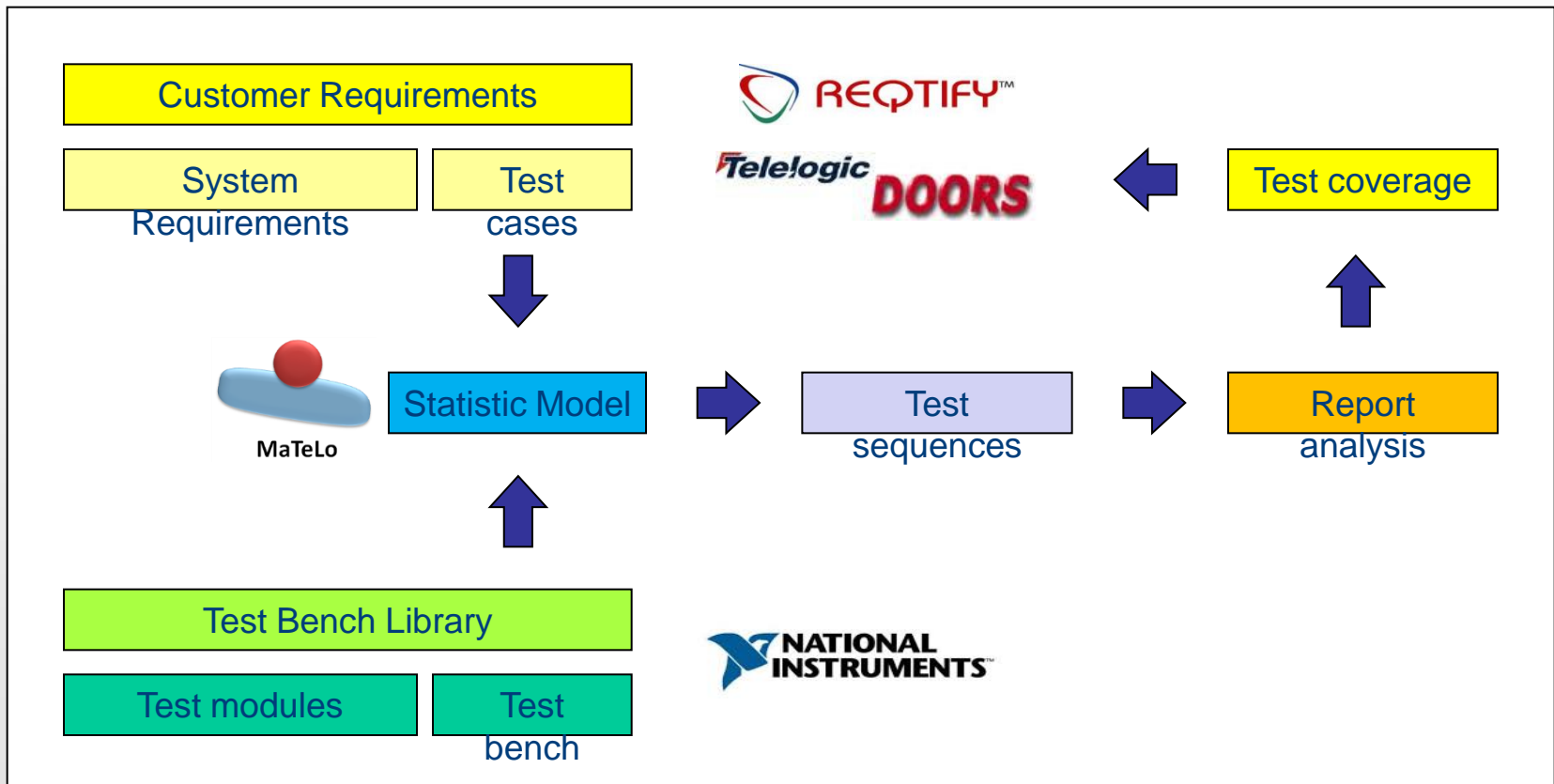
Citroën C4 Picasso



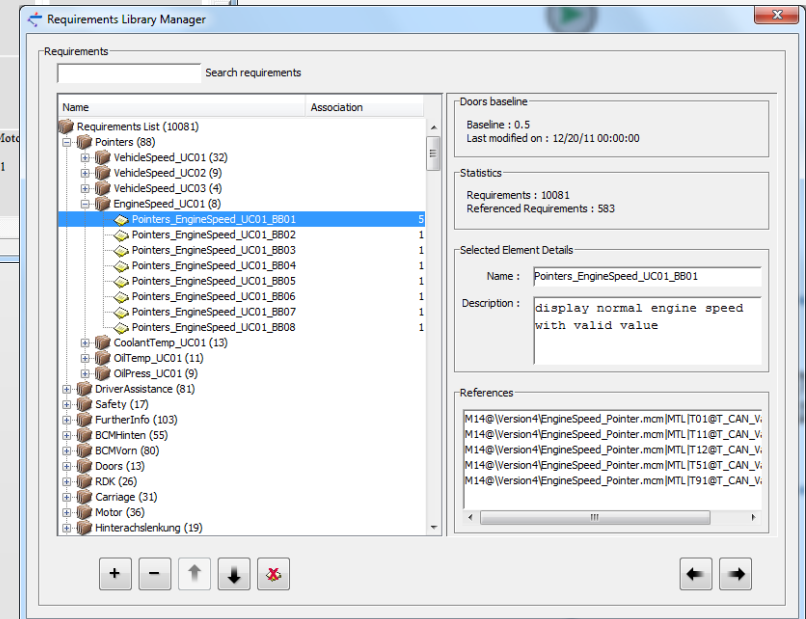
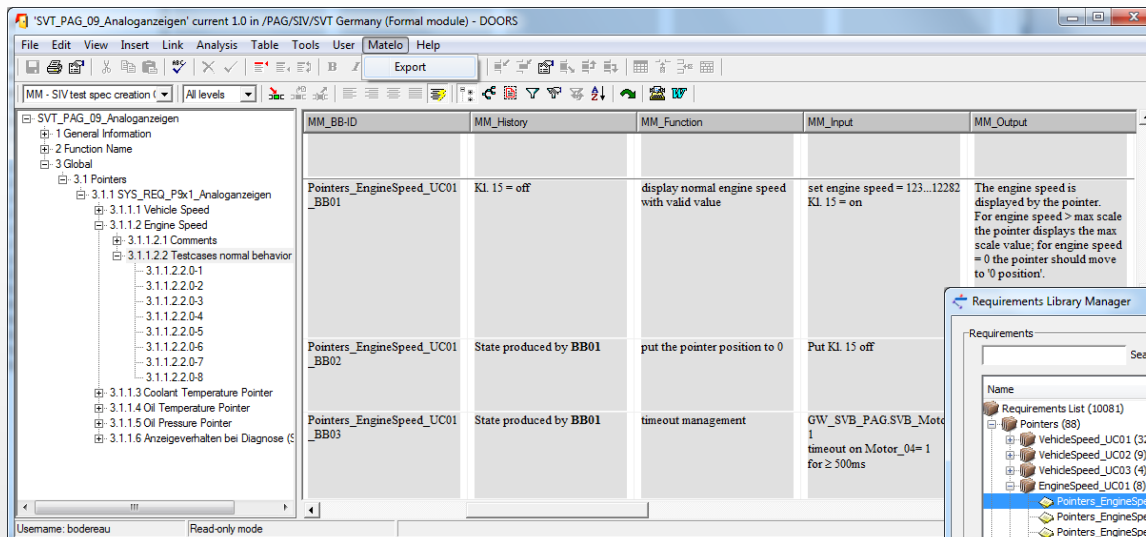
Instrument Clusters & Displays development process is based on **V-model** in which is included **System Validation**.



