An Approach of Combining Model-based Testing with Product Family Management

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Agenda

- Overview of the MBAT project
- Current state of practice
- Combining test models with variability models
- Introduction to the use case
- Demonstrator
- Evaluation results
- Way ahead

Overview of the MBAT Project

MBAT: combined model-based analysis and testing of embedded systems

Objectives

- Reduce validation and verification (V&V) cost and time-to-market by advanced model-based V&V technology
- Provide a Reference Technology Platform (RTP) for effective V&V of embedded systems
- Ensure in several use cases that the MBAT RTP can be used in industry.

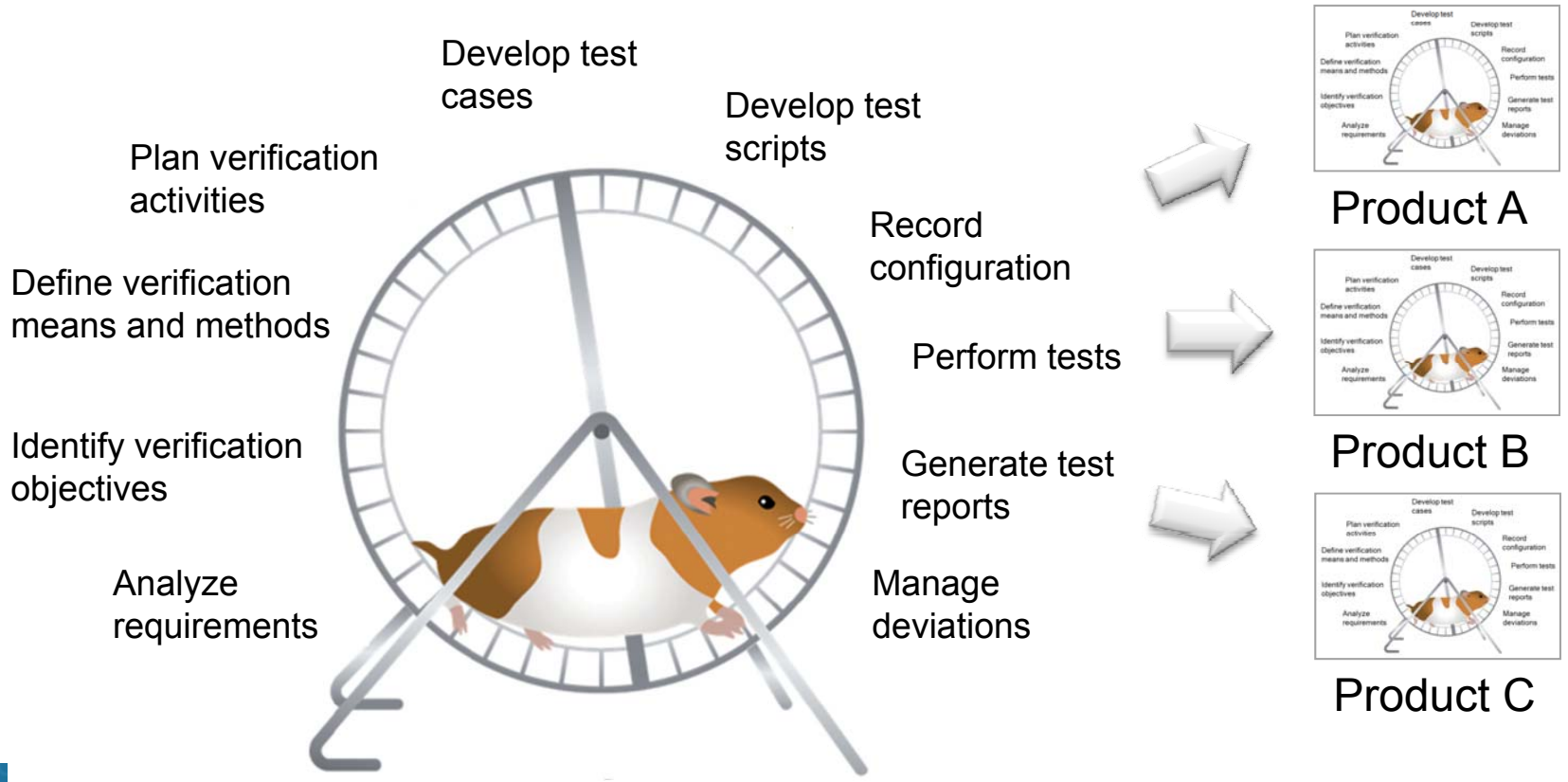
Key Data

- EU project (Artemis JU)
- 41 partners from automotive, aerospace and rail domain
- 8 countries
- Total budget: 34.5 Mio €
- 3 years (Nov 2011 – Oct 2014)
- Project coordinator: Daimler AG
- Further information: http://www.mbat-artemis.eu



