



# Model-Based Black Box Testing and its Standardization Layers



***THE SOLUTION TO BOOST  
YOUR TEST EFFICIENCY***

Since 1998

French: 45 experts

Turnover 2010: 4 M€

Expertise offer:

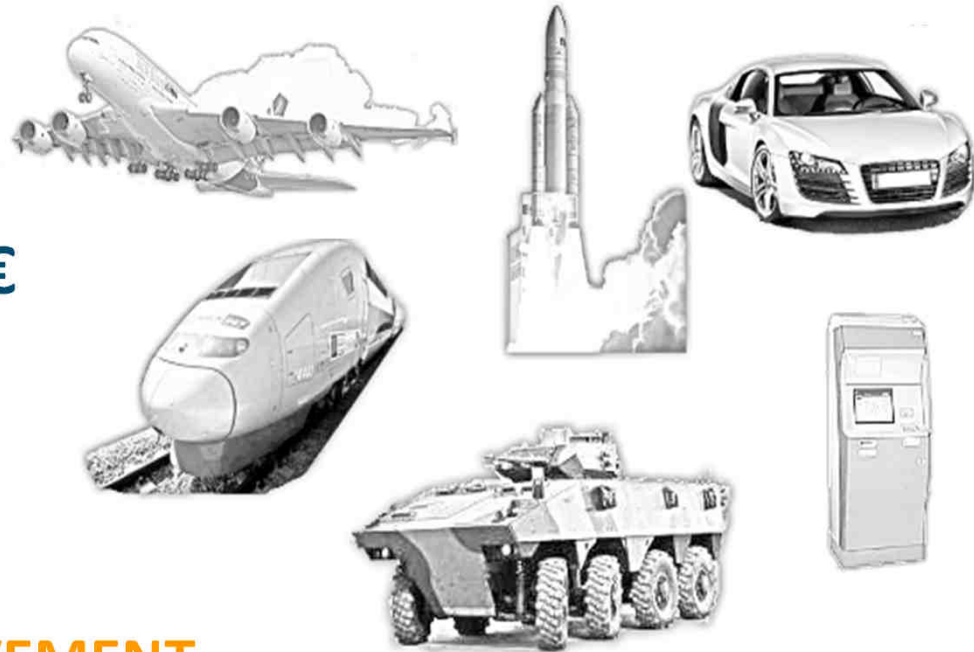
⇒ **PROCESS IMPROVEMENT**

⇒ **SAFETY ENGINEERING**

⇒ **SYSTEM ENGINEERING**

⇒ **OPTIMIZED TESTING**

⇒ **SOFTWARE RELIABILITY**



**EMBEDDED  
SYSTEMS**

# OUR COMPETENCES OFFER



Training

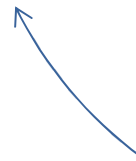
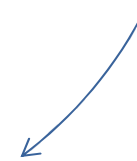
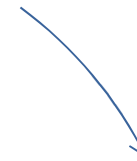
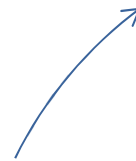


Tooling

Consulting

- MaTeLo
- EXAM
- M Elopée
- Safety Architect

Engineering



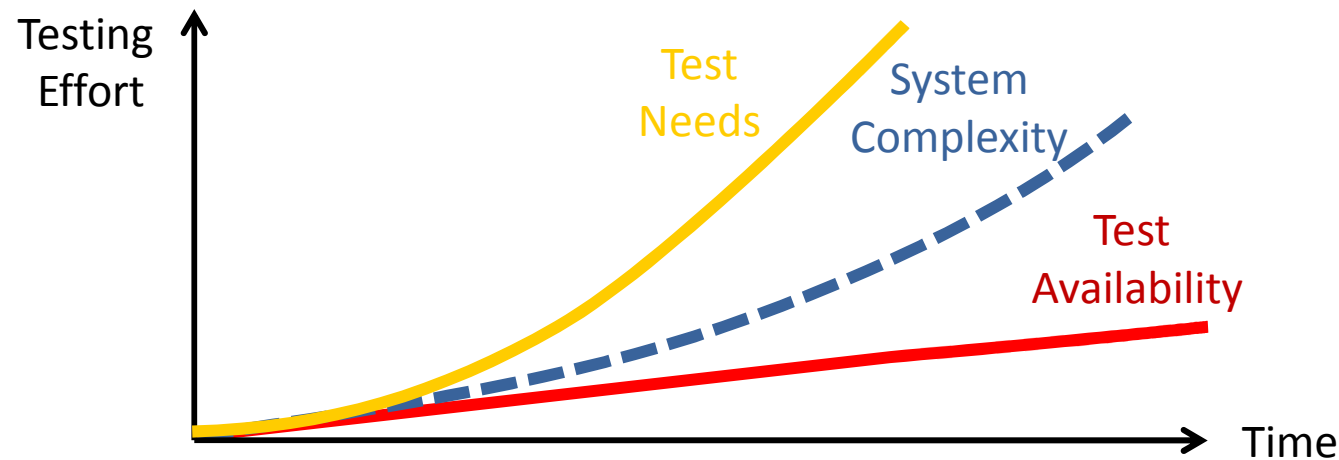
# AGENDA

---

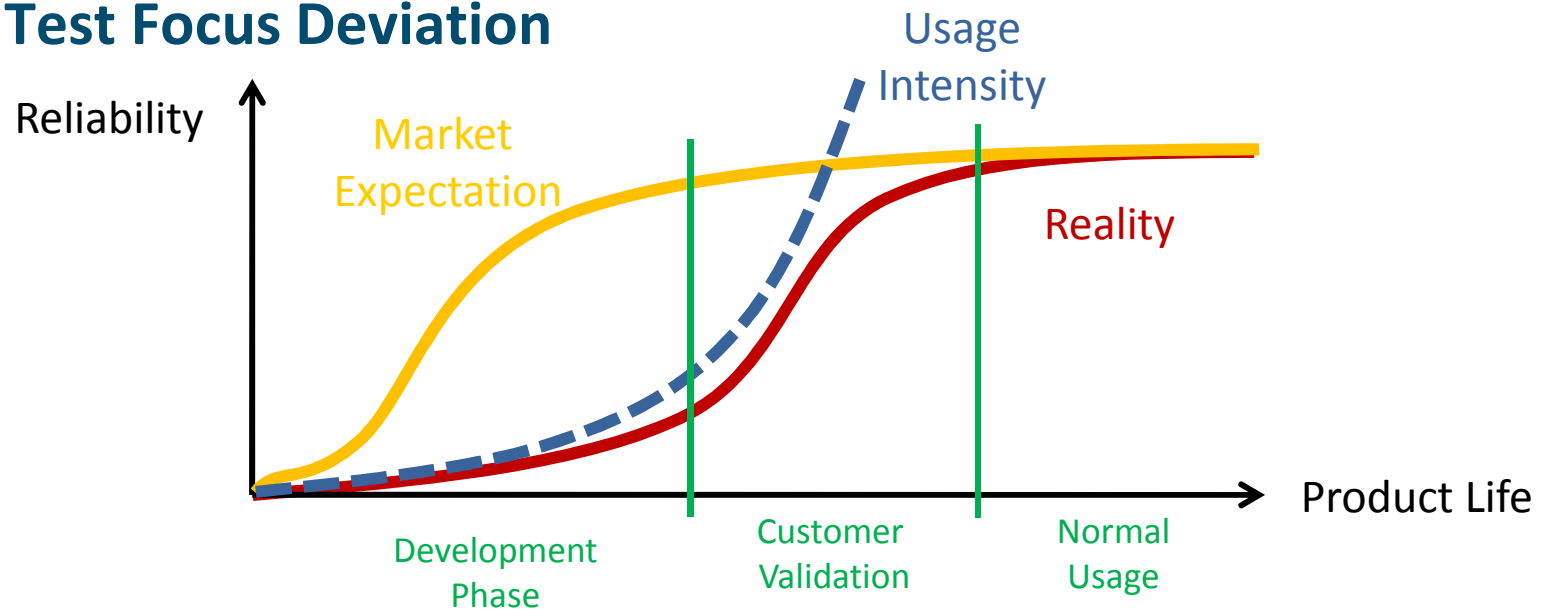
- ☐ THE TEST PROBLEM
- ☐ THE EXPECTED SOLUTION
- ☐ THE MODEL-BASED TESTING SOLUTION
- ☐ A PRAGMATIC INDUSTRIAL USE-CASE
- ☐ A MORE STANDARDIZED TOOLS INTEGRATION

# THE TESTING PROBLEM

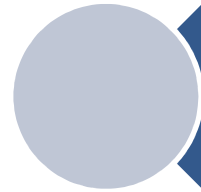
## ❑ Test Resources Lack



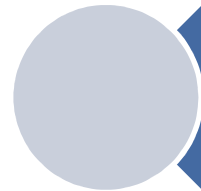
## ❑ Test Focus Deviation



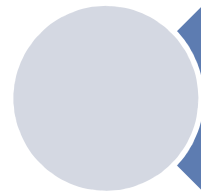
# HOW TO SOLVE THIS ISSUE?