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



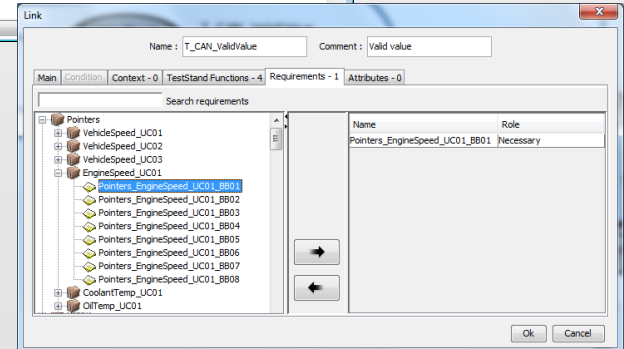
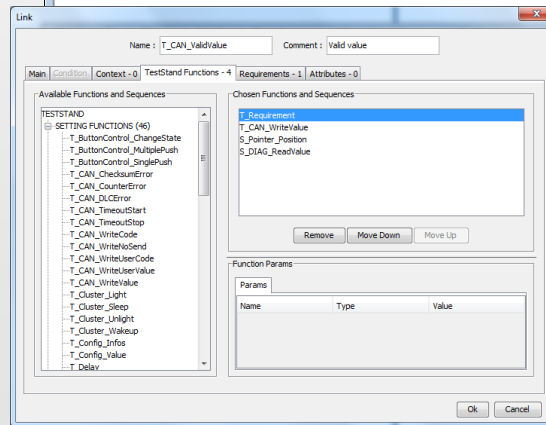
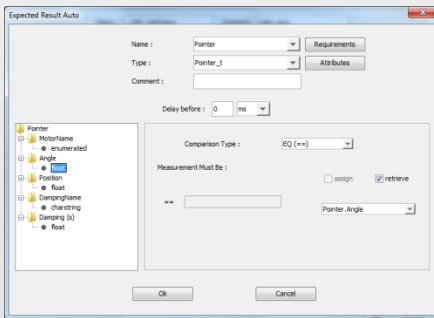
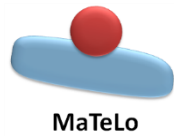
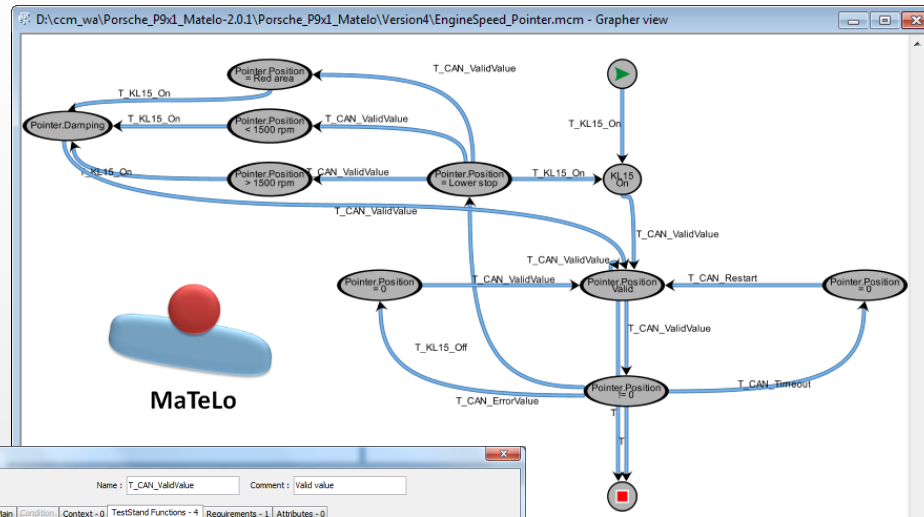
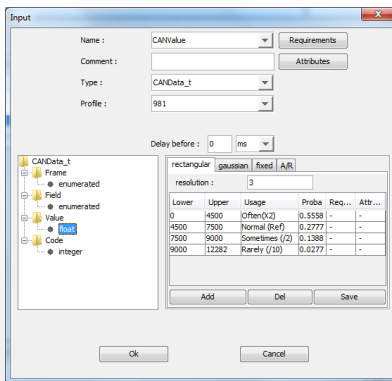
System Validation library is composed of basic modules that manage Setting & Measurement test steps.