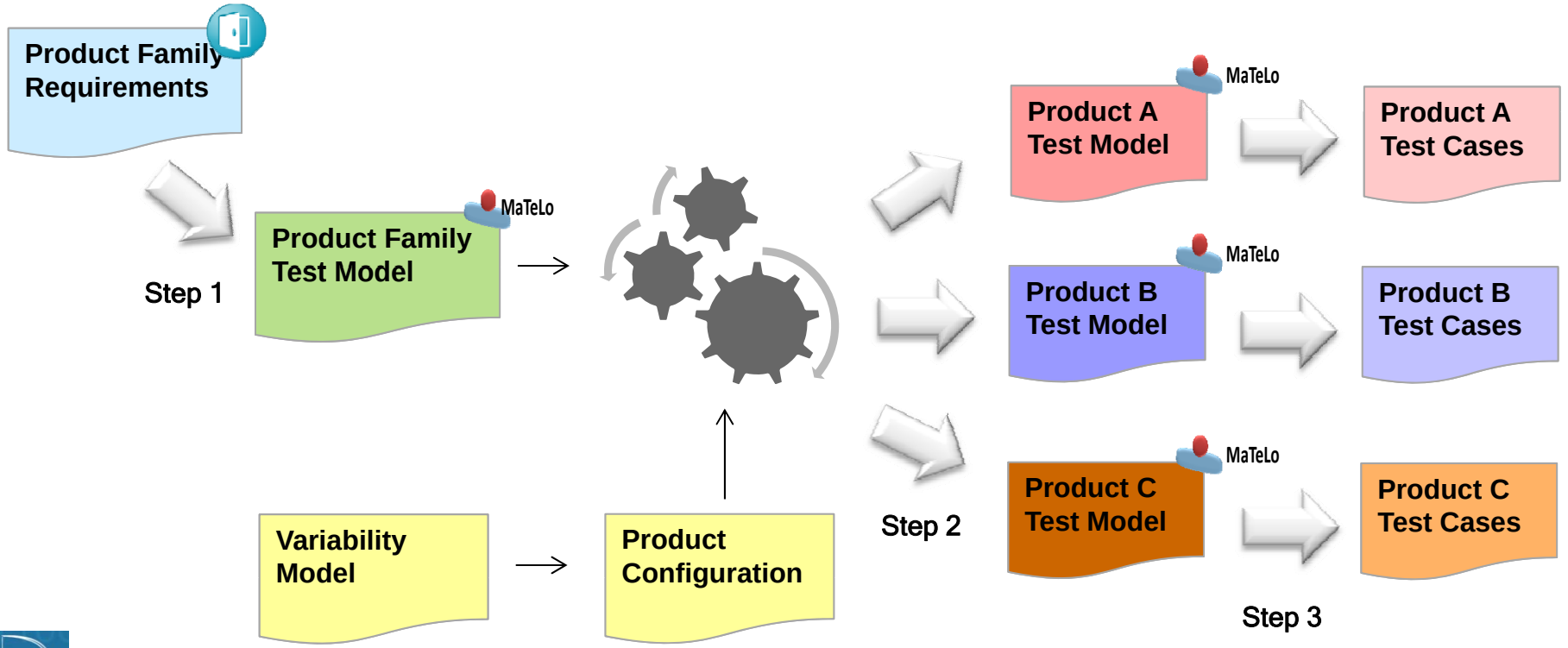
Current State of Practice

- Test process is mainly driven by (quality of) requirements and low degree of test automation
- Similar products are tested independently with no re-use of test artefacts



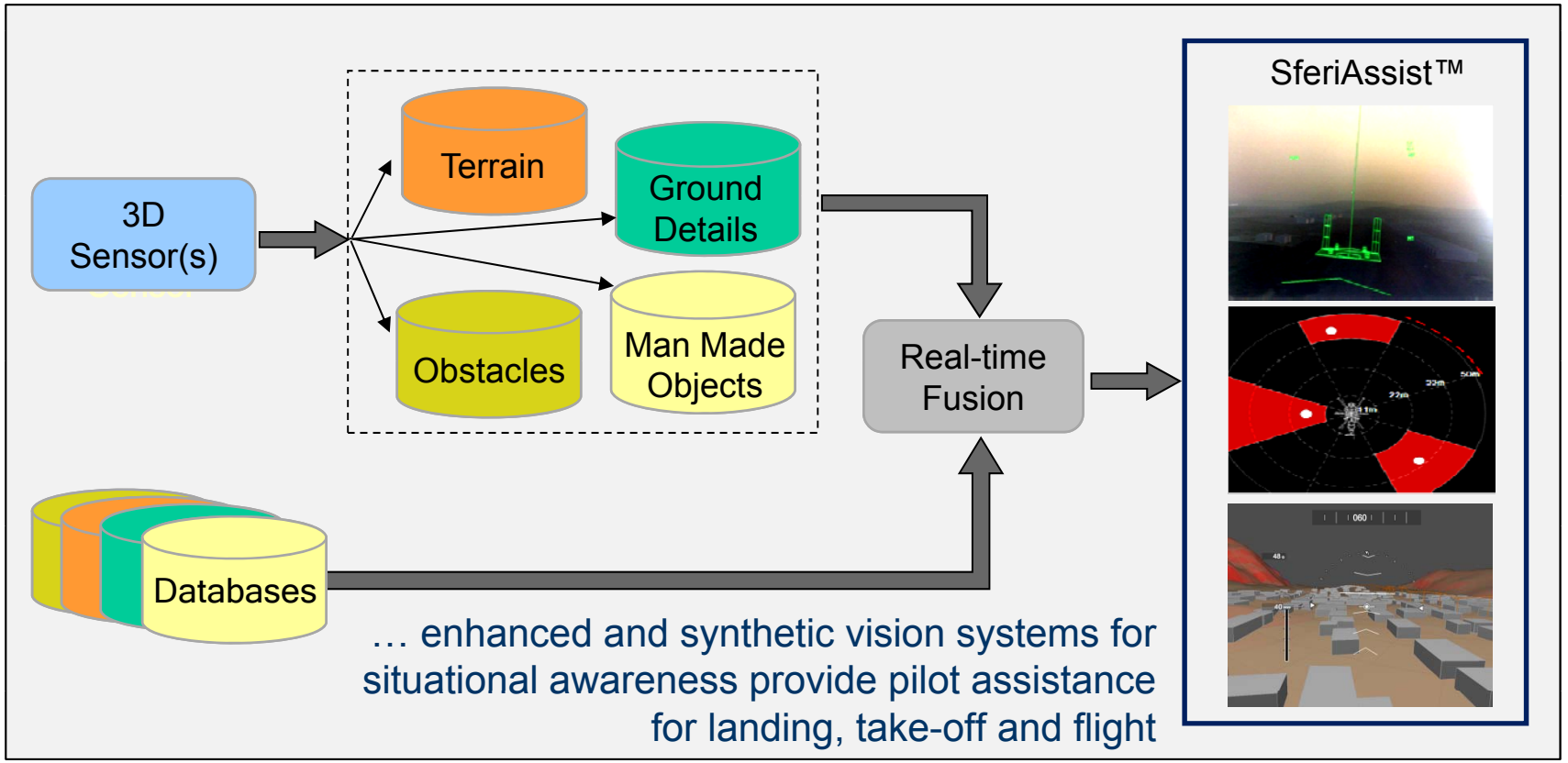
Combining Test Models with Variability Models