Test the SUT usage  
before product release



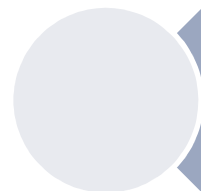
Use best in class  
engineering process



Widely use  
automatic generation

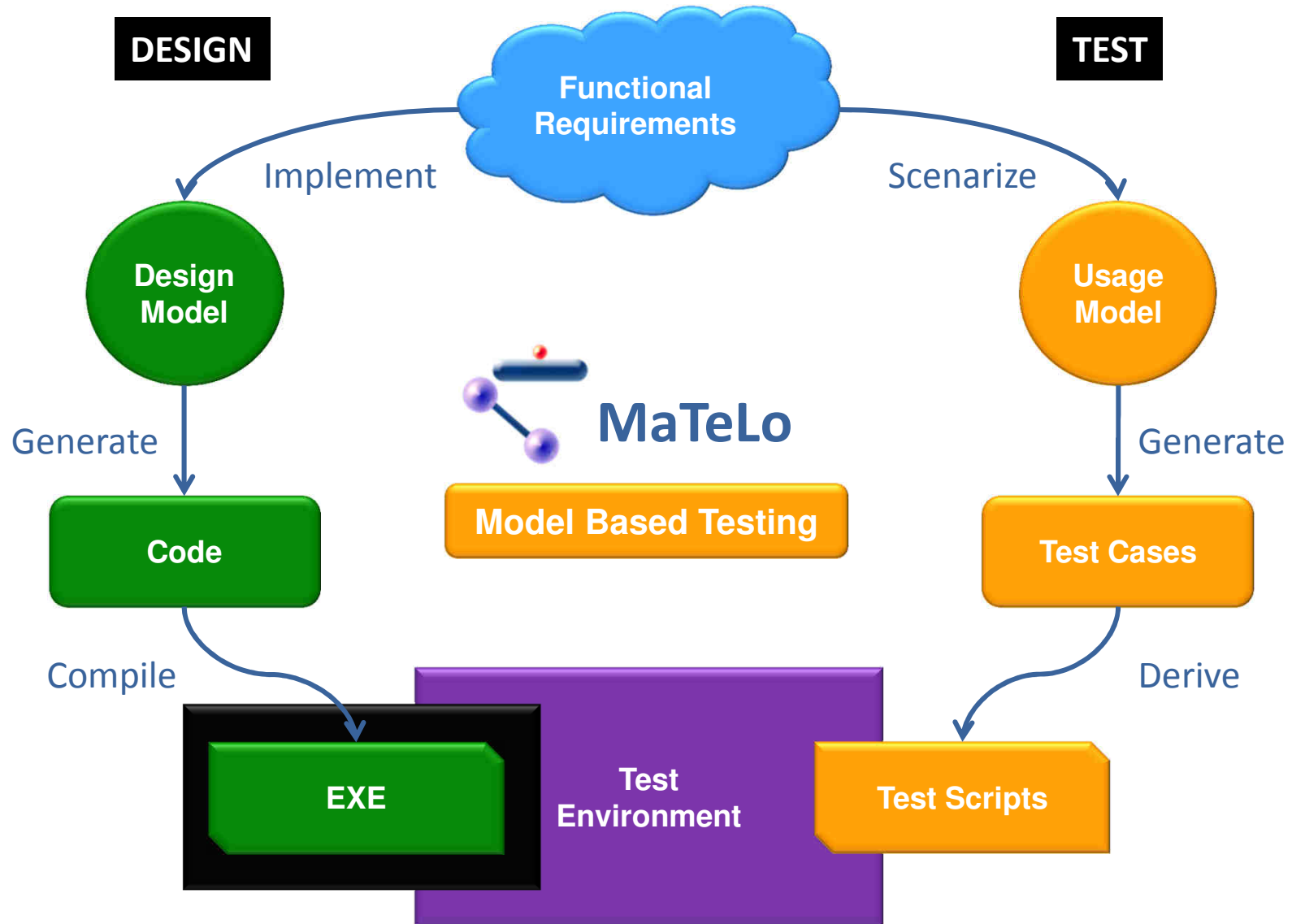


Use dedicated tools that decouple  
engineering productivity



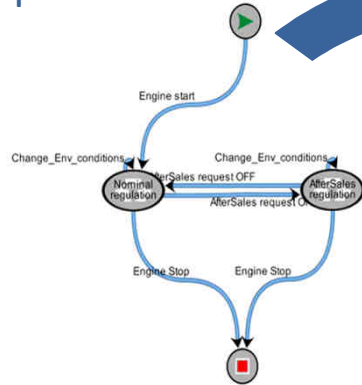
Use formalization  
and traceability

# MODEL-DRIVEN ENGINEERING

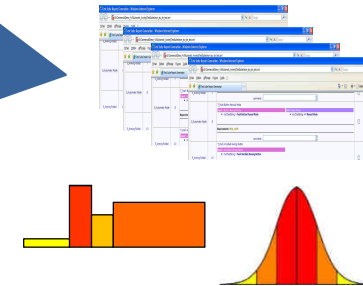
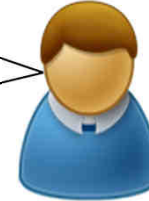


