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A Better Design with Model-Based Systems Engineering

Functional Verification using System-Level Modeling

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Q&A Panel

Hisashi Miyashita, PhD, Director of MBSE Development, Maplesoft

Joydeep Banerjee, PhD, Application Engineer, Maplesoft

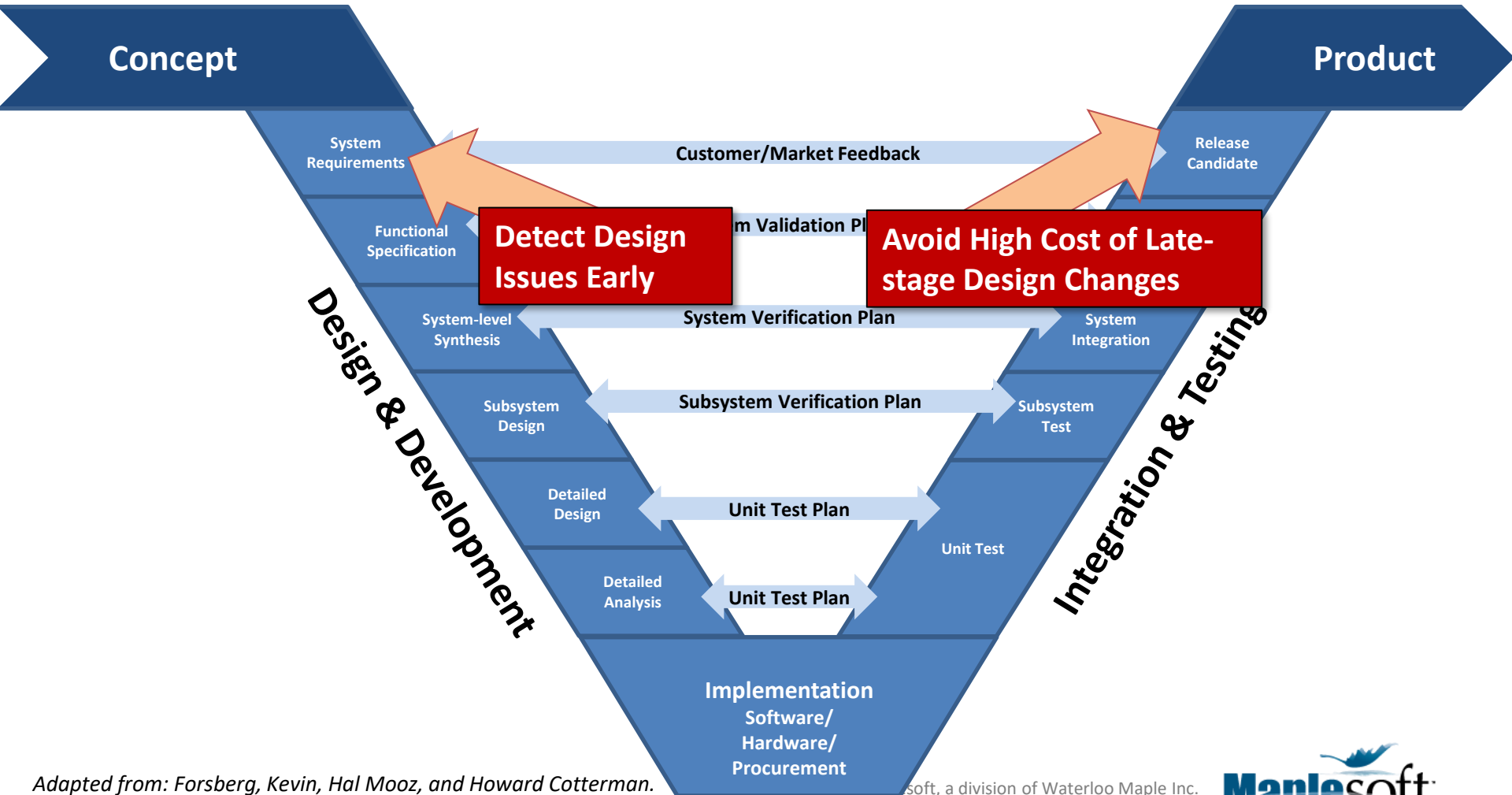
Systems Design & Development Process



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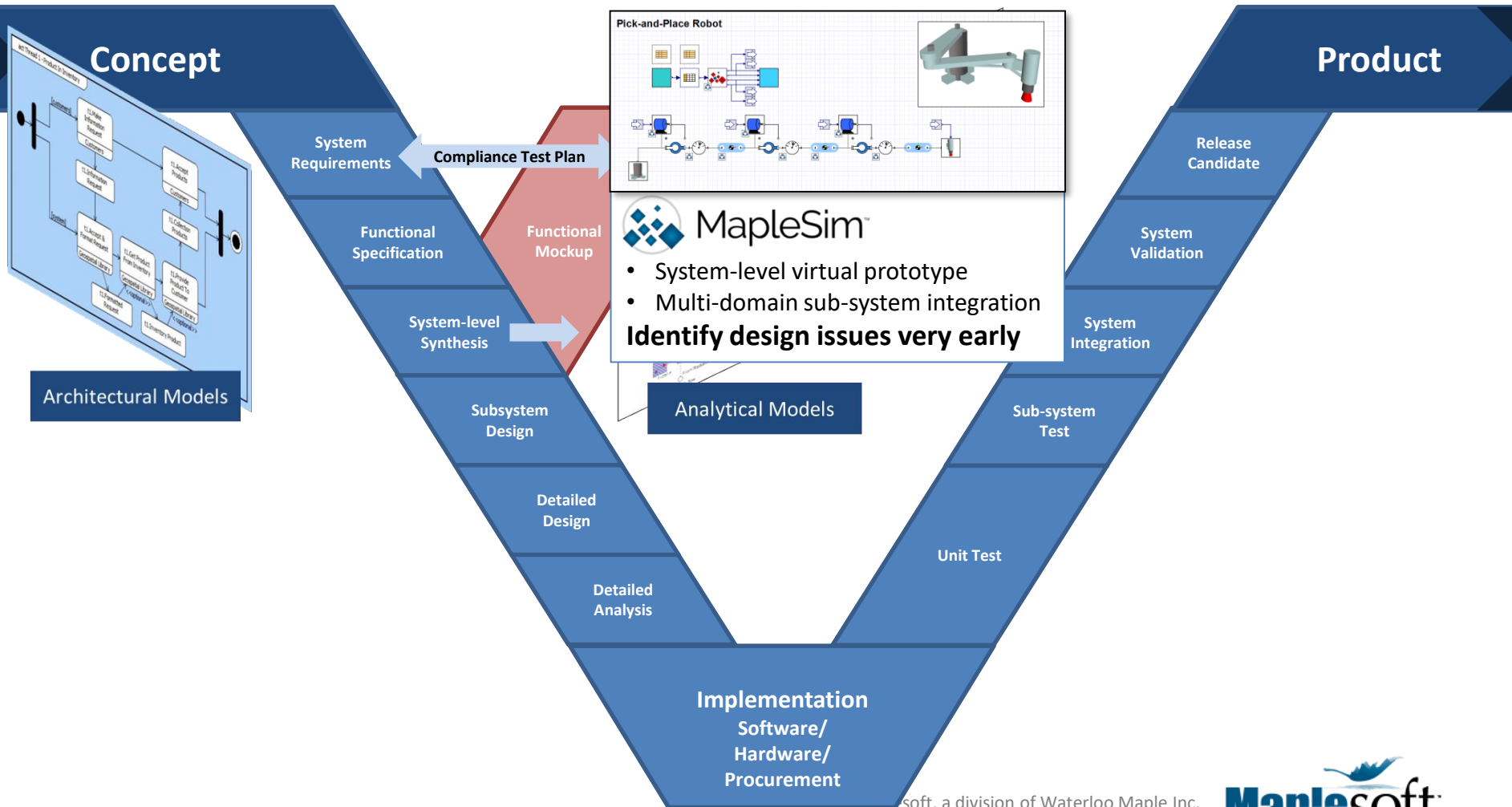
Adapted from: Forsberg, Kevin, Hal Mooz, and Howard Cotterman.
Visualizing Project Management. John Wiley & Sons. Hoboken, NJ. 2005.