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

- SETTING FUNCTIONS
 - T_ButtonControl_ChangeState
 - T_ButtonControl_MultiplePush
 - T_ButtonControl_SinglePush
 - T_CAN_ChecksumError
 - T_CAN_CounterError
 - T_CAN_DLCErrror
 - T_CAN_TimeoutStart
 - T_CAN_TimeoutStop
 - T_CAN_WriteCode
 - T_CAN_WriteValue
 - T_Cluster_Light
 - T_Cluster_Sleep
 - T_Cluster_Unlight
 - T_Cluster_Wakeup
 - T_Cluster_Sleep
 - T_Cluster_Unlight
 - T_Cluster_Wakeup
 - T_Downgraded_4BPulse
 - T_Downgraded_Undervoltage
 - T_IOControl_LogicalInput
 - T_IOControl_ResistiveInput
 - T_IOControl_ResistiveSensor
- MEASUREMENT FUNCTIONS
 - S_CAN_ReadCode
 - S_CAN_ReadValue
 - S_DIAG_ReadErrorMemory
 - S_DIAG_ReadValue
 - S_EEPROM_ReadValue
 - S_Pointer_Angle
 - S_Pointer_Movement
 - S_Pointer_Position
 - S_RAM_ReadValue
 - S_Sound_Control

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.



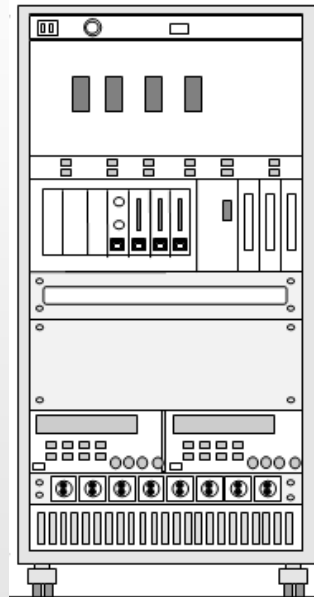
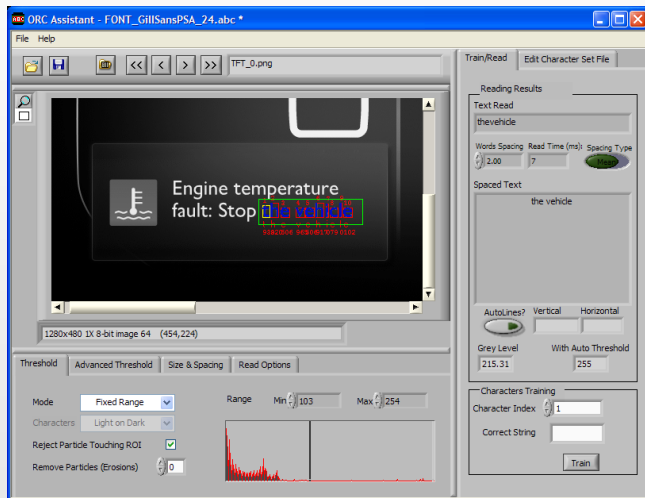
Name	Version	Owner	Status
PSA_B78_TEST_root	2.0.0	bodereau	prep
PSA_B78_TEST_root	1.2	murat	released
PSA_B78_CanMatrix	3.19.3	murat	released
PSA_B78_DynamicFunctions	1.0.1	murat	released
PSA_B78_MATELO	2.0.0	abbaoui	integrate
PSA_B78_ManualMode	3.22.2	charnace	released
PSA_B78_SV_SEQUENCE_EDITOR	1.0	murat	released
PSA_B78_SW_TOOL	2.0.0	bodereau	working
Specifications	1.0	murat	released
HW	1.1	bodereau	working
SW	1.1	bodereau	working
System	1.1	bodereau	working

Name	Version	Owner	Status	Type / Release / Task
PSA_B78_SW_TOOL	2.0.0	bodereau	working	project / PSA_B78_SW_TOOL_2.0 / SECT95#7170
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#9534
ATSEP2	2.1	helias	released	dir / TEMPLATE_SW_TOOL_2.0 / SECT95#506.S
CAN_Matrix	1.3	murat	released	dir / PSA_B78_SW_TOOL_1.7 / SECT95#626
CAN_Server	2.0	helias	released	dir / TEMPLATE_SW_TOOL_2.0 / SECT95#4627.S
Mutex	2.0	helias	released	dir / TEMPLATE_SW_TOOL_2.0 / SECT95#4627.S
PdI	2.0	helias	released	dir / TEMPLATE_SW_TOOL_2.0 / SECT95#4627.S
Sound	2.3	bodereau	released	dir / TEMPLATE_SW_TOOL_2.0 / SECT95#4627.S
Tools	2.2	helias	released	dir / TEMPLATE_SW_TOOL_2.0 / SECT95#45138.S
Vision	2.0	helias	released	dir / TEMPLATE_SW_TOOL_2.0 / SECT95#4627.S
Out	2.0	bodereau	integrate	dir / PSA_B78_SW_TOOL_2.0 / SECT95#7172
PSA_B78_SW_TOOL.cws	2.0	bodereau	integrate	ascii / PSA_B78_SW_TOOL_2.0 / SECT95#7172
PSA_B78_SW_TOOL.ptj	2.0	bodereau	integrate	ptj / PSA_B78_SW_TOOL_2.0 / SECT95#7172
Public_int	1.0	murat	released	dir / PSA_B78_SW_TOOL_1.0 / SECT95#5210
Sic	1.1	murat	released	dir / PSA_B78_SW_TOOL_1.1 / SECT95#9534
Test	1.0	murat	released	dir / PSA_B78_SW_TOOL_1.0 / SECT95#5210