# WHAT IS MaTeLo?

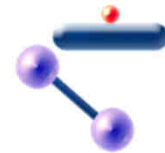
Formal Test Specification



Product Usage  
Point of View



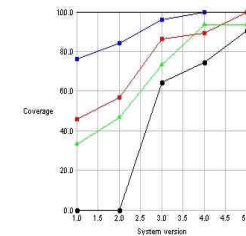
More  
Productive  
Coverage



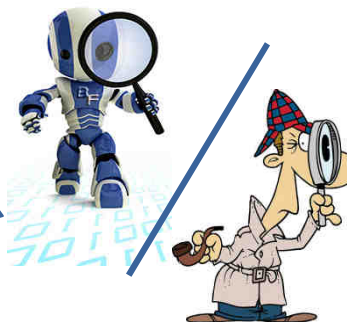
MaTeLo

Markov Test Logic

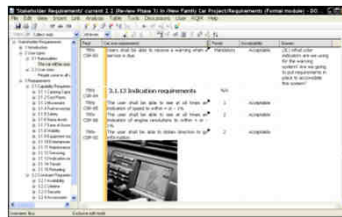
Fully  
Measured  
Process



Test Execution  
Compatibility



Bidirectional  
Requirements  
Traceability

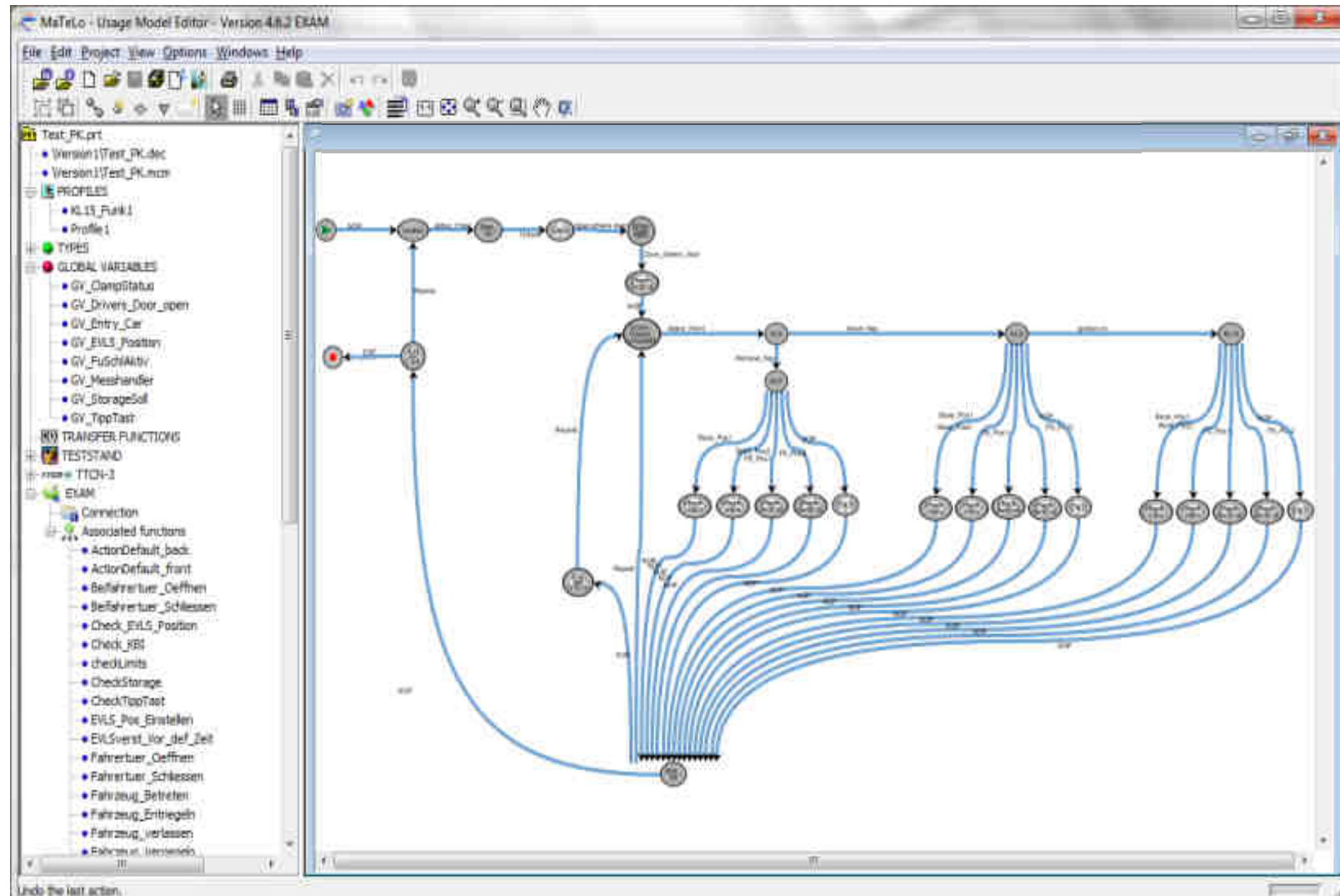


Systematic  
Engineering  
Productivity

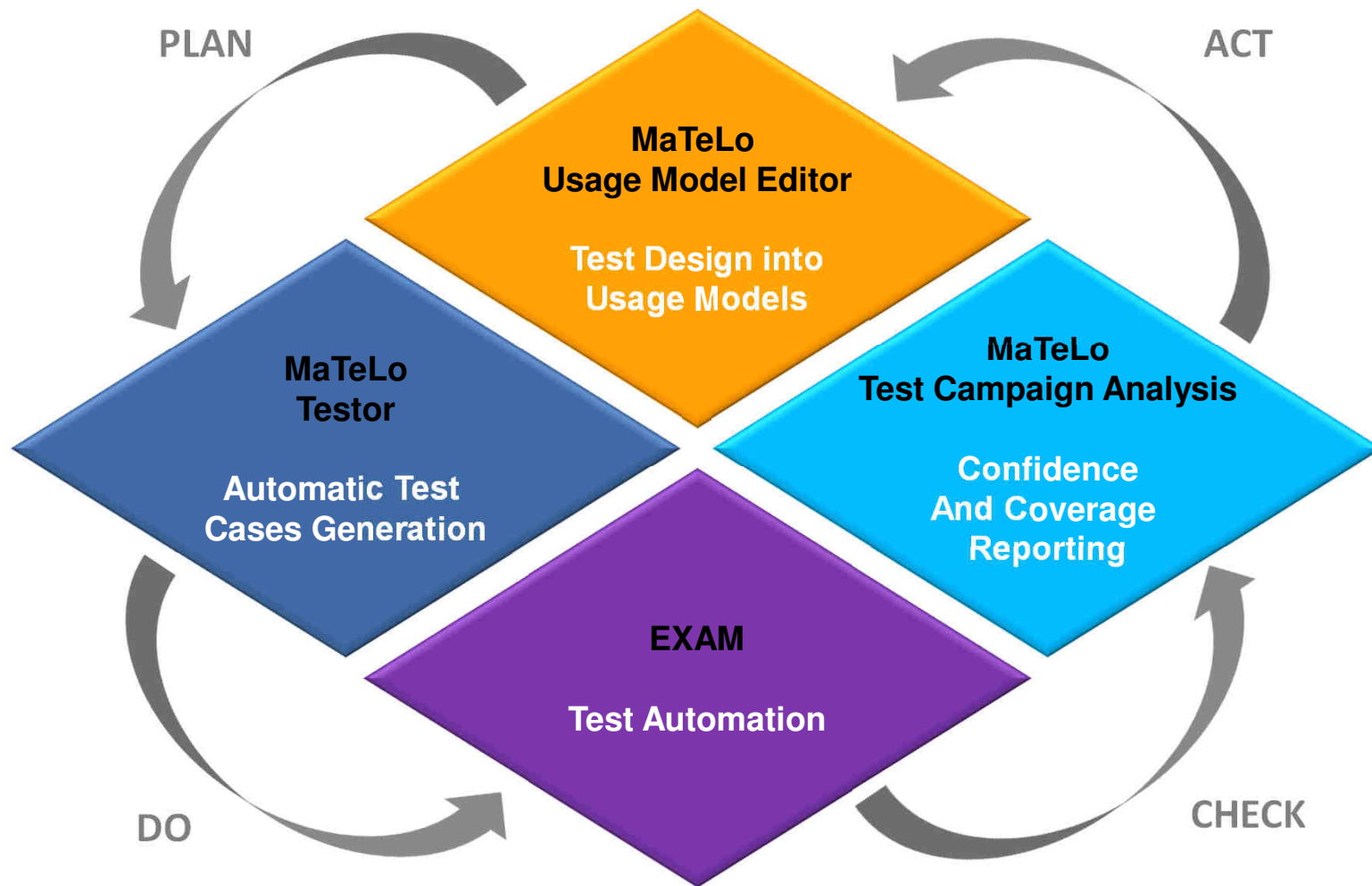


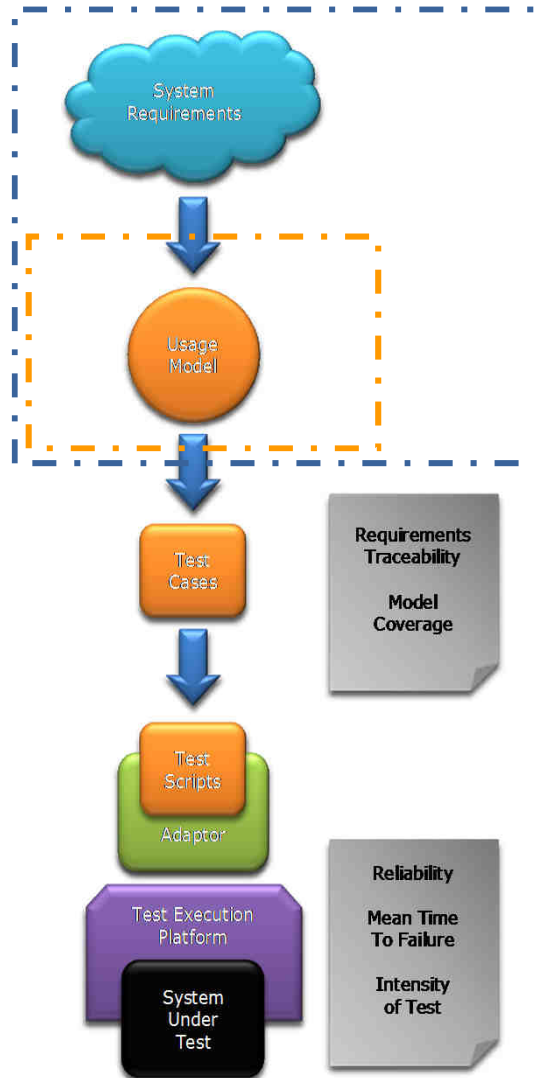


## MATELO SCREENSHOT



# INTEGRATED TEST WORKFLOW





## MaTeLo EDITOR Usage Model Design

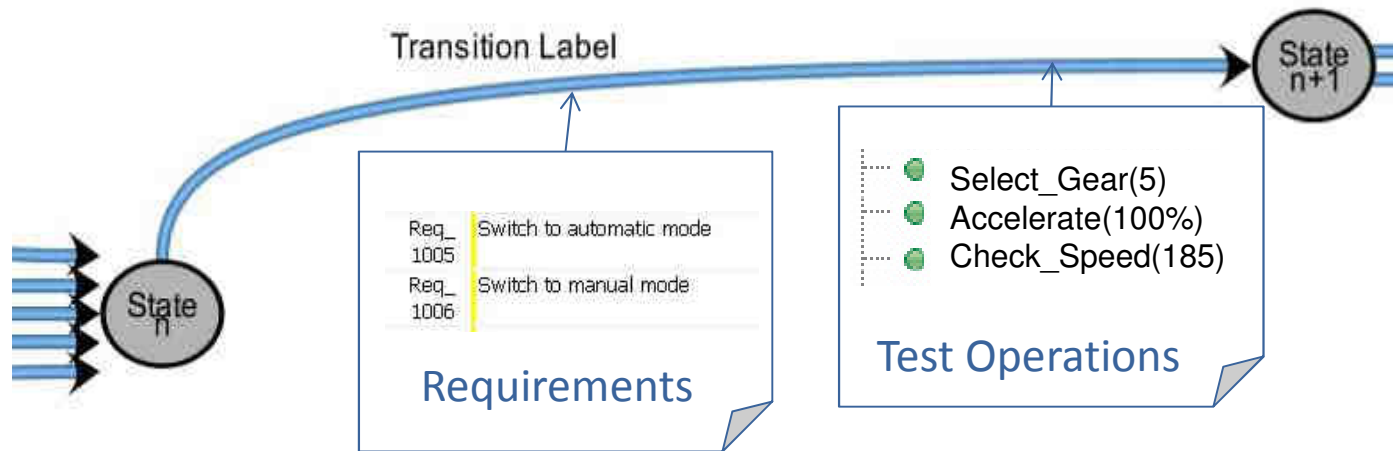
- # BEGINNING



STATE

**END**

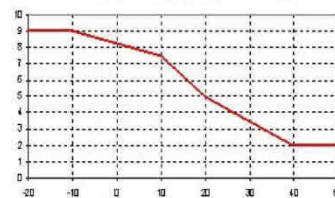
# MODEL TRANSITION = TEST STEP



## Stimulations

Inputs Stimulation  
Equivalence Classes  
Timing

## Test Oracle



Outputs =  $f(\text{Inputs})$



## Verifications

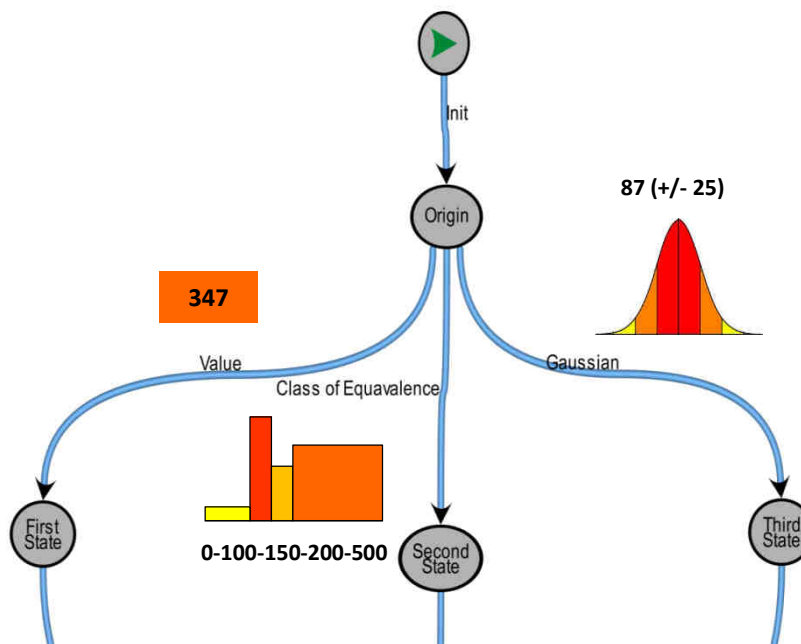
Expected Outputs  
Timing

## □ Profiles can be embedded to qualify the usage model

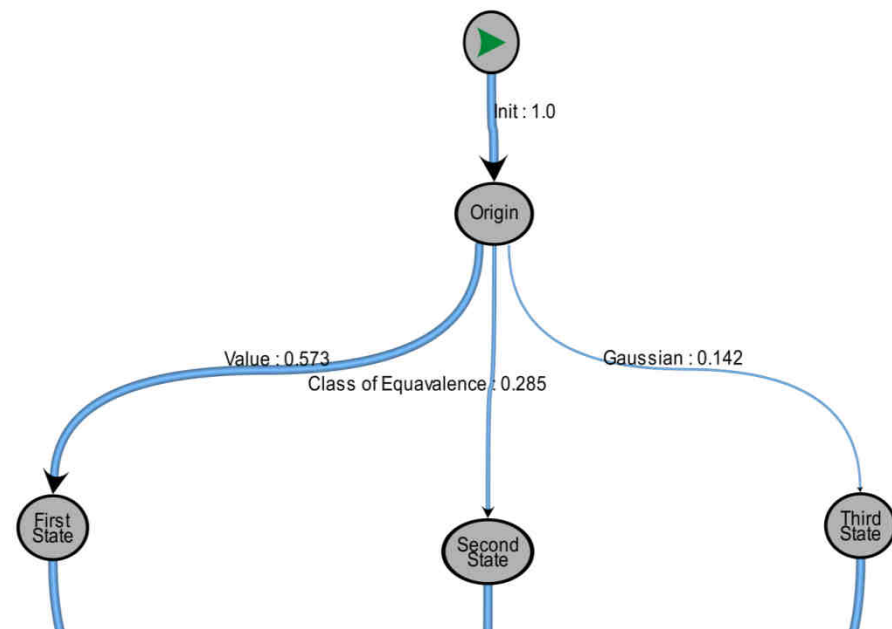
⇒ Operational profiles

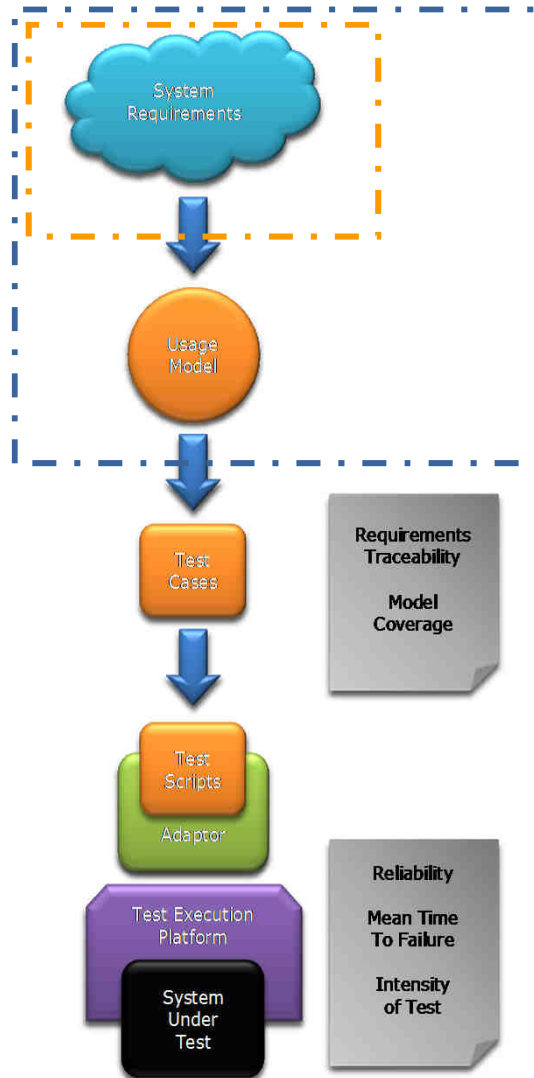
⇒ Test profiles

### Data distribution



### Usage path probability

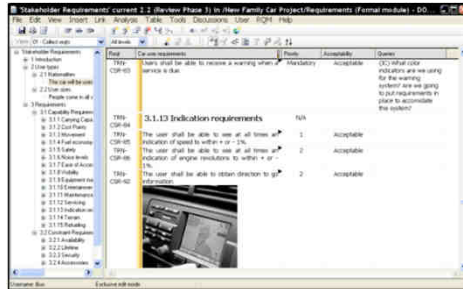




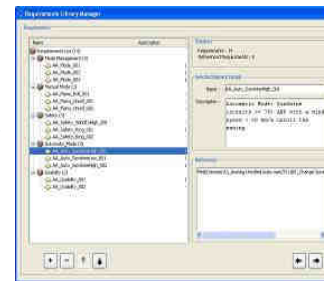
## MaTeLo EDITOR Requirements Management

# REQUIREMENTS MANAGEMENT

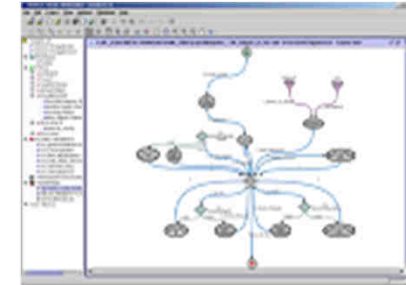
## IBM Rational Doors



## MaTeLo Requirements Library



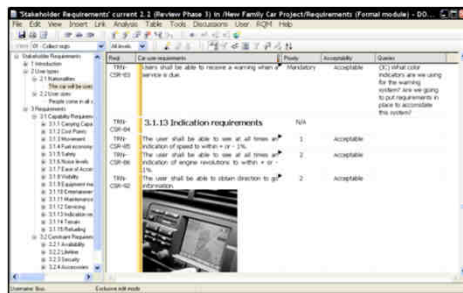