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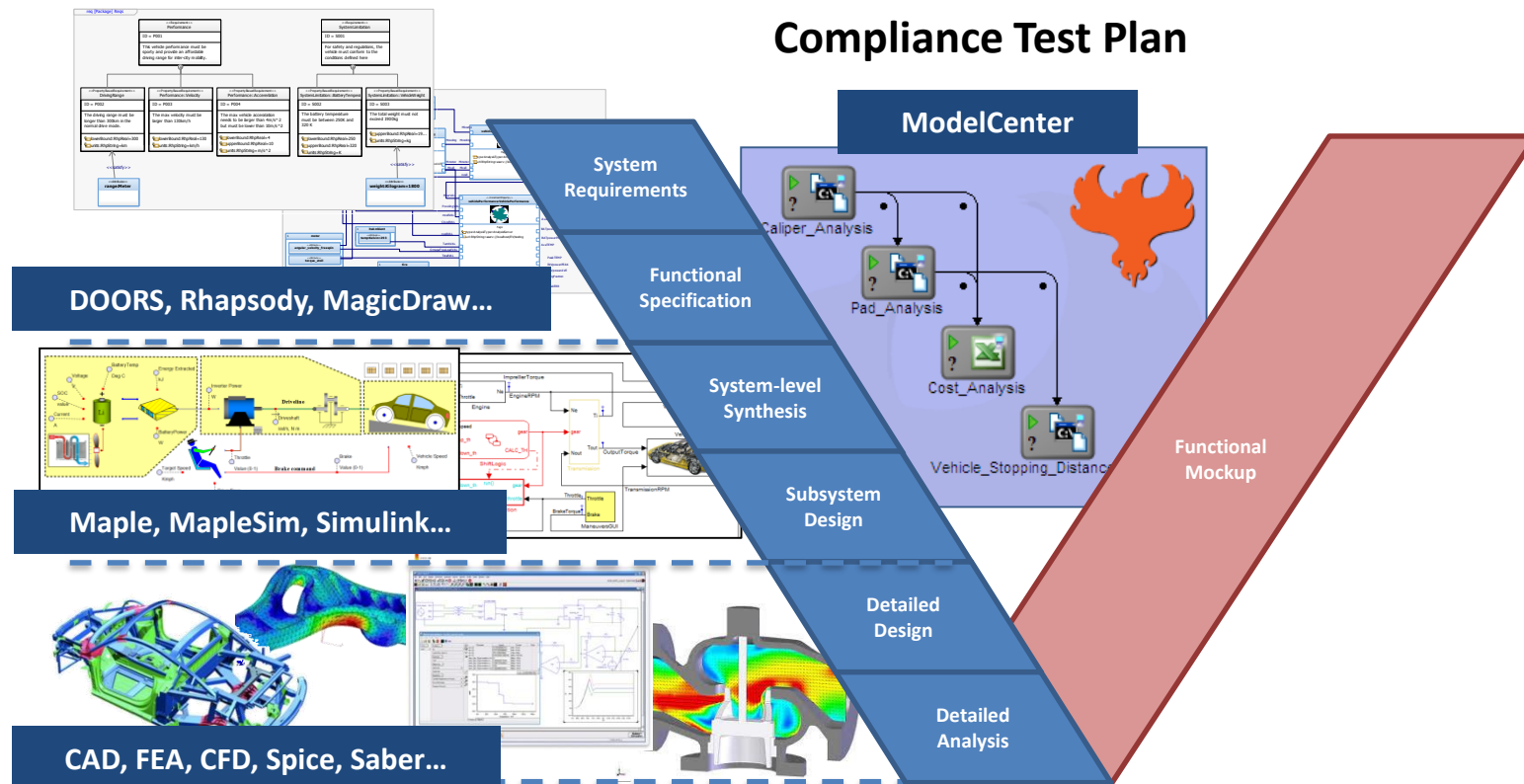
Systems Design & Development Process