Name	Version	Owner	Status
PSA_B78_MATELO	2.0.1	bodereau	working
PSA_B78_MATELO	1.1	murat	released
CompletionDictionary.ini	2.4	abbaoui	integrate
PSA_B78_MATELO.ptj	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
Sequencet.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 equipment setup consists in :

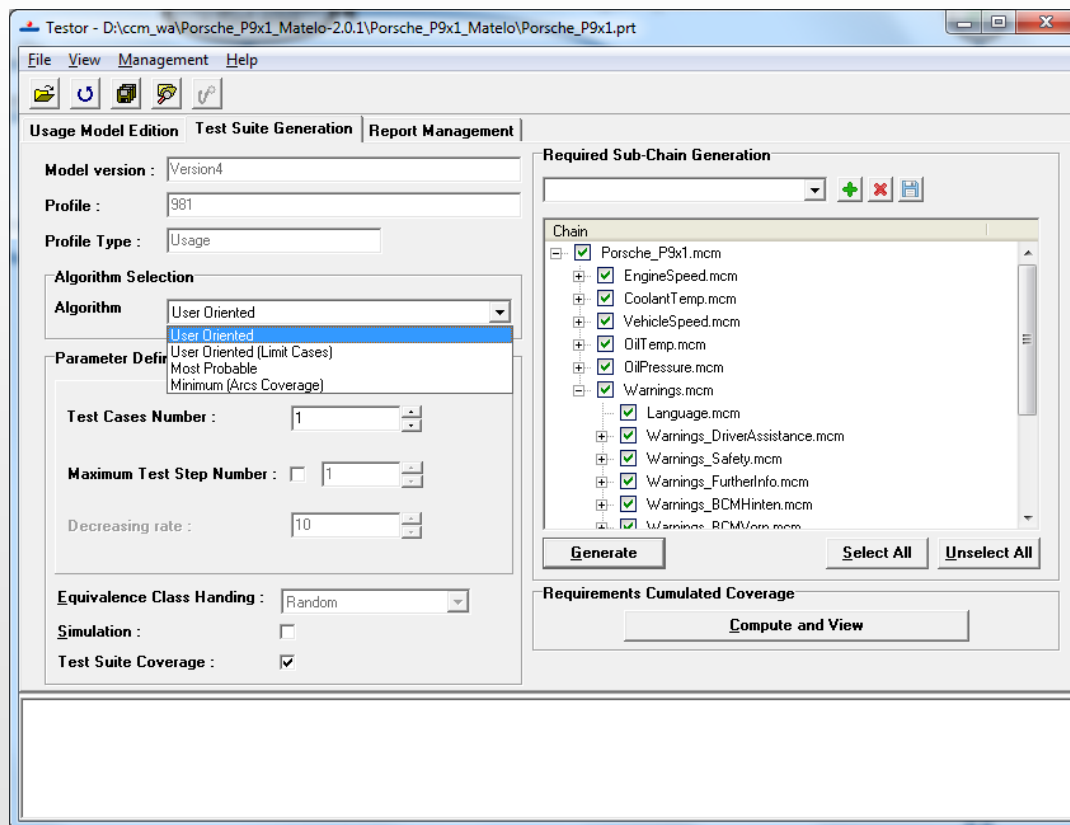
- I/O setup from customer connector description
- Vision training for pattern matching & OCR
- Sound training