## MaTeLo Usage Model



Import

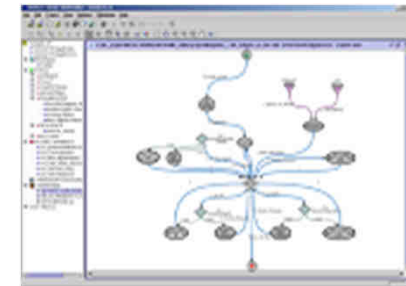
Association  
(N,M)

Requirement Update  
New Baseline



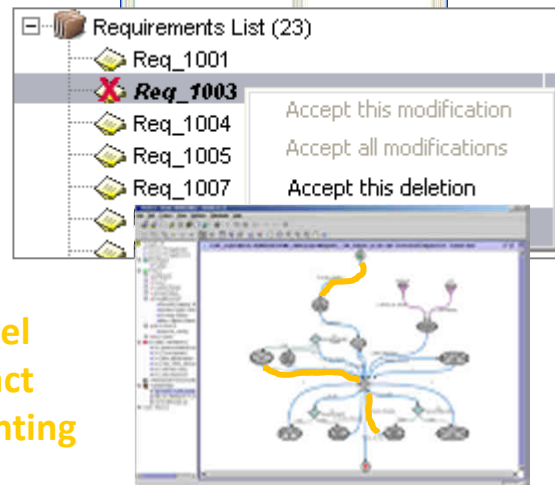
Update

Quick  
Model  
Update



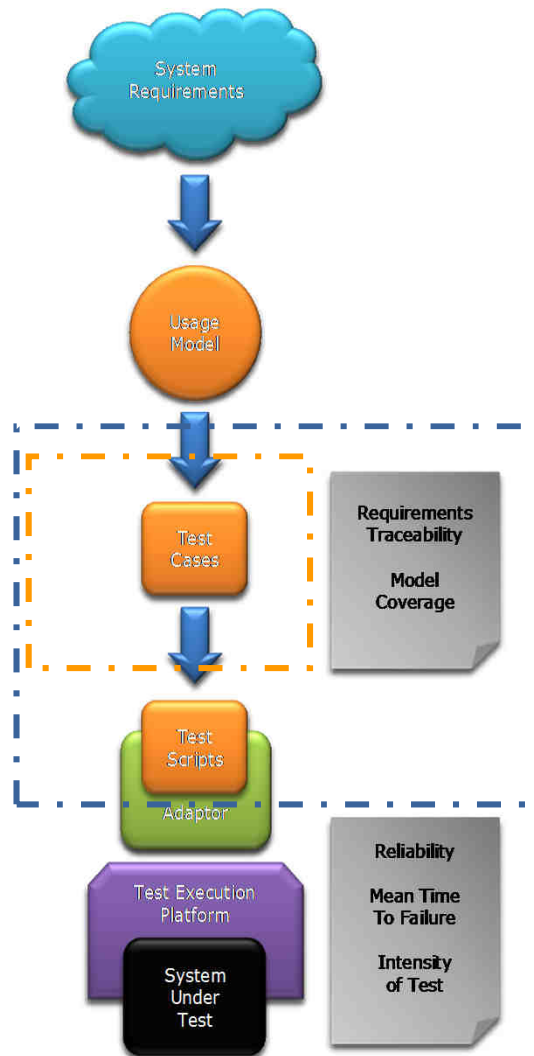
Requirements  
Change  
Analysis

Model  
Impact  
Highlighting



Available for  
other ReqMgt tools  
with import of  
XML or CSV files

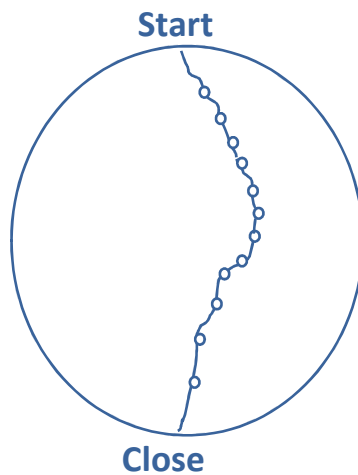




## MaTeLo TESTOR Test Cases Generation

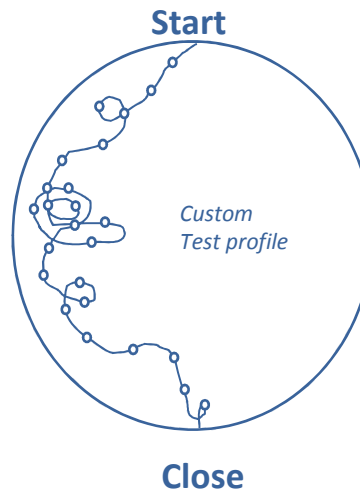
# MaTeLo TEST STRATEGY

## Most probable approach



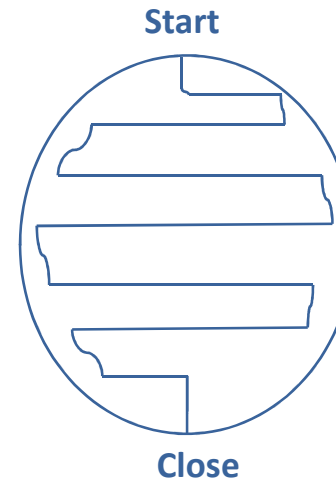
FREQUENCY  
FOCUS

## Risk based approach



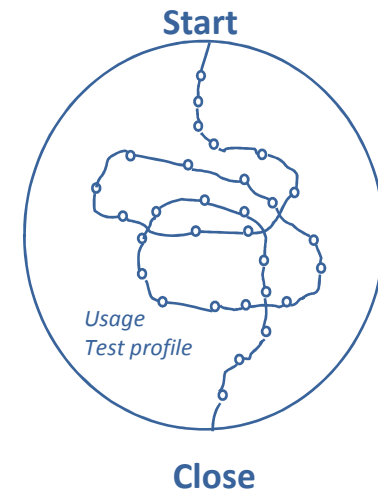
CRITICALITY, COMPLEXITY  
UPDATE FOCUS

## Arcs coverage approach



REQUIREMENTS  
COVERAGE

## Usage approach



OPERATIONAL  
COVERAGE

## □ DEFINE THE TEST STRATEGY, BY CHOOSING

- ⇒ Test Algorithm
- ⇒ Test Profile
- ⇒ Part of model to test

Generate

# MaTeLo TESTOR: HTML TEST PLAN

11

Wind blows equal or over 30 kmh

Input : Weather

- Weather :
  - Sunshine Intensity : 27
  - Wind Force : 69

TestStand Associations				
Name	Params Name	Type	Data	Value
Set Wind Force	Parameter	Input	Weather.Wind Force	69
Set Sunshine Intensity	Parameter	Input	Weather.Sunshine Intensity	27

12

Awning started Rolling up

Input : Rolling up Time

ERA : Buzzer\_State

- myInteger : 14
- myBoolean : == true

TestStand Associations				
Name	Params Name	Type	Data	Value
Wait	TimeExpr	Input	Rolling up Time	14
Buzzer Ring				