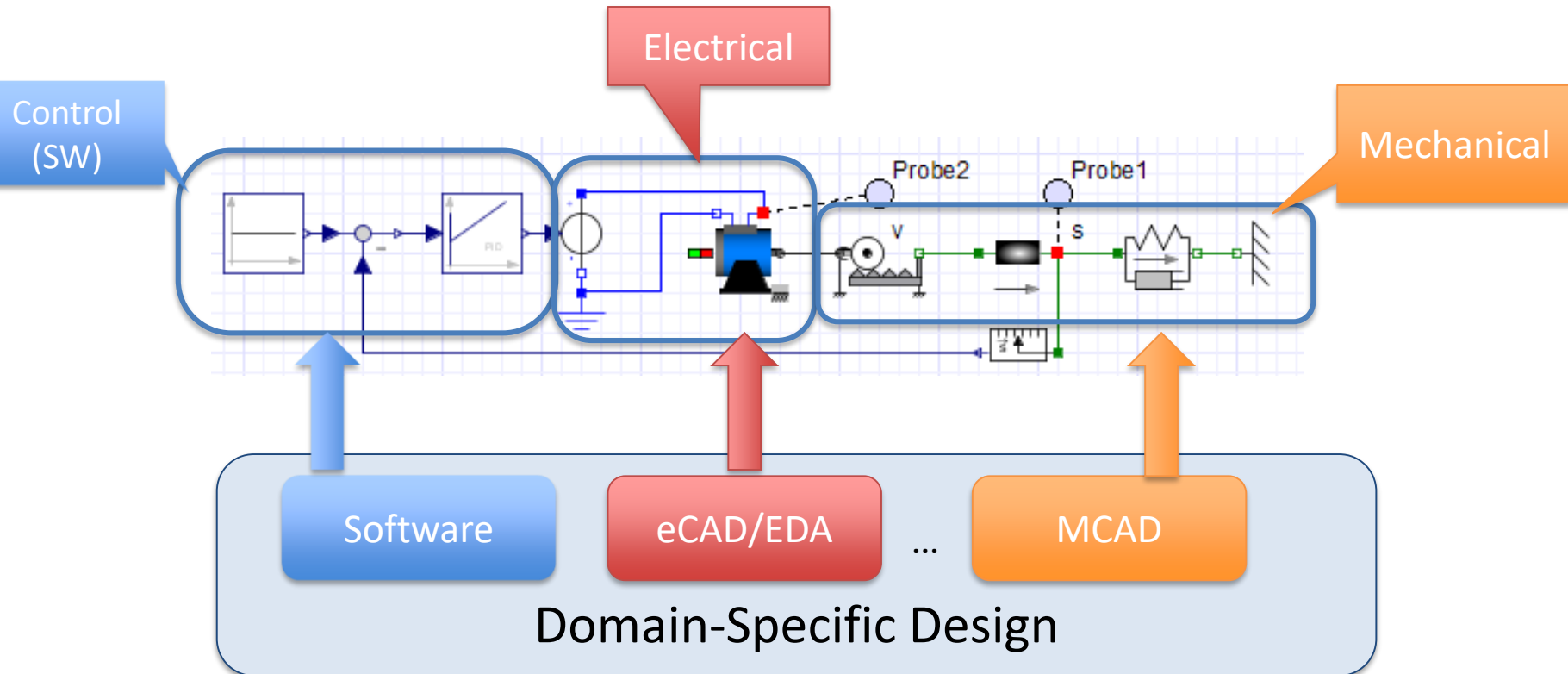
Functional Verification



Systems Design & Development Process

Functional Verification



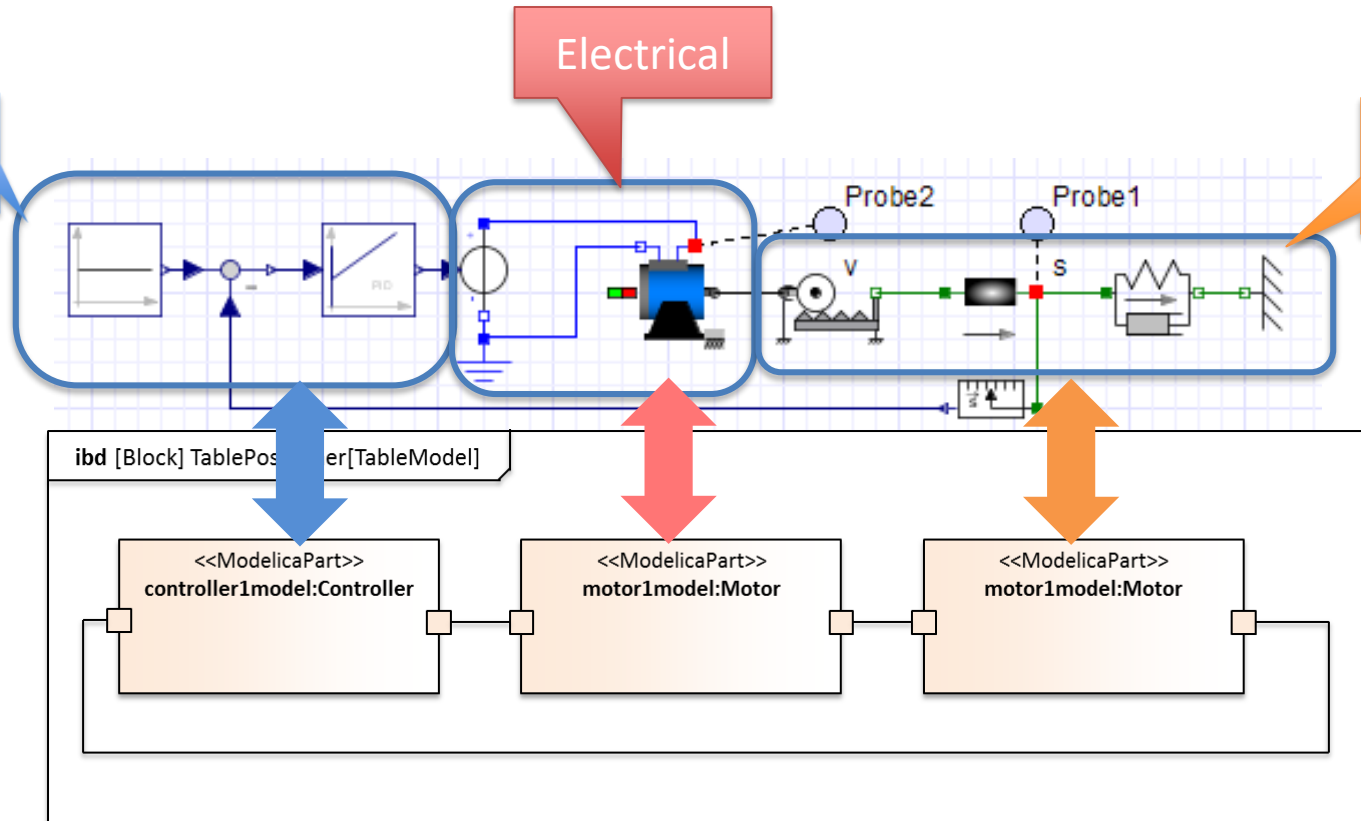


Functional Verification against formal requirements models

Control
(SW)

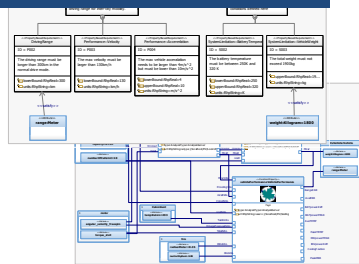
Electrical

Mechanical



How to scale MBSE beyond “Expert use”?