Test campaign -> Generation

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

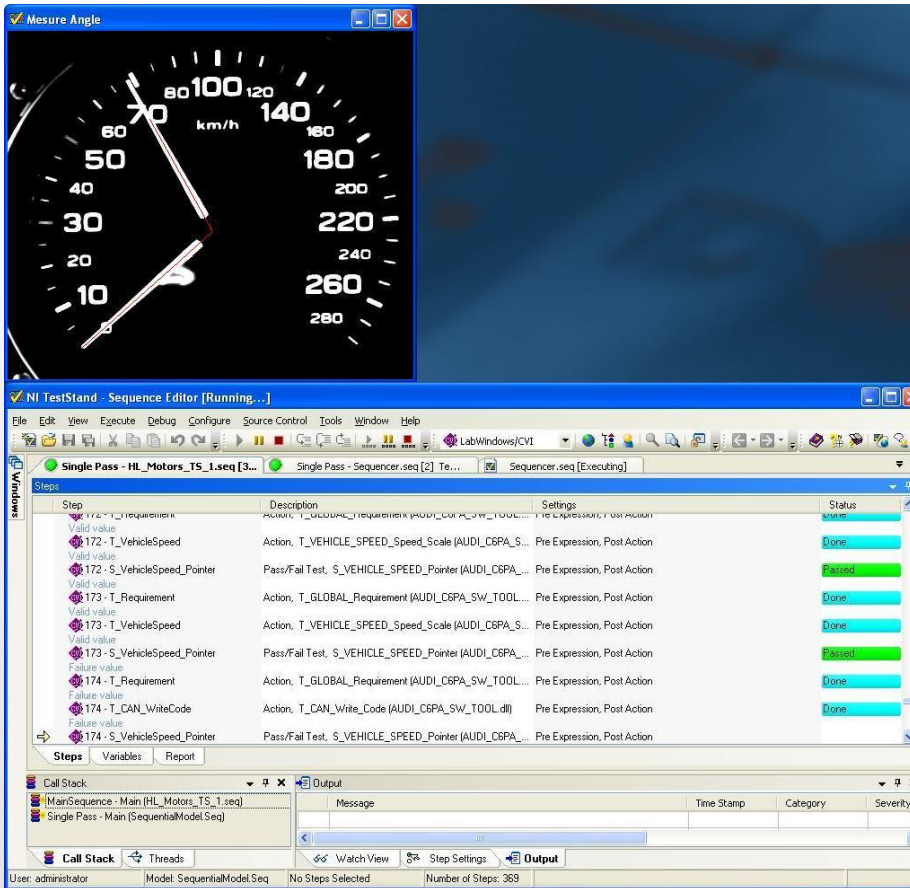
Test sequences are **generated** from the **statistic model** with several profiles.