Requirements : AA\_Safety\_Ring\_001

13

Awning is Rolling up

Input : Remaining Rolling up Time

ERA : Awning\_State

- myInteger : 1
- Rolled up Unrolled State : == Rolled up

TestStand Associations				
Name	Params Name	Type	Data	Value
Wait	TimeExpr	Input	Remaining Rolling up Time	1

Requirements : AA\_Usability\_001

State

Input

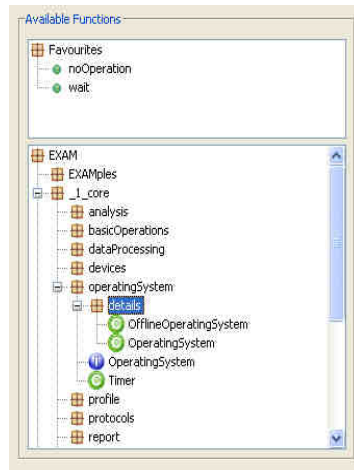
Test Function

Requirement

Expected Result

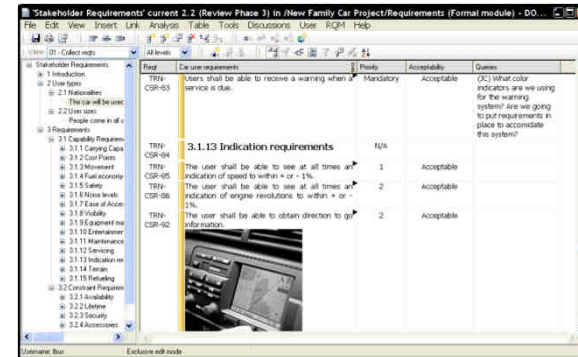
Verdict

# Example: MaTeLo FOR EXAM



## Test Repository

- ❑ SUT Interface
- ❑ Test Operations
- ❑ Stimulation
- ❑ Measurement
- ❑ Administration
- ❑ Sub Test Sequences



## Requirements

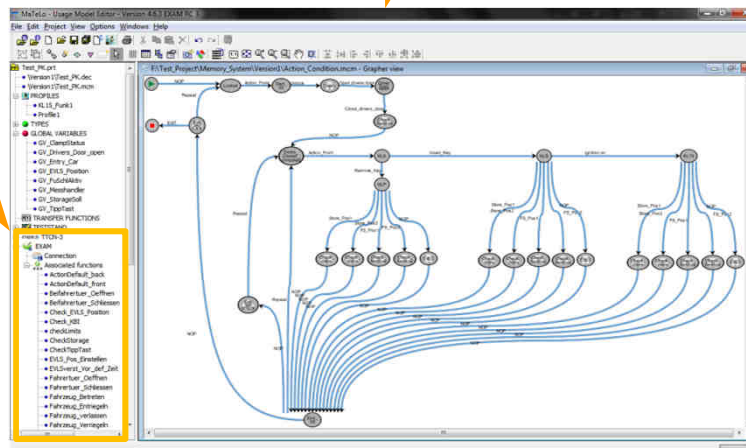
- ❑ Name
- ❑ UUID
- ❑ Description

## Association

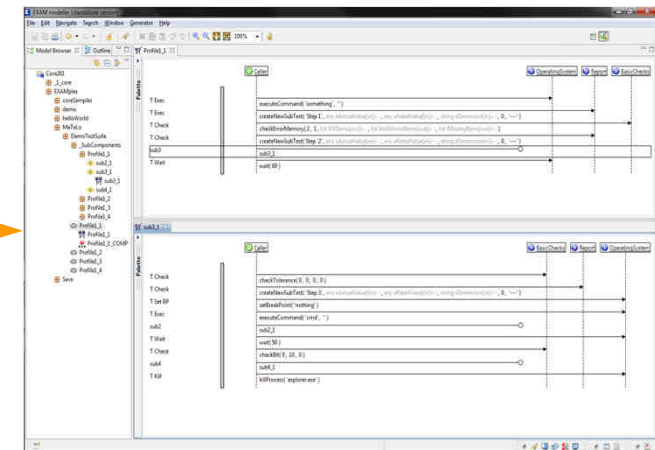
## Association

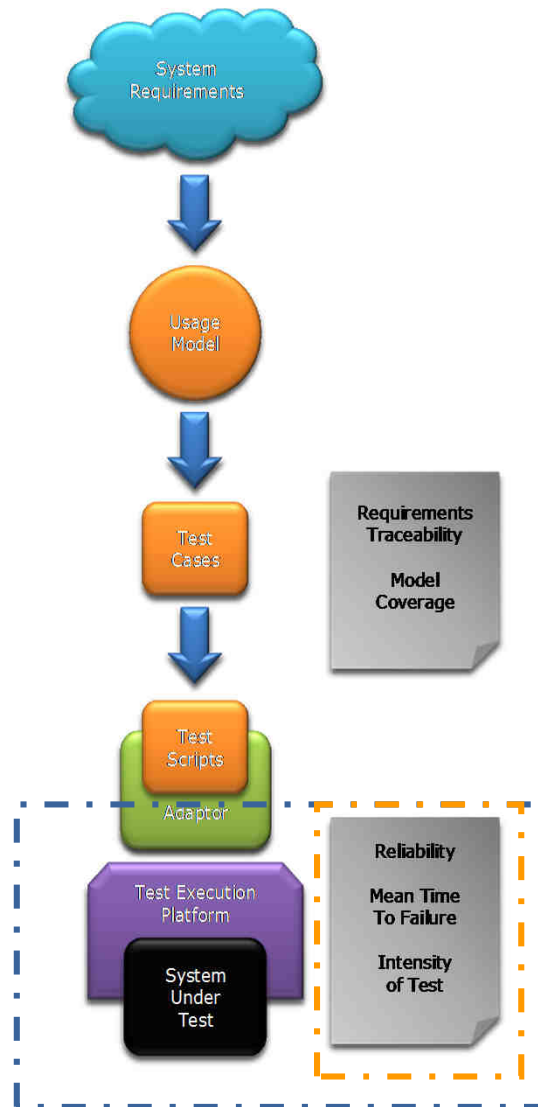
## Automatic Test Cases

- ❑ Automatic call of Test Operation
- ❑ Automatic parameterisation
- ❑ Requirements association
- ❑ Test Case description generation
- ❑ Usage model respect