- Test models describe what needs to be tested in the product family
- Variability models define variation points in the product family
- Product configuration enables automatic generation of test models
- Product test models allow generating product test suites



Introduction to the Sferion™ Use Case

Degraded visual environment …



… enhanced and synthetic vision systems for situational awareness provide pilot assistance for landing, take-off and flight

Overview of the Demonstrator

Product Family Analysis

- Identify product family scope
- Develop variability model

Product Family Test Model

- Create usage model for product family
- Associate requirements with test model

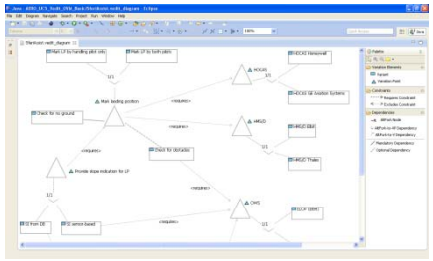
Product Management

- Associate requirements and features
- Define products
- Generate product test models

Product Test Suite Generation and Execution

- Generate test suites for products
- Execute test suites with test automation solution

Vedit OVM Editor



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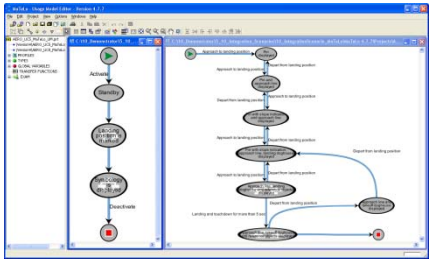
MaTeLo Usage Model Editor



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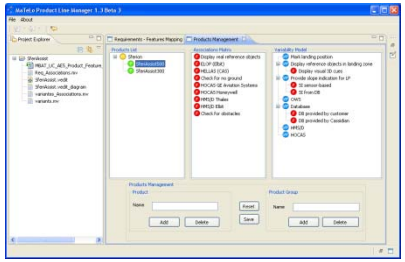
MaTeLo Product Line Manager



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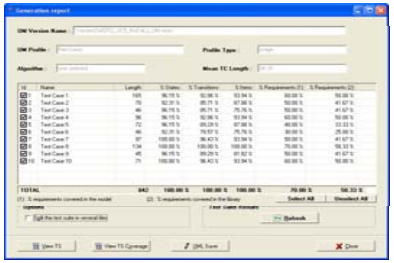
MaTeLo Testor



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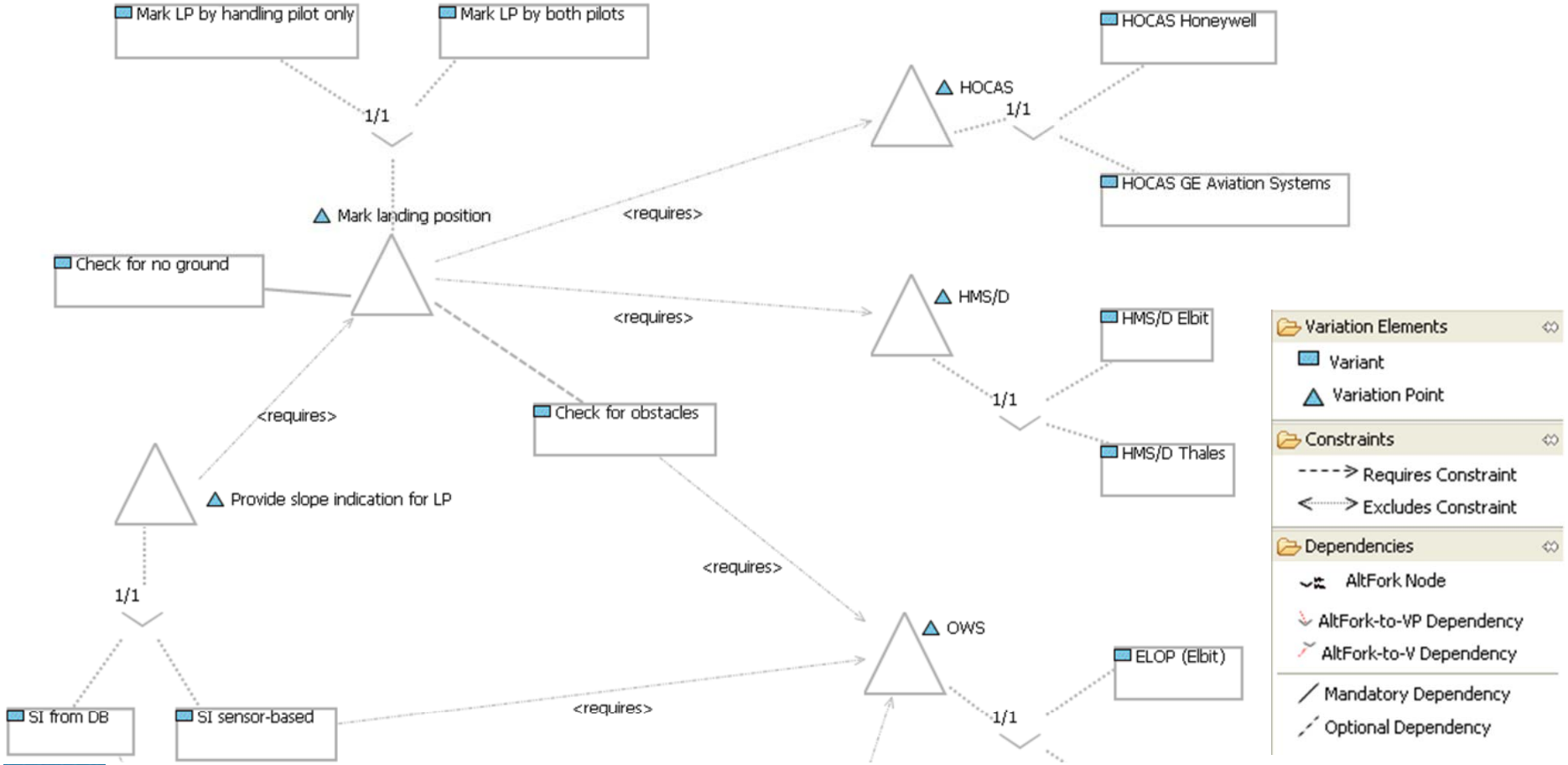
Product Family Analysis (1/2)

