MapleMBSE

An Excel-based MBSE Tool for Knowledge Sharing and Collaboration across the Enterprise

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Maplesoft
Mathematics • Modeling • Simulation
A Cybernet Group Company

Maplesoft

More than 30 years of Engineering Computation

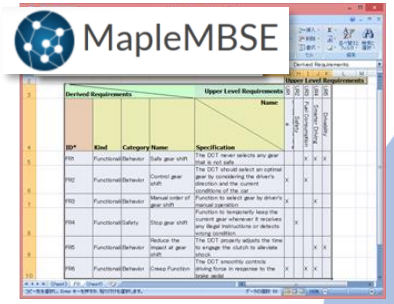
- 1980: Research project at University of Waterloo, Ontario
- Company founded in 1988
- Leading provider of high-performance solutions for engineering, science and mathematics

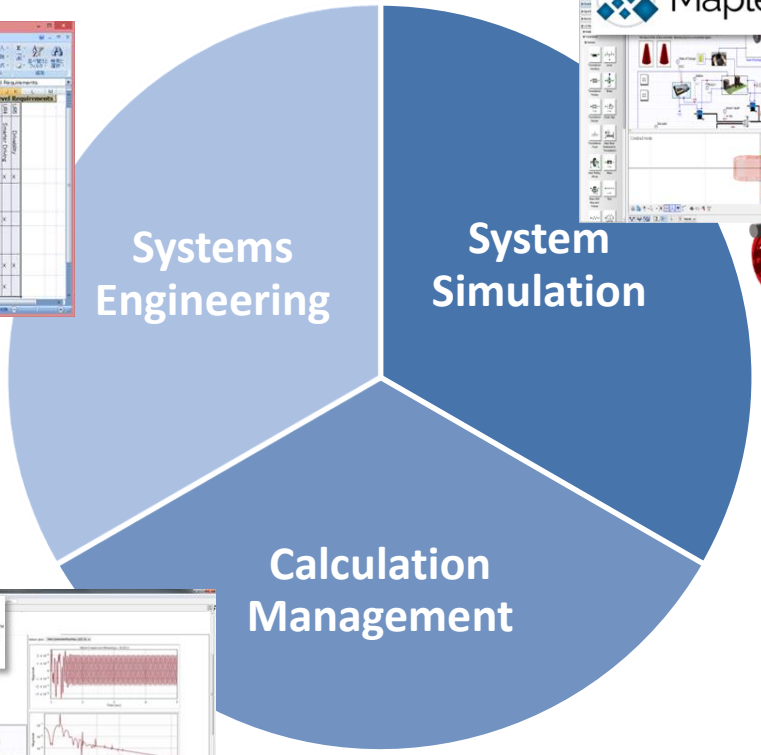
Global Presence

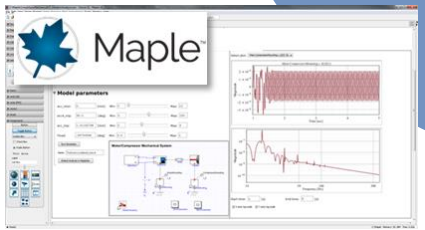
- Part of the Cybernet Group (since 2009)
- Offices in Canada, US, Germany, France, UK, China, Japan
- >30 partners worldwide