Test campaign -> Execution & Analysis



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

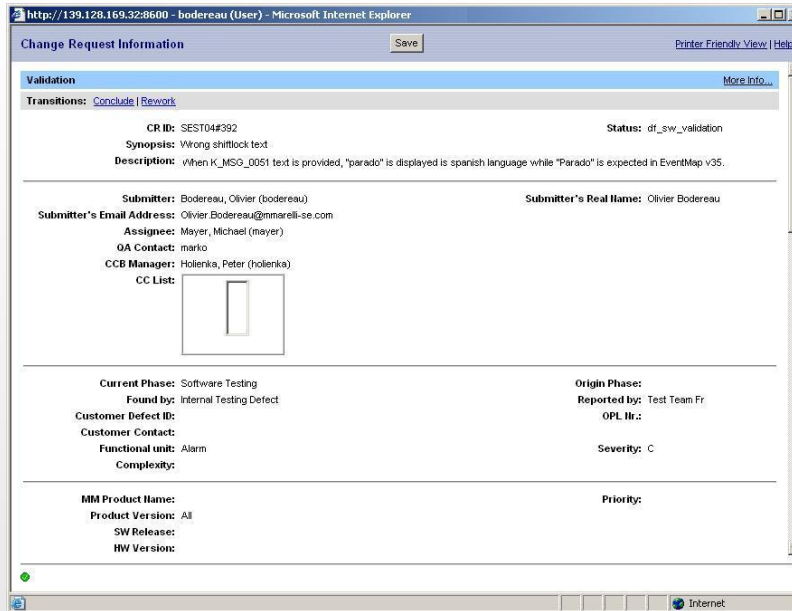


Sub chain : Warnings_Chassis_ChildProofCatch	
27 - T_KL15	
Status:	Done
CAN Klemmen_Status.ZA1_ZAS_Kl_15 : 1.000 / 0x01	
28 - T_Requirement	
Status:	Done
Requirement : Warnings_Chassis_ChildProofCatch_UC01_BB01	
28 - T_CAN_WriteCode	
Status:	Done
CAN TSG_FT_1.FT_Kisi_Fehler : 1.000 / 0x01 (Kindersicherungsfunktion nicht m)	
28 - S_Warning_State	
Status:	Failed
Sound : Gong600 (1x)	
Expected duration : 1.00 s - Measured duration : 0.93 s	
Expected frequency : 600 Hz - Measured frequency : 601 Hz	
Expected text : Sécurité- ! enfants! ! Dysfonct.	
Displayed text : Sécurité- ! enfants! ! Dysfonct.	
To see picture, click here	
29 - T_Requirement	
Status:	Done
Requirement : Warnings_Chassis_ChildProofCatch_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 sound : no sound	
Expected text :	
Displayed text :	

Requirements	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.



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

Sub chain : BCMVomKessy	
48 - T_CAN_WriteCode	
Status:	Done
Module Time:	0.032 s
CAN GW_SVB_PAG_SVB_BCM1 : 1 / 0x01 (SG_verbaut)	
49 - T_CAN_WriteCode	
Status:	Done
Module Time:	0.032 s
CAN Klemmen_Status_01.ZAS_KI_15 : 1 / 0x01 (ein)	
80 - T_Requirement	
Status:	Done
Module Time:	0.002 s
Requirement : BCMVom_Kessy_UC01_BB14;	
80 - T_CAN_WriteValue	
Status:	Done
Module Time:	0.064 s
CAN Kessy_02.FBS_Prio_Warn_04 : 1 / 0x01 (Kombi Prio Warnung FBS 4)	
80 - S_Warning_State	
Status:	Failed
Issues:	1816
Module Time:	6.277 s
<ul style="list-style-type: none"> Warn-ID : 75 Expected value : 75 - Displayed value : 75 Sound : Ton3 Expected sound : Ton3 Measured sound : Ton3 Pictogram : Schluessel_gelb Expected state : On - Displayed state : On Text : W_FBS_4 Expected text : イグニッションキー/スイッチ部を時計ず左へ回す Displayed text : イグニッション/スイッチ部を時計ず左へ回す >>> see picture Acknowledge : none Expected state : Off - Displayed state : Off 	
82 - T_Requirement	
Status:	Done
Module Time:	0.001 s
Requirement : BCMVom_Kessy_UC01_BB01;	
82 - T_CAN_WriteValue	
Status:	Done
Module Time:	0.062 s
CAN Kessy_02.FBS_Prio_Warn_04 : 0 / 0x00	
82 - S_Warning_State	
Status:	Passed
Module Time:	2.037 s
<ul style="list-style-type: none"> Warn-ID : 75 Expected value : no value - Displayed value : no value Sound : Expected sound : No sound Measured sound : No sound Pictogram : Schluessel_gelb Expected state : Off - Displayed state : Off Text : Expected text : no text - Displayed text : no text Acknowledge : none Expected state : Off - Displayed state : Off 	

Requirements	Passed	Failed	Issues
BCMVom_Kessy_UC01_BB01	89	0	
BCMVom_Kessy_UC01_BB02	0	0	
BCMVom_Kessy_UC01_BB03	0	0	
BCMVom_Kessy_UC01_BB06	1	0	
BCMVom_Kessy_UC01_BB07	1	0	
BCMVom_Kessy_UC01_BB08	1	0	
BCMVom_Kessy_UC01_BB09	0	0	
BCMVom_Kessy_UC01_BB10	1	0	
BCMVom_Kessy_UC01_BB11	1	0	
BCMVom_Kessy_UC01_BB13	1	0	
BCMVom_Kessy_UC01_BB14	0	1816	1816

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