MagicDraw, Rhapsody...



MBSE Experts



Architecture

MapleMBSE

| ID | Kind | Category/Name | Specification |
|-----|-----------------------|---------------|------------------------------------|
| R01 | FunctionalRequirement | System goal | The OJT must ensure we grow... |
| R02 | FunctionalRequirement | Control goal | The OJT must ensure an optimal... |
| R03 | FunctionalRequirement | Control goal | The OJT must ensure the control... |
| R04 | FunctionalRequirement | Control goal | The OJT must ensure the control... |
| R05 | FunctionalRequirement | Control goal | The OJT must ensure the control... |
| R06 | FunctionalRequirement | Control goal | The OJT must ensure the control... |

Design Stakeholders

Engineering, UX, Software,
Business process etc

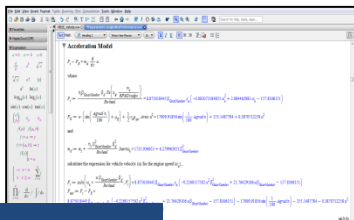


Detailed Architecture

Impact Analysis

**System Architecture
(SysML)**

Structure
Behavior
Requirements
Parametric Constraints



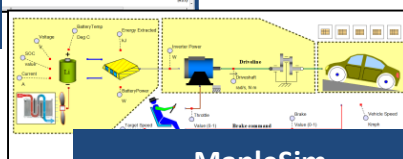
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Engineering Analysts



Compliance Tests

Trade studies, etc



MapleSim

...many stakeholders need to do “modeling”

The aim of Systems Engineering is for many stakeholders to collaborate across many disciplines, so modeling tools for non-experts are vital

Integrate models with
commonly used
spreadsheet interface

Req.
Analysts



Electronics
Engineer



Project
Manager



De



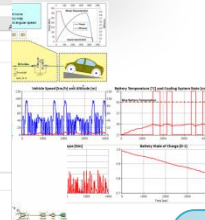
Engineer



Software
Engineer



The screenshot shows a spreadsheet interface with two main tables. The first table, 'Derived Requirements', has columns for ID, Kind, Category, Name, and Specification. It lists various requirements for a vehicle's gear shifting system, such as 'The DCT never selects any gear that is not safe' and 'The DCT should select an optimal gear by considering the driver's direction and the current conditions of the car'. The second table, 'Layer Level Requirements', has columns for ID, Name, and a grid of checkboxes indicating the status of each requirement across different layers (e.g., L1, L2, L3, L4, L5, L6, L7, L8, L9, L10, L11, L12, L13, L14, L15, L16, L17, L18, L19, L20, L21, L22, L23, L24, L25, L26, L27, L28, L29, L30, L31, L32, L33, L34, L35, L36, L37, L38, L39, L40, L41, L42, L43, L44, L45, L46, L47, L48, L49, L50, L51, L52, L53, L54, L55, L56, L57, L58, L59, L60, L61, L62, L63, L64, L65, L66, L67, L68, L69, L70, L71, L72, L73, L74, L75, L76, L77, L78, L79, L80, L81, L82, L83, L84, L85, L86, L87, L88, L89, L90, L91, L92, L93, L94, L95, L96, L97, L98, L99, L100). The checkboxes are marked with 'X' or left blank.