- Analyze potential product variants and features during the scoping with the help of the product feature matrix
- Prioritize features and define the product family scope

			Assessment				Products		
ID	Feature Name	Classification	Customer Satisfaction	Risk	Cost	Relevance	Chinook-Aus	CH53-Ger	NH90-Nor
F1	System	Dom							
F2	Capabilities	Dom							
F3	Functions	Dom							
F4	Terrain slope, roughness indication for the landing point	Opt	2	1	1	2,00		x	
F5	Display real reference objects (sensor-based)	Opt	2	2	2	1,33		x	
F6	Display artificial reference objects	Ftr	3	1	1	2,33	x	x	x
F7	Approach line	Ftr							
F8	Direct	Alt	2	1	1	2,00	x		x
F9	Flightpath to landing position	Alt	3	1	2	2,00		x	
F10	Take-off grid	Ftr							
F11	Artificial	Alt	2	1	1	2,00	x		x
F12	Sensor-based	Alt	3	1	2	2,00		x	
F13	Set landing point	Ftr	3	1	1	2,33	x	x	x
F14	Handling pilot only	Alt	3	1	1	2,33		x	x
F15	Both pilots	Alt	2	2	2	1,33	x		
F23	Data fusion (with way points)	Opt	3	2	2	1,67		x	
F16	HMI	Dom							
F17	Presentation symbology (static)	Ftr							
F18	Doghouse	Alt	3	1	2	2,00		x	
F19	NATO T	Alt	2	0	1	2,33			x
F20	Helipad H	Alt	2	0	1	2,33			x
F21	Low-cost doghouse	Alt	1	1	1	1,67	x		
F22	Distance-dependent symbology (dynamic)	Cst	3	1	1	2,33	c	c	c
F24	Interfaces	Dom							
F25	HMSD	Ftr							
F26	Anvis HUD	Alt	3	1	2	2,00	x	x	
F27	MARK II Thales	Alt	3	1	2	2,00			x
F28	MFD	Ftr	2	1	1	2,00	x	x	x

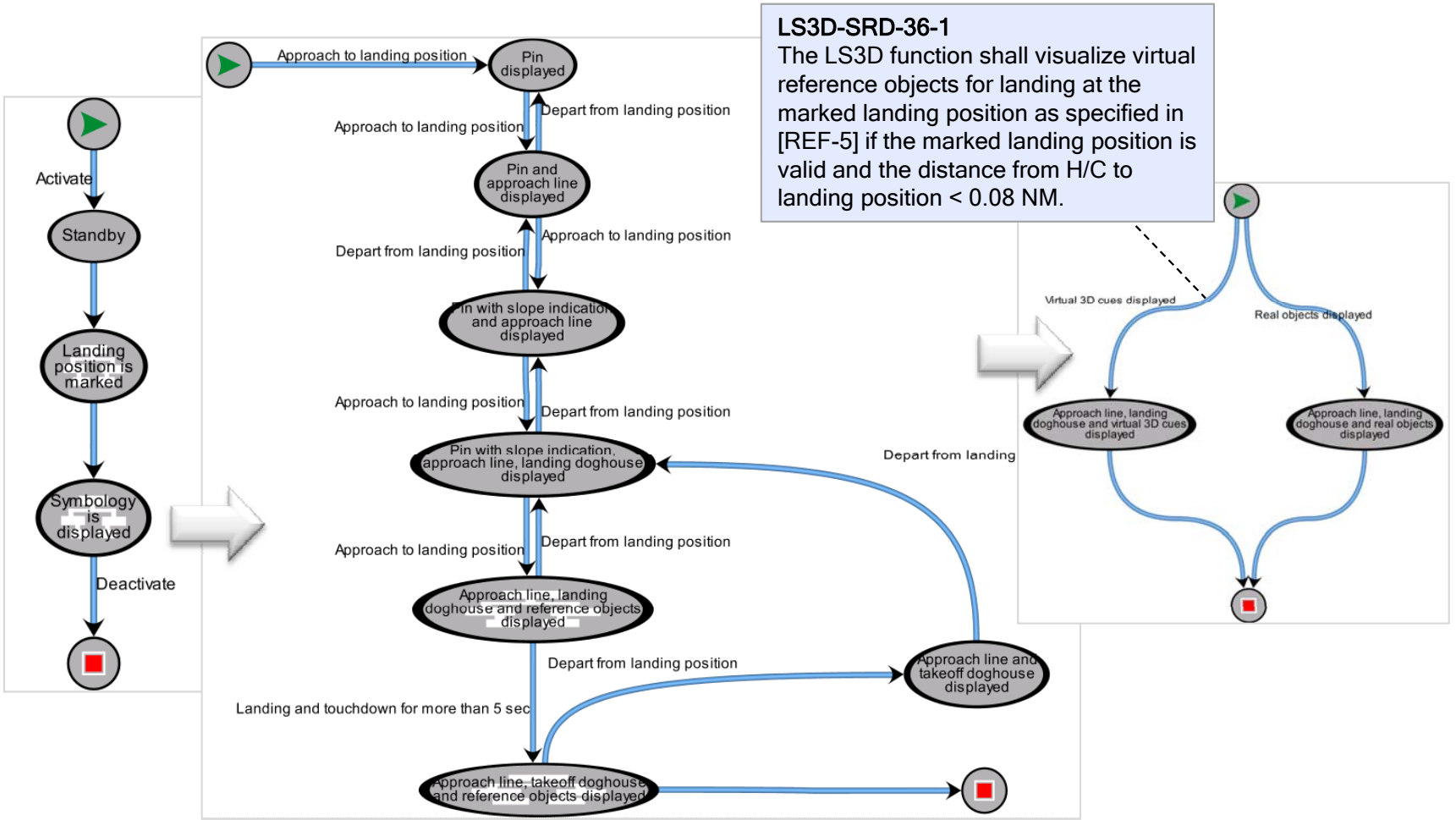
Product Family Analysis (2/2)