Selected Customers…

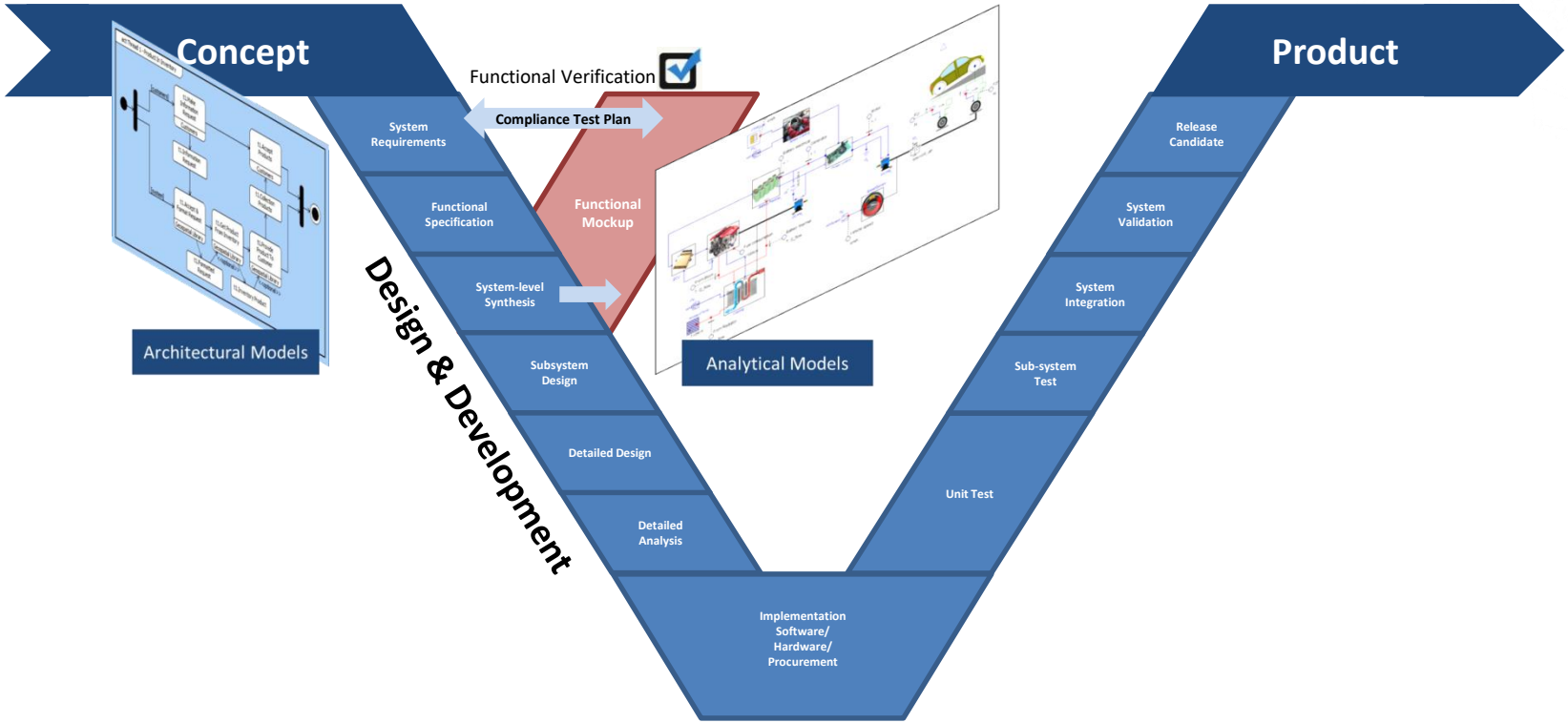
Model-driven Innovation for Engineering : Systems Design



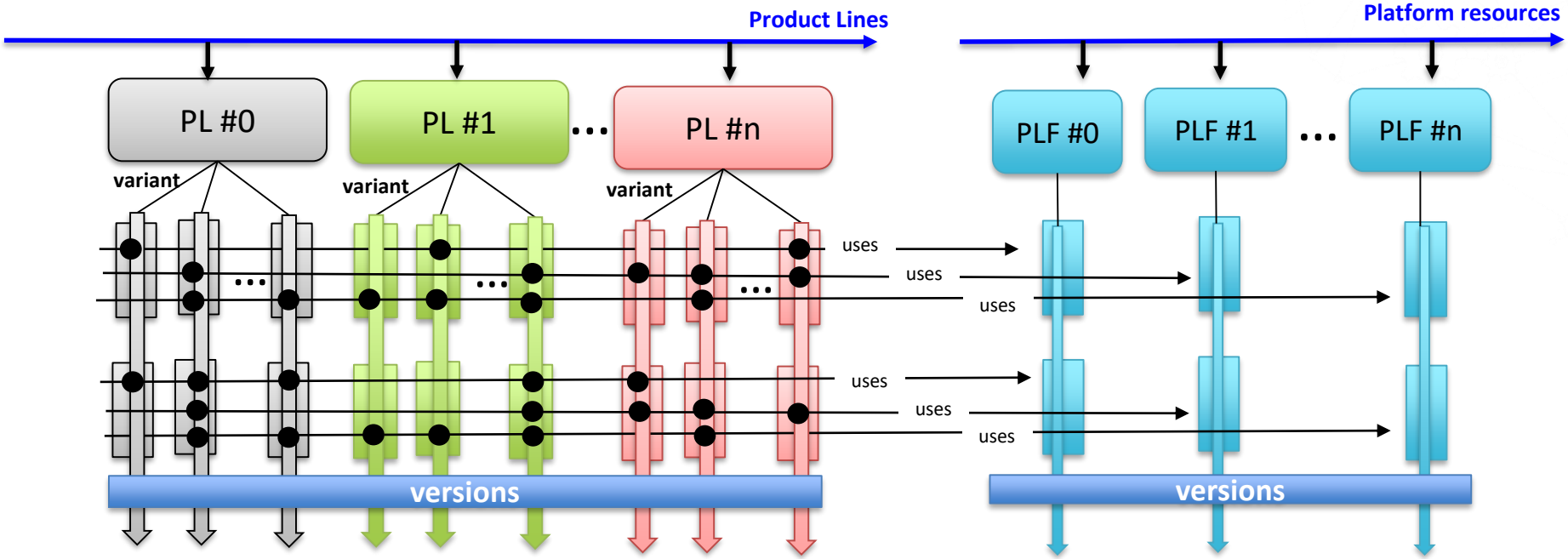