Excel-based development of requirements

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Andy Ko

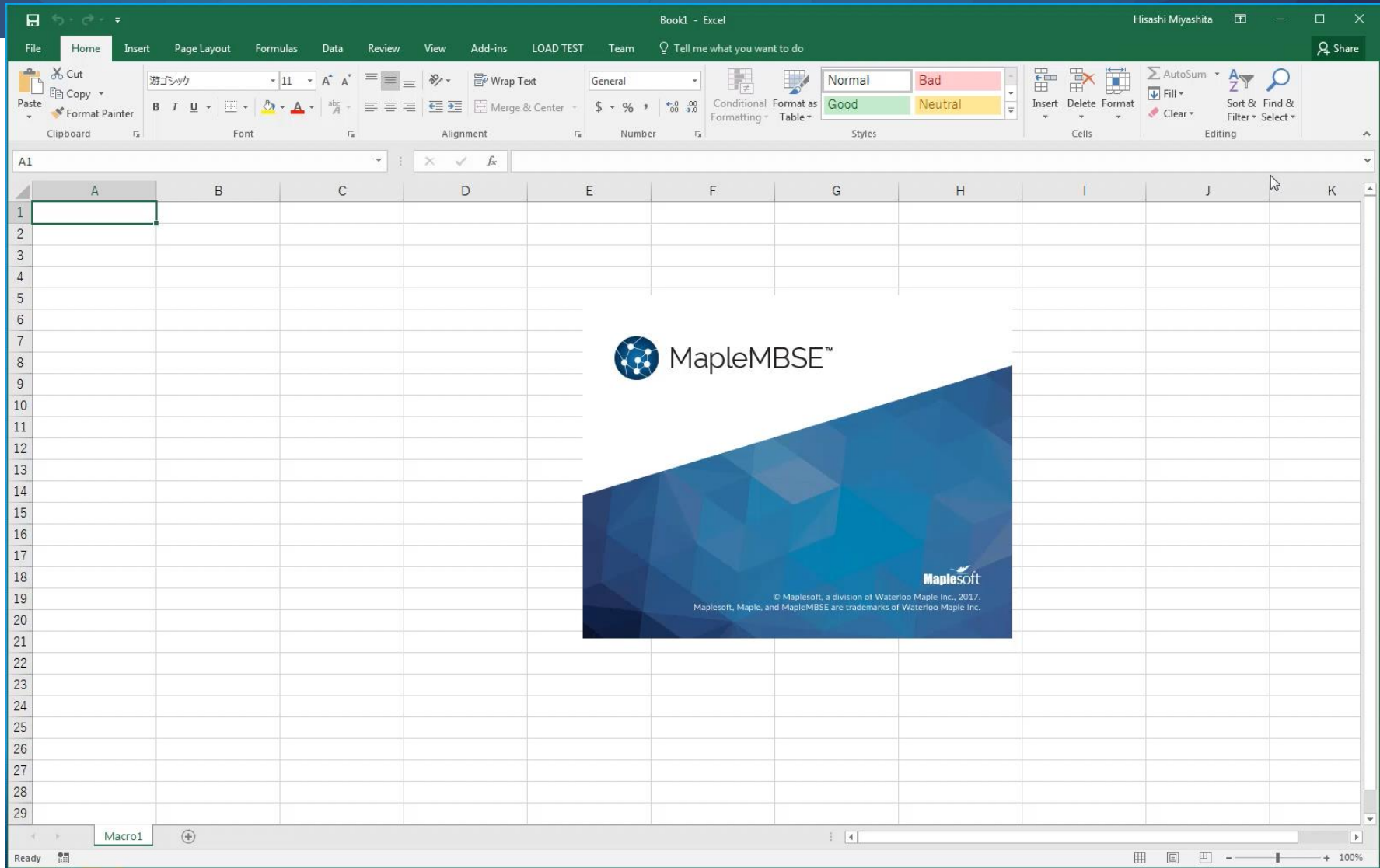
Design Verification with ModelCenter

Maple

No Magic Teamwork Cloud

Cameo Systems Modeler

Compliance verification demo



The screenshot displays the Microsoft Excel application window. The title bar indicates the file is 'Book1 - Excel' and the user is 'Hisashi Miyashita'. The ribbon is set to the 'Home' tab, showing various formatting and editing options. The spreadsheet grid is visible, with a large graphic centered in the middle. The graphic features the 'MapleMBSE' logo, which consists of a blue globe icon with white dots. Below the logo, the text 'MapleMBSE' is displayed. The graphic also includes a blue geometric pattern and the 'Maplesoft' logo. At the bottom of the graphic, there is a copyright notice: '© Maplesoft, a division of Waterloo Maple Inc., 2017. Maplesoft, Maple, and MapleMBSE are trademarks of Waterloo Maple Inc.' The status bar at the bottom of the Excel window shows 'Macro1' and a zoom level of 100%.

Summary

- MBSE: Proven business methodology for managing design complexity, risk and costs