- Document variation elements and constraints with the help of an Orthogonal Variability Model.

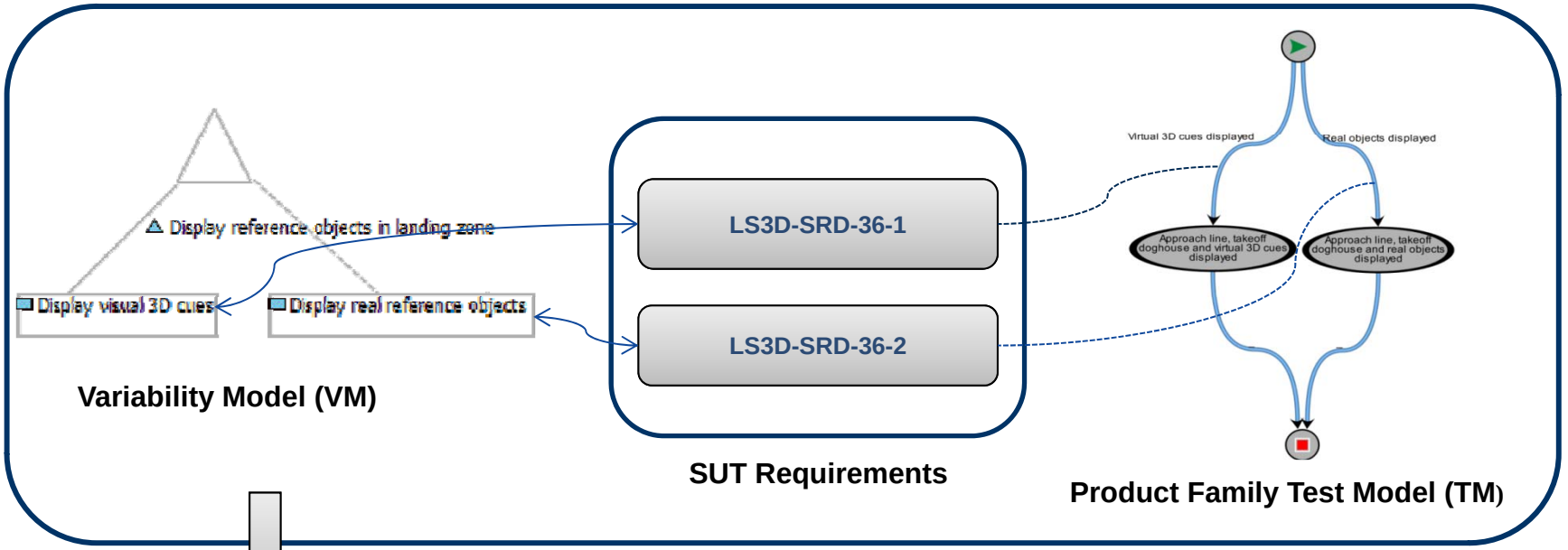


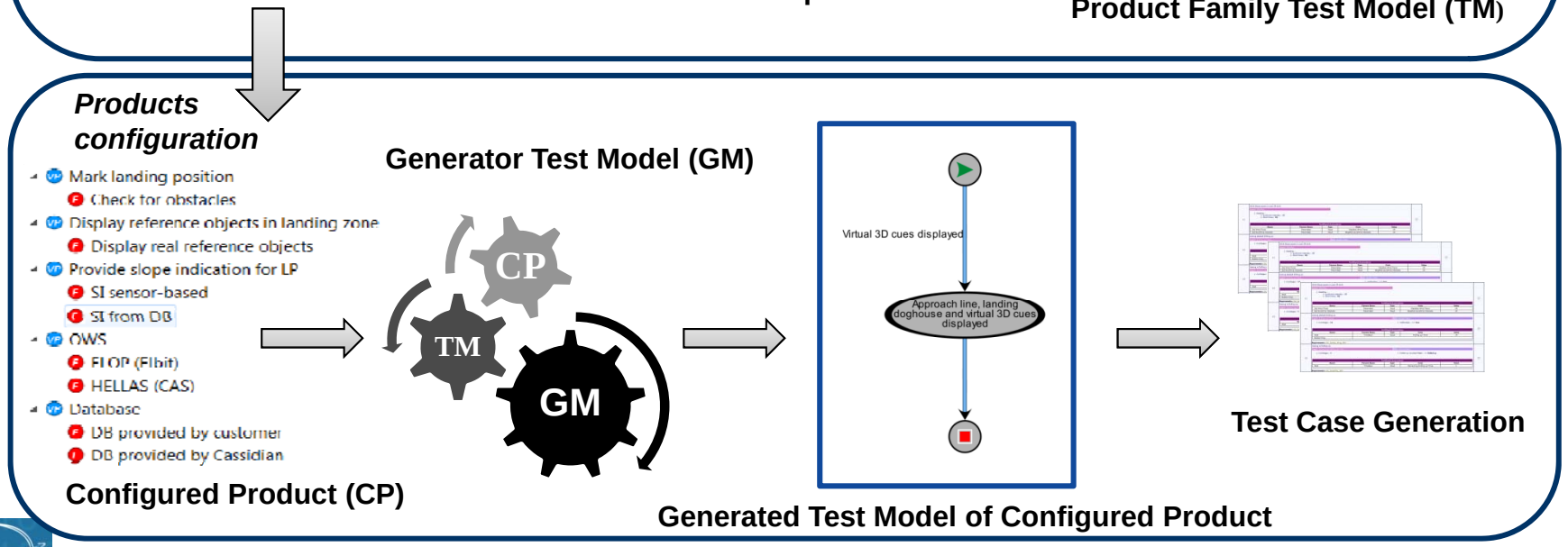
Product Family Test Model