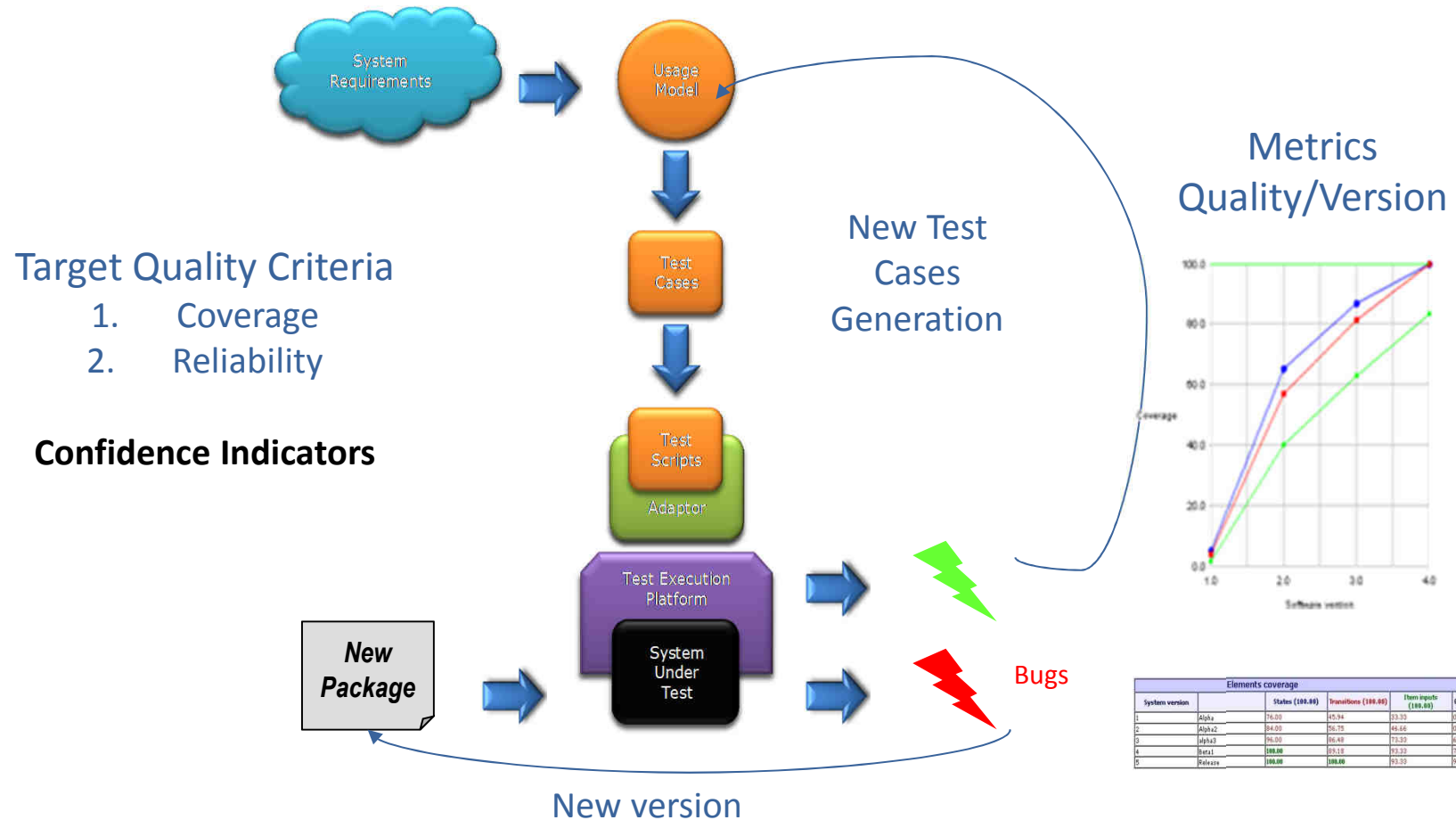
## Generate



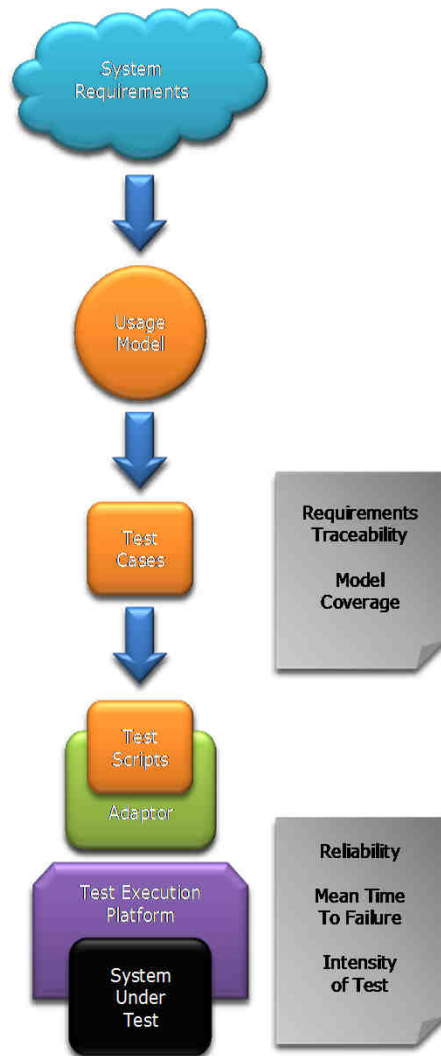


## MaTeLo TCA Test Campaign Analysis

# TEST CAMPAIGN PROCESS

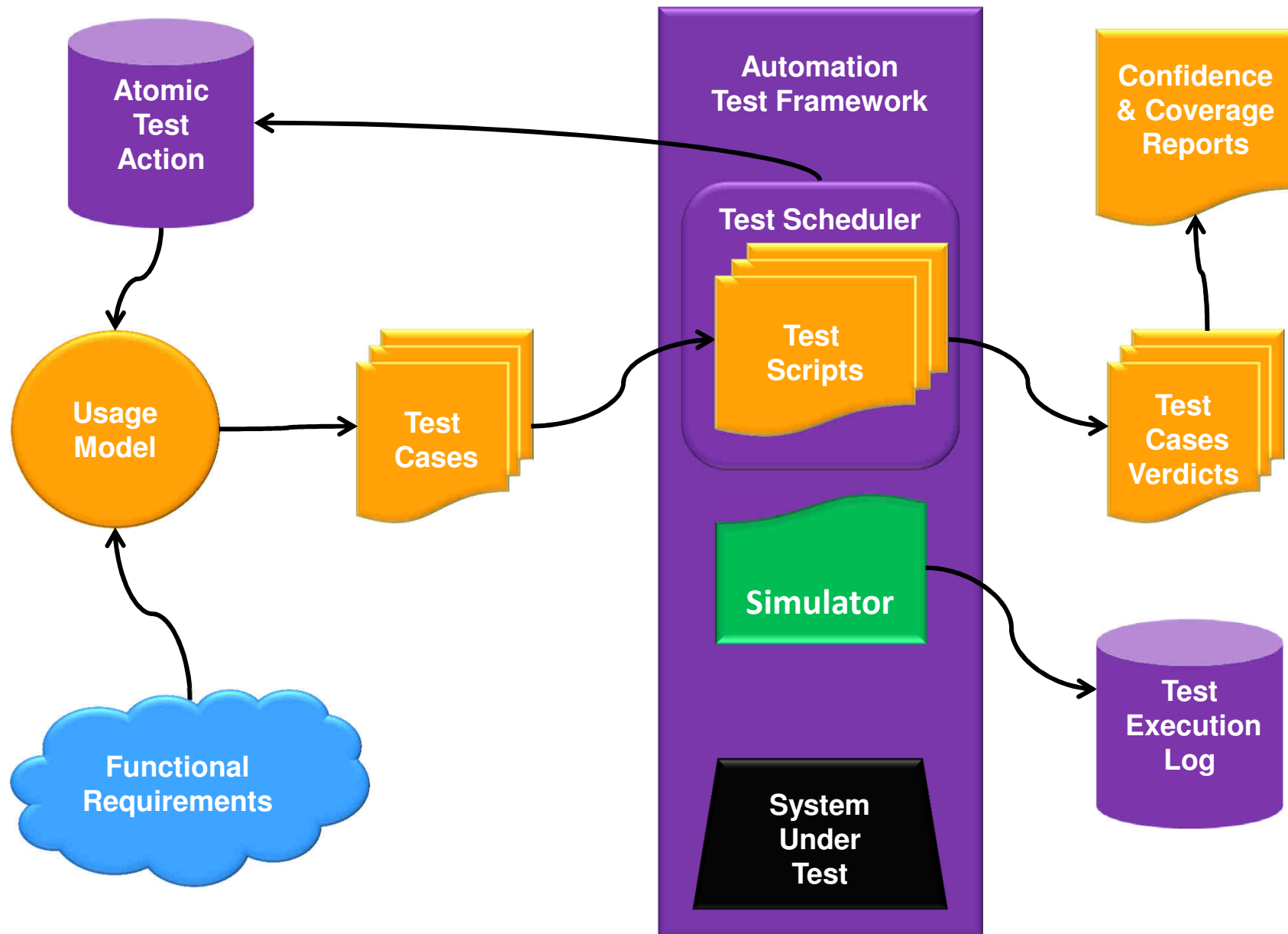


- ☐ Operational Confidence
- ☐ Needs Coverage
- ☐ Functional Coverage



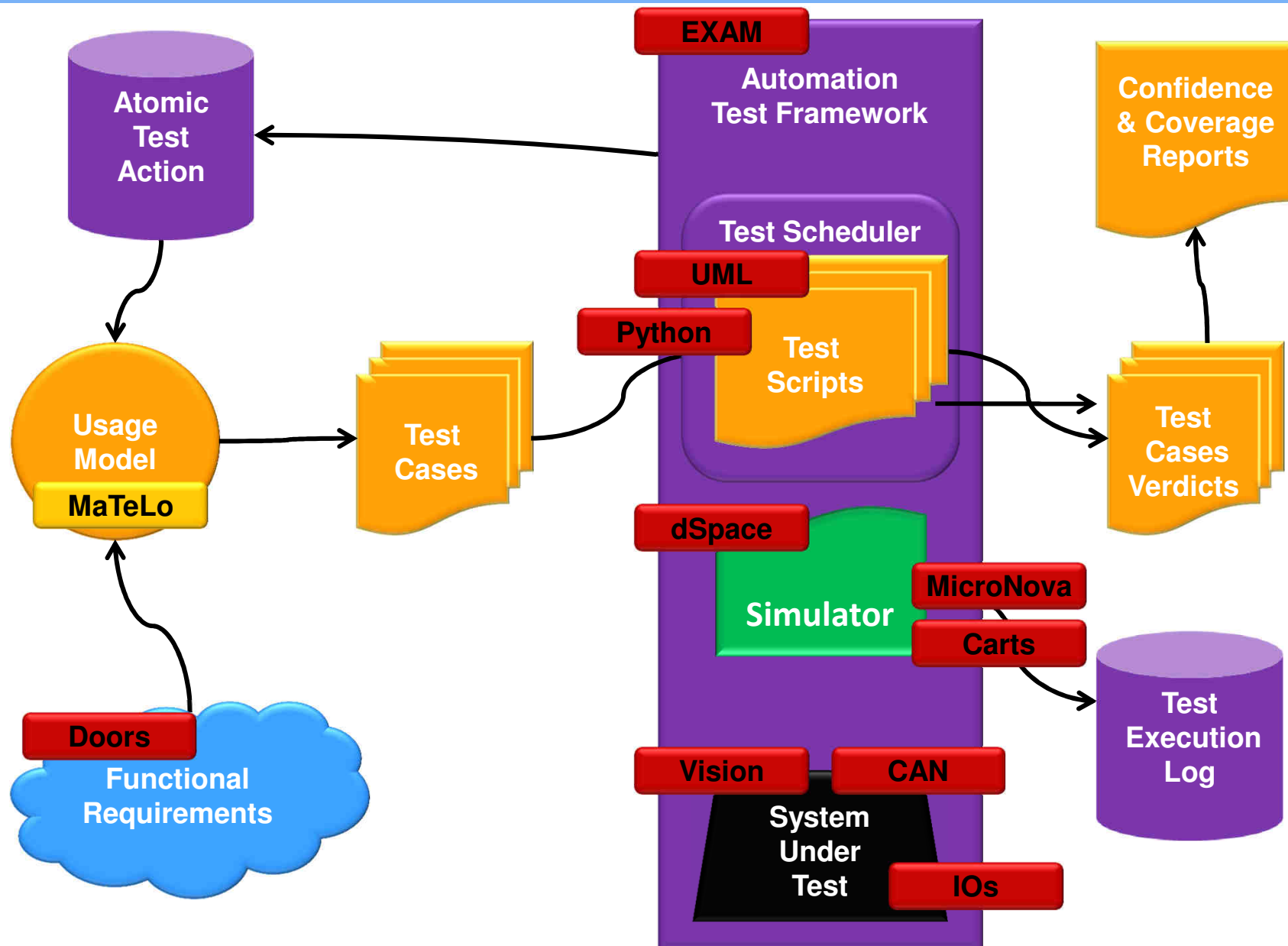
From  
Pragmatic Tools Integration  
To  
Its Standard Adoption