- MapleMBSE provides Excel-based UI for detailed product definition by a wide range of stakeholders, while maintaining integration with SysML architectural model
- MapleSim provide rapid functional mockups for verification of complex multidomain dynamic systems
- ModelCenter brings everything together for rapid requirements-compliance testing, trade-off studies, and impact analysis due to changes in design requirements
- **Convergence of tools helps realize the V process**



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FREE Maple Plug-in for ModelCenter

www.maplesoft.com/products/toolboxes/modelcenter



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- Easy implementation of Maple calculation worksheets in ModelCenter.

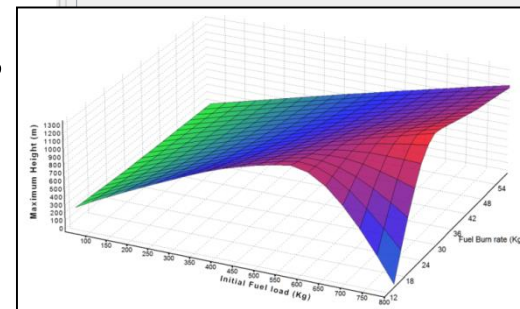
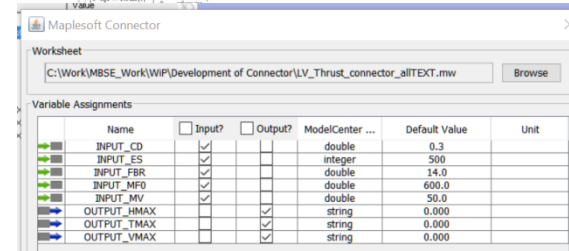
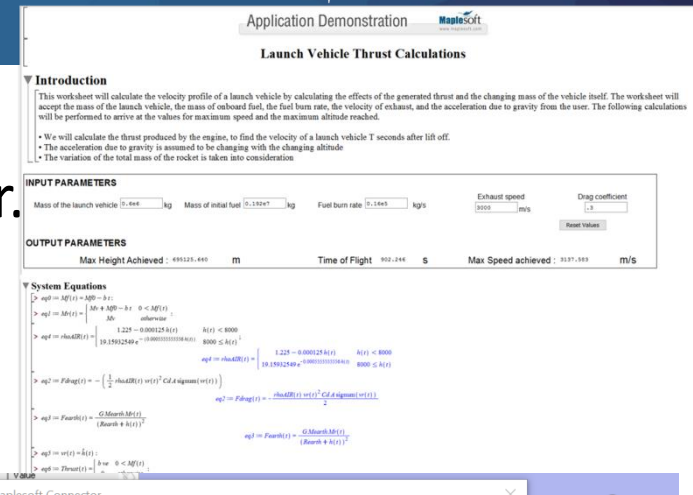
- No need to convert to scripts
- No “ModelCenter version” required

- Automatic detection of inputs and outputs from header information

- Dimensional units support

- Support for execution of MapleSim models

- Pre-processing of model parameters
- Model execution
- Post-processing of results





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Thank You

Questions?