- Develop a test model which covers all functions of the product family and is associated with product family requirements



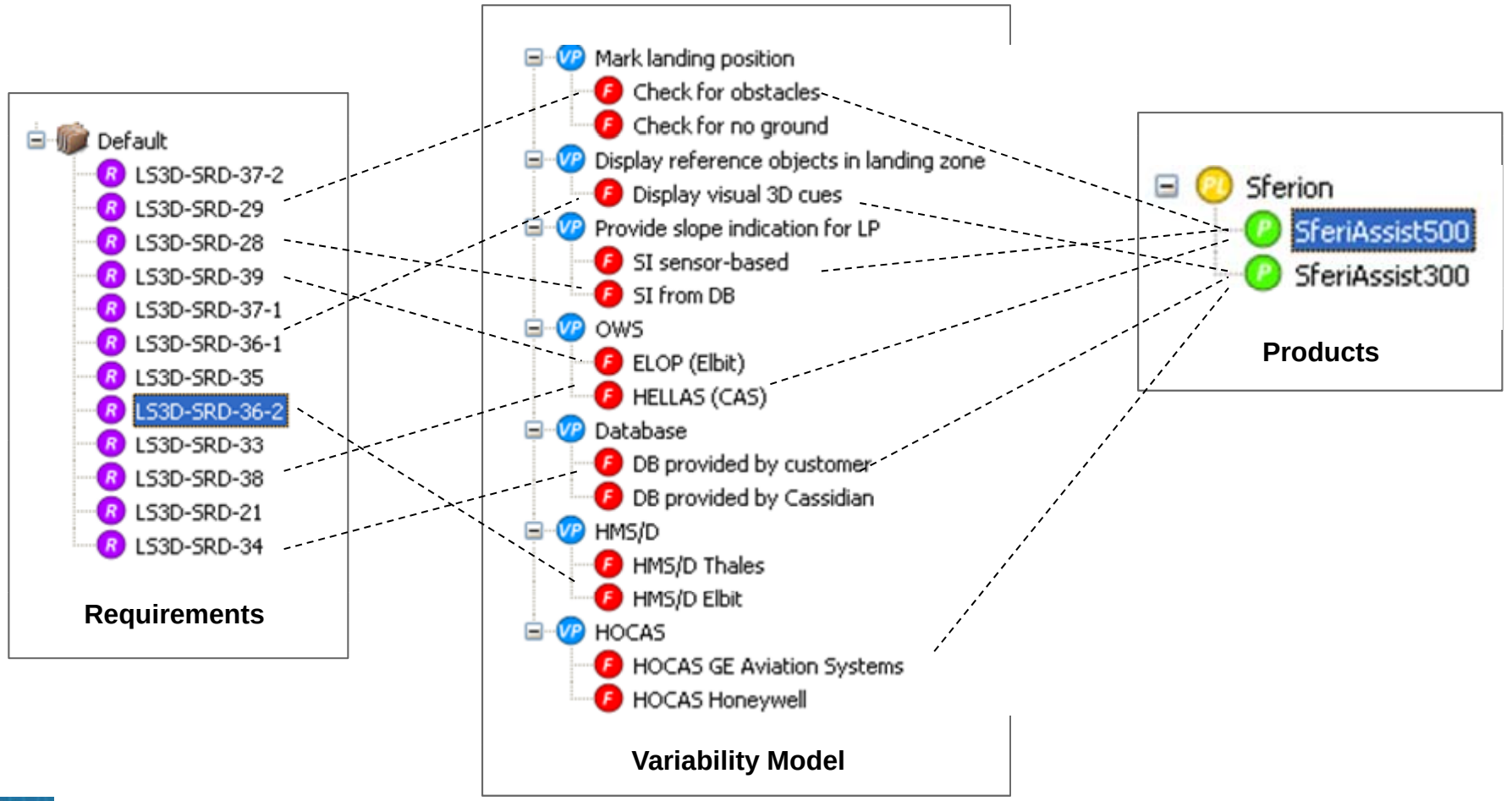
Product Management (1/3)





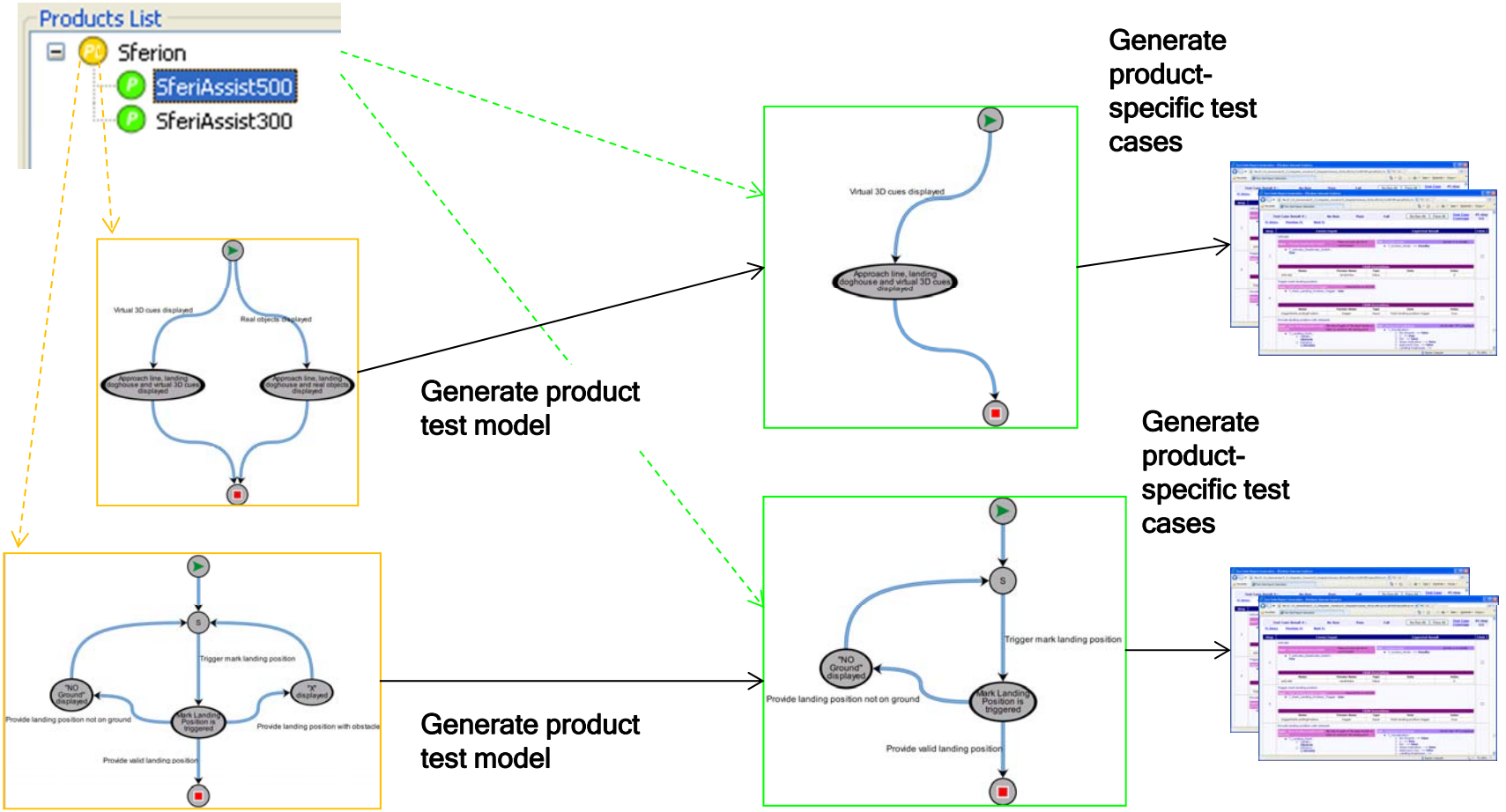
Product Management (2/3)

- Map requirements to be verified with their associated features
- Configure product variants



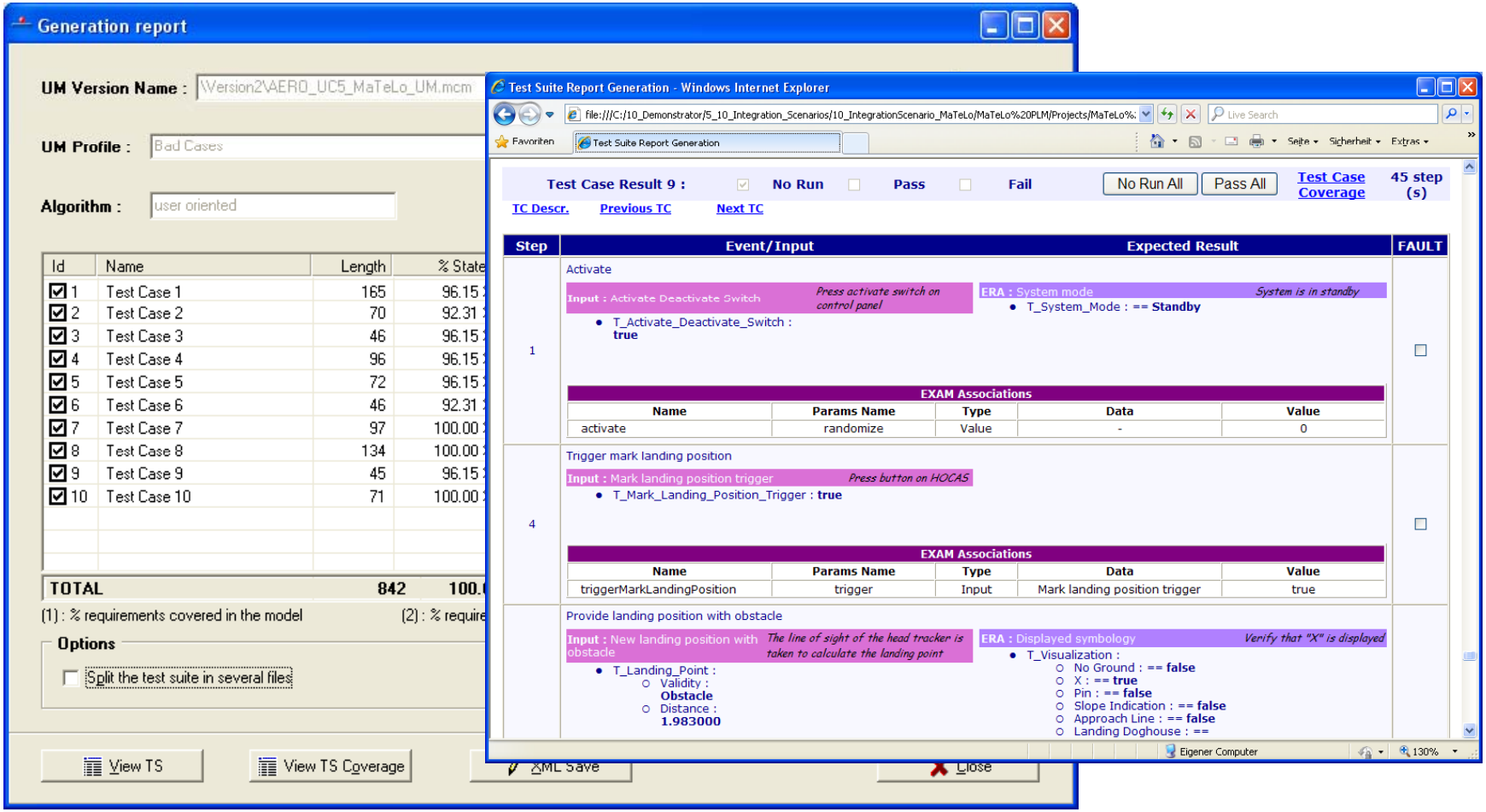
Product Management (3/3)

- Generate test models for product variants
- Generate product-specific test cases



Product Test Suite Generation

- Test cases and procedures are generated from product-specific test model and can be imported into test automation system.

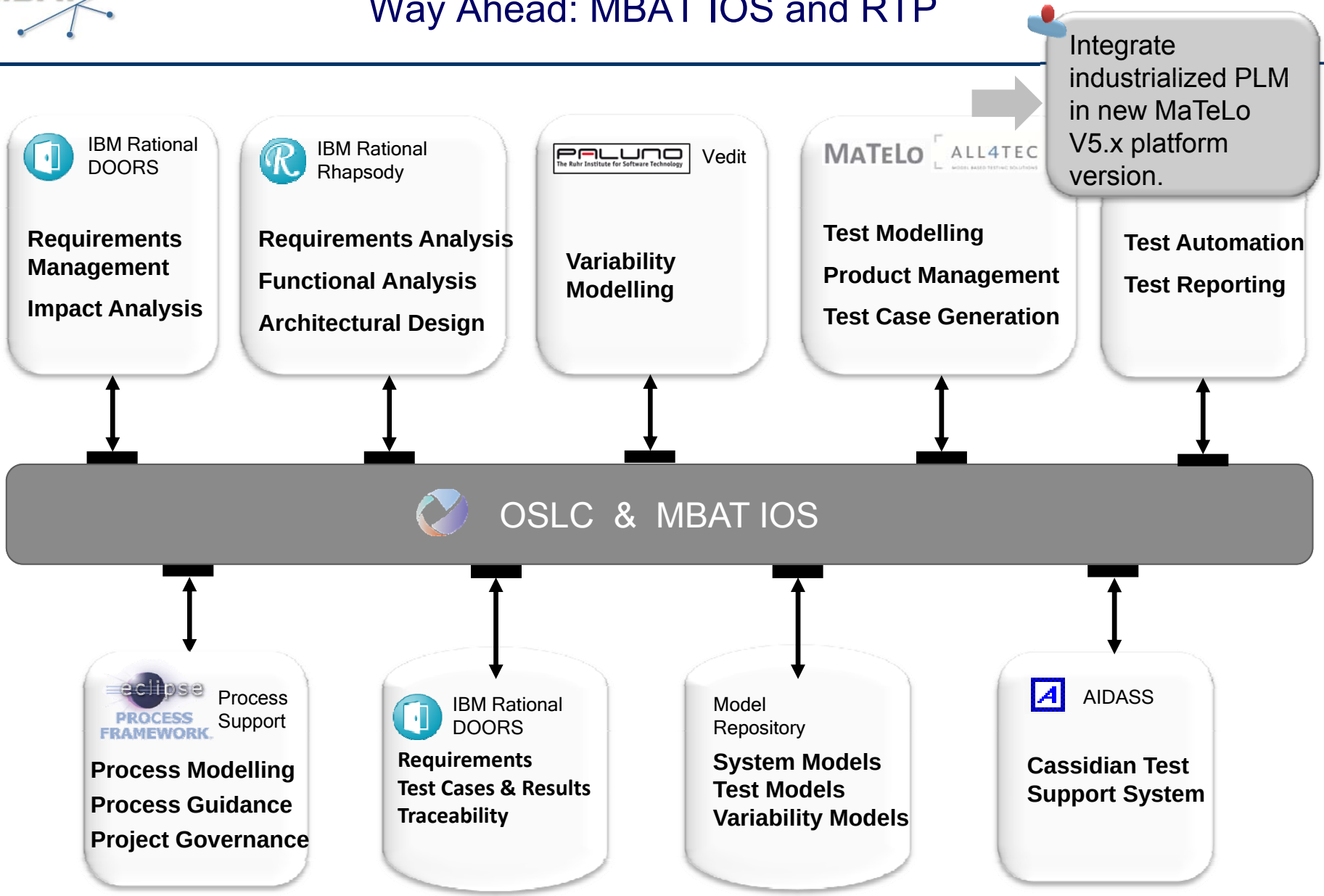


Evaluation Results

- Clear potential that the combined approach of model-based testing and product family management leads to **better quality test design** at **less time** and **less cost**:
  - Model-based testing allows to automate parts of the test design.
  - Test models are reviewed and applied in many products in different contexts and various scenarios which leads to higher quality.
  - Test artefacts are re-used for each new product, rather than starting from scratch.
  - Less test artefacts need to be maintained for the product family since re-use is managed at the model level.

- The MaTeLo PLM tool is available as a prototype, but **not fully industrialized** yet:
  - Some usability and interoperability topics need to be improved in order to raise the acceptance by industrial end users.

Way Ahead: MBAT IOS and RTP



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Thank you