# THEORETICAL MBT WORKFLOW

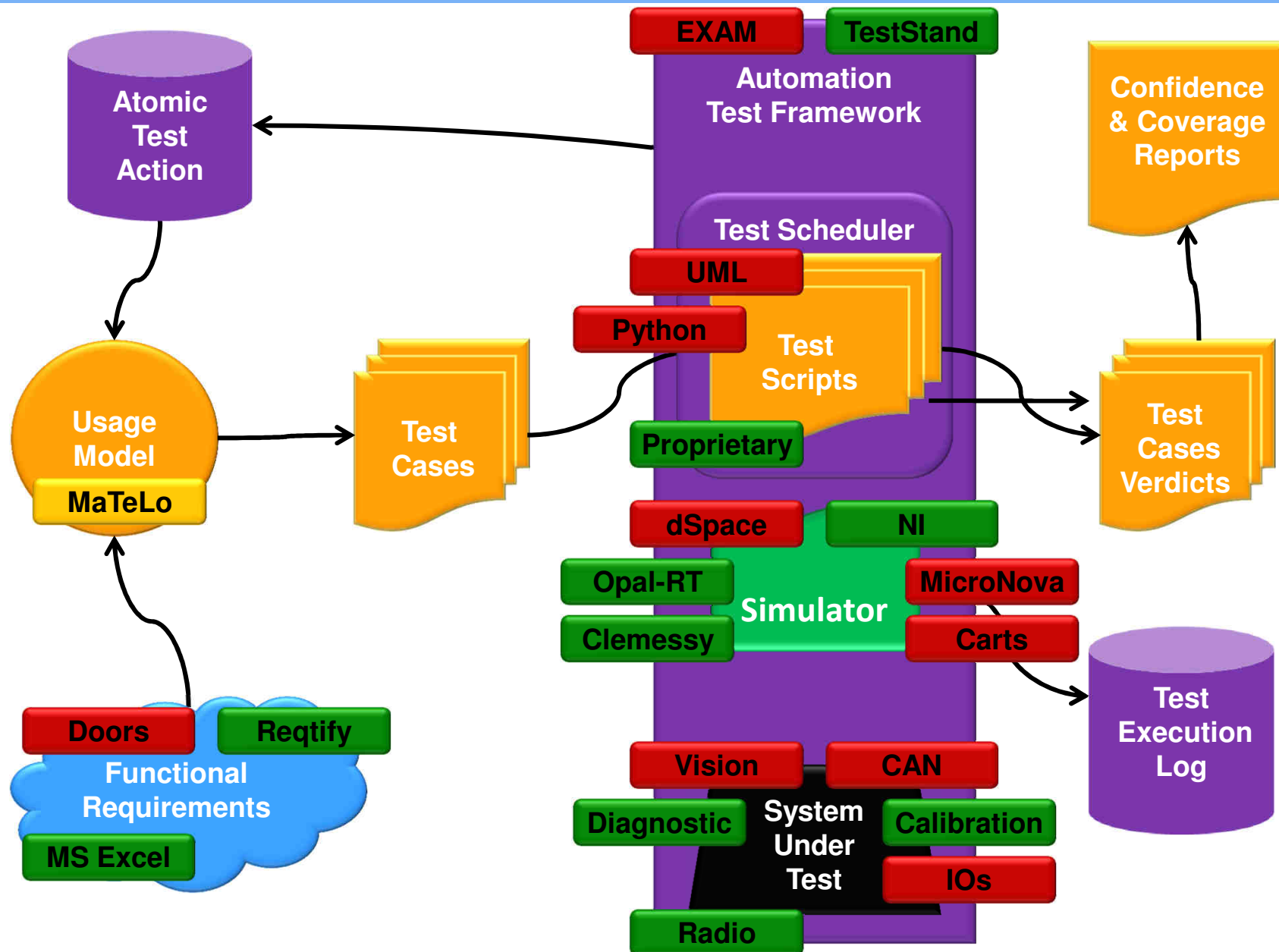




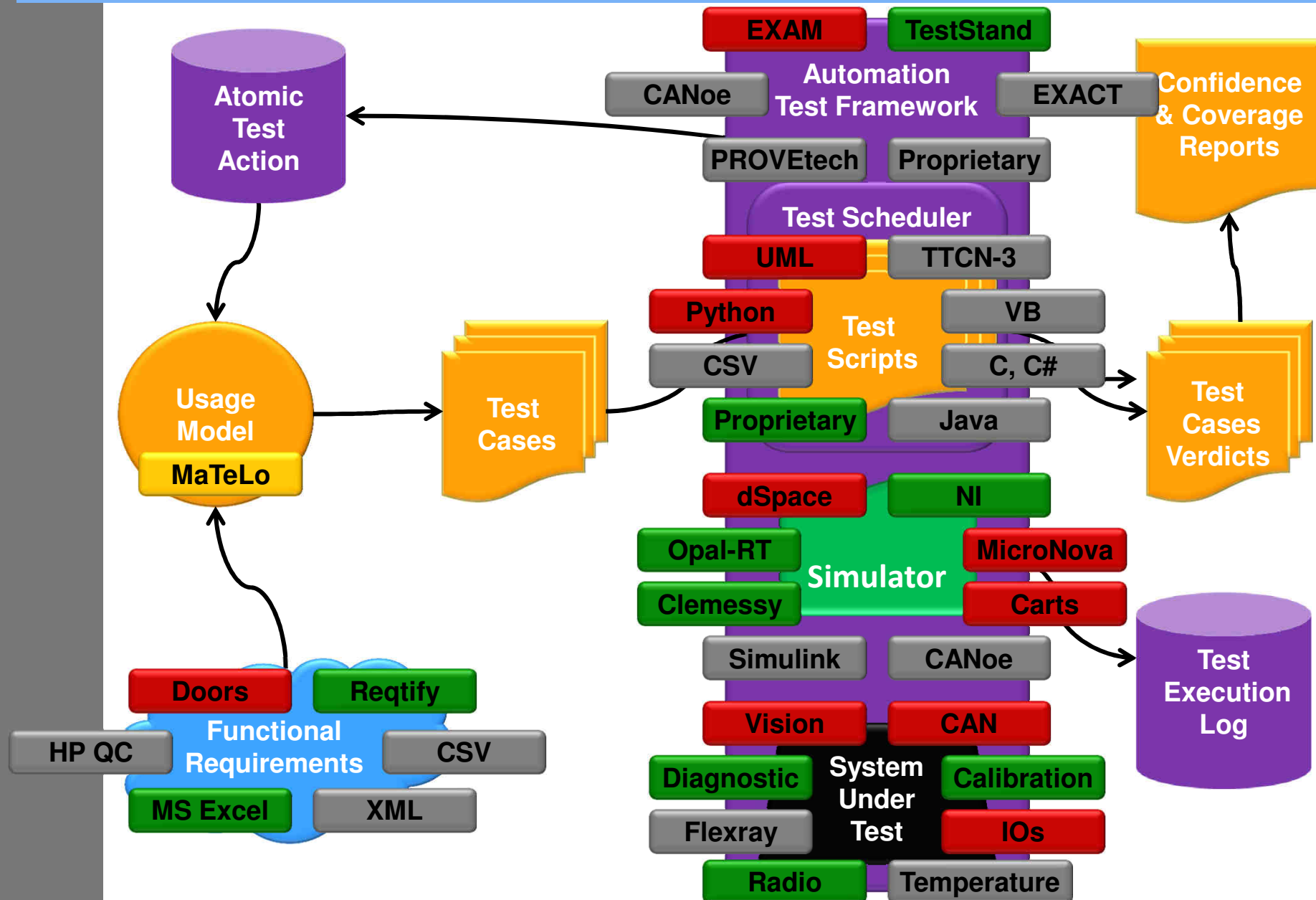
# A 1<sup>ST</sup> INDUSTRIAL TOOLS INTEGRATION



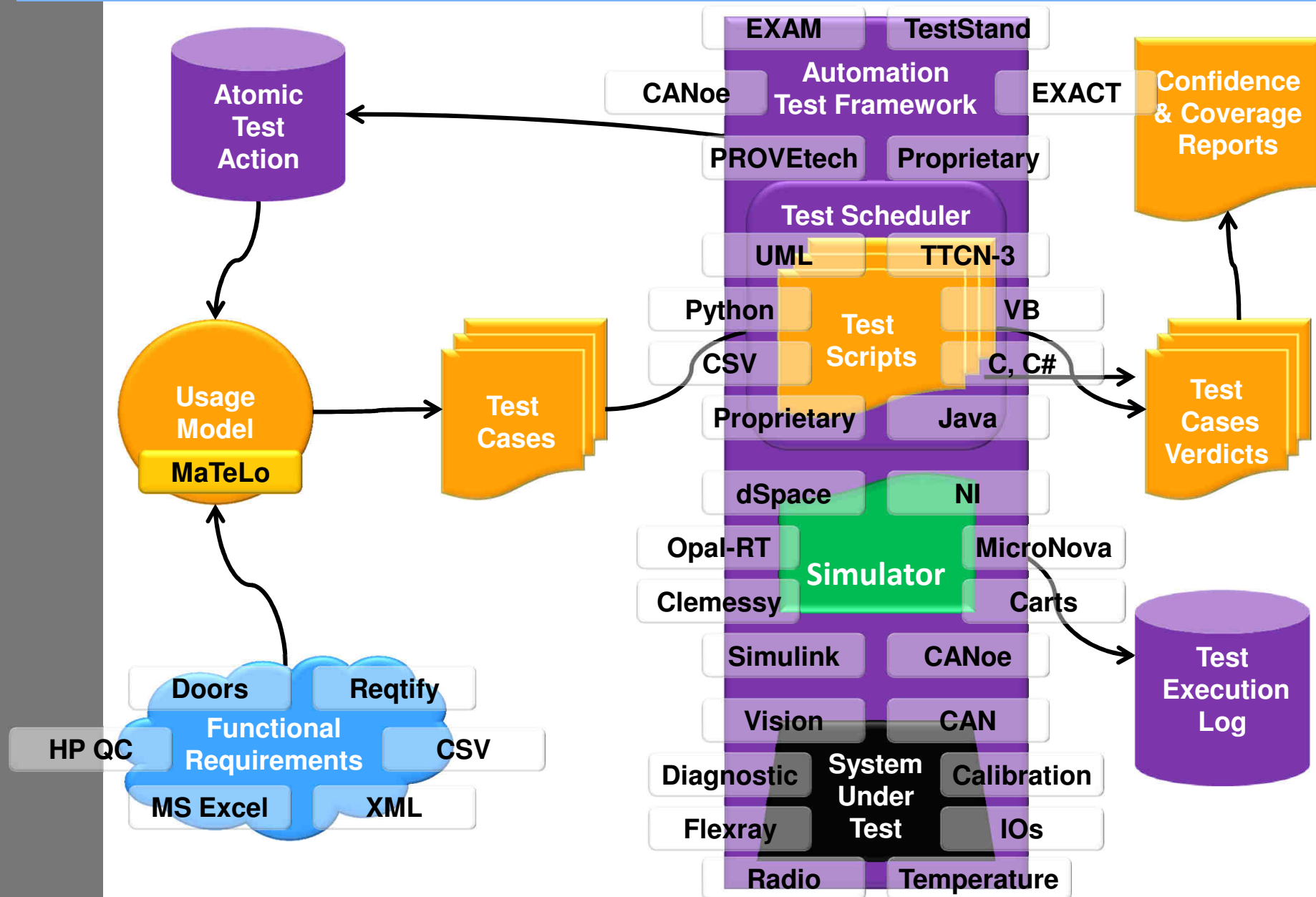
# A 2<sup>nd</sup> INDUSTRIAL TOOLS INTEGRATION



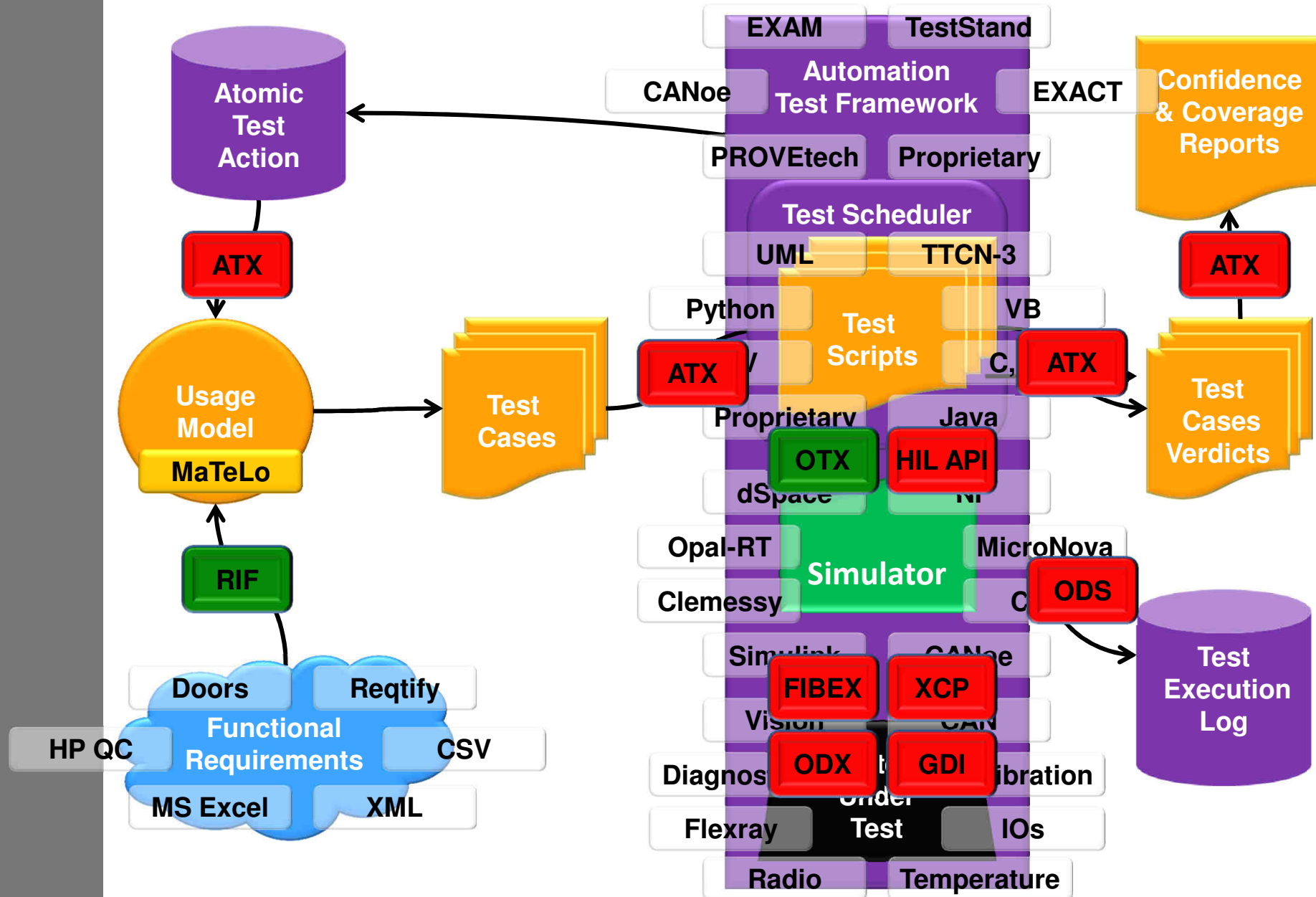
# VARIOUS TOOLS INTEGRATION



# VARIOUS TOOLS INTEGRATION



# MBT AND ITS STANDARDS



	Items	Tools	Standard	Application Feeling
	Requirements	Doors	RIF, ReqIF	3/5
	Test Specification Model	MaTeLo, Word	- (DSL)	-
	Test Cases Specification	Doors, Word, EXAM	ATX, OTX	0/5 , 2/5
	Test Campaign, Management	MaTeLo, Quality Center	ATX	0/5
	Test Case Implementation	EXAM, ECU TEST, TestStand, vb, python...	HIL API, TTCN3	1/5 , 2/5
	Test Execution	-	-	-
	•Physical Signal	NI, dSPACE, Vector...	HIL API	1/5
	•Network Signal	CAN, LIN, FlexRay...	FIBEX	3/5
	•ECU parameter	CANape, INCA	XCP	5/5
	•Diagnostic	CANdela,	ODX, UDS	5/5
	•Simulator Signal	Simulink, AMESim...	HIL API	1/5
	•Test Device Signal	Agilent, LeCroy...	GDI	3/5
	Test Case Execution Log, Trace	NI, EXAM, dSPACE, ETAS...	ODS, ATML	2/5, 2/5
	Test Case Verdict	Quality Center, MaTeLo	ATX	0/5
	Issue	BugZilla, Jira, Quality Center	ISSUE	?
	Requirement Coverage	Doors, Quality Center, MaTeLo	ATX, ReqIF	0/5 , 2/5
	Confidence Indicator	Quality Center, MaTeLo	ATX	0/5

# QUESTION ?

[www.all4tec.net](http://www.all4tec.net)

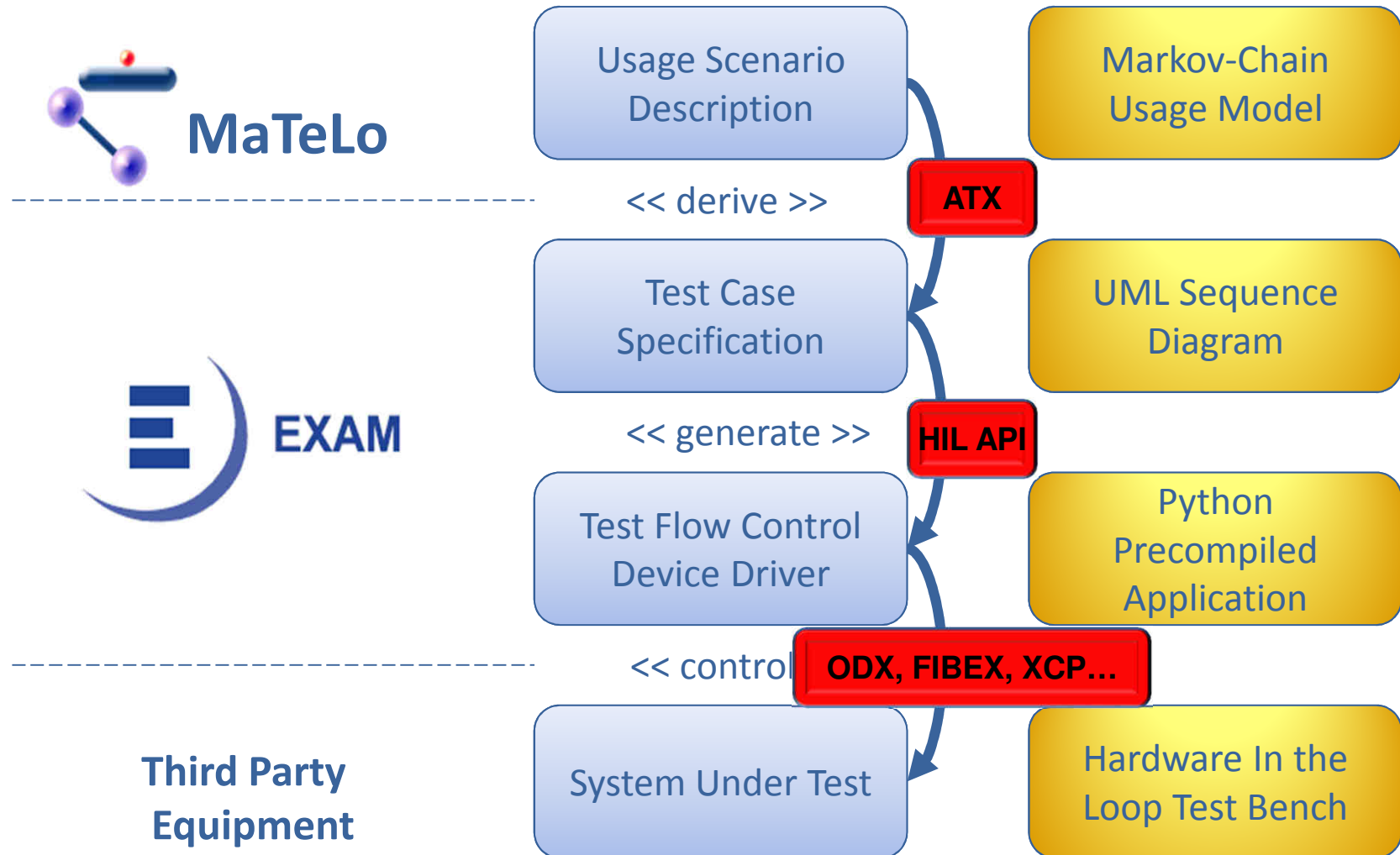
Sales contact

anthony.faucogney@all4tec.net  
+33 6 80 88 40 59

Wiki & Forum & Documentation

[www.all4tec.net](http://www.all4tec.net)

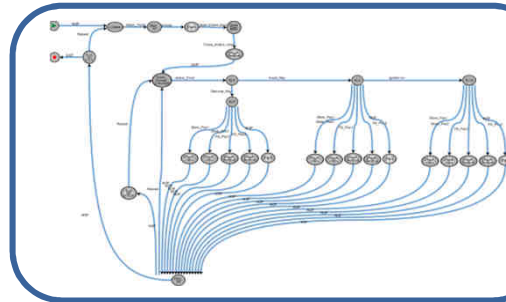
# ABSTRACTION LAYERS





# EXAM ABSTRACTION MANAGEMENT

## Possible Usage Scenarios



## Strategic Test Cases

ATX

### Test Case 1



### Test Case 2



### Test Case n



## Available Test Configurations

### HIL Platform

HIL API

NovaSim  
Carts  
ASAM HIL API  
Proprietary

...

### Network

CAN\_1  
CAN\_2  
LIN\_X  
FlexRay\_1  
FlexRay\_2

...

### Functions

ODX, FIBEX, XCP...

Auto Gear  
Hand Free  
ACC  
StartStop

...

### Test Tools

CANoe  
CANape  
INCA  
MS Excel  
Diag Tool

...

### Env. Model

HIL API

Diesel  
Turbo  
Hybrid  
Electric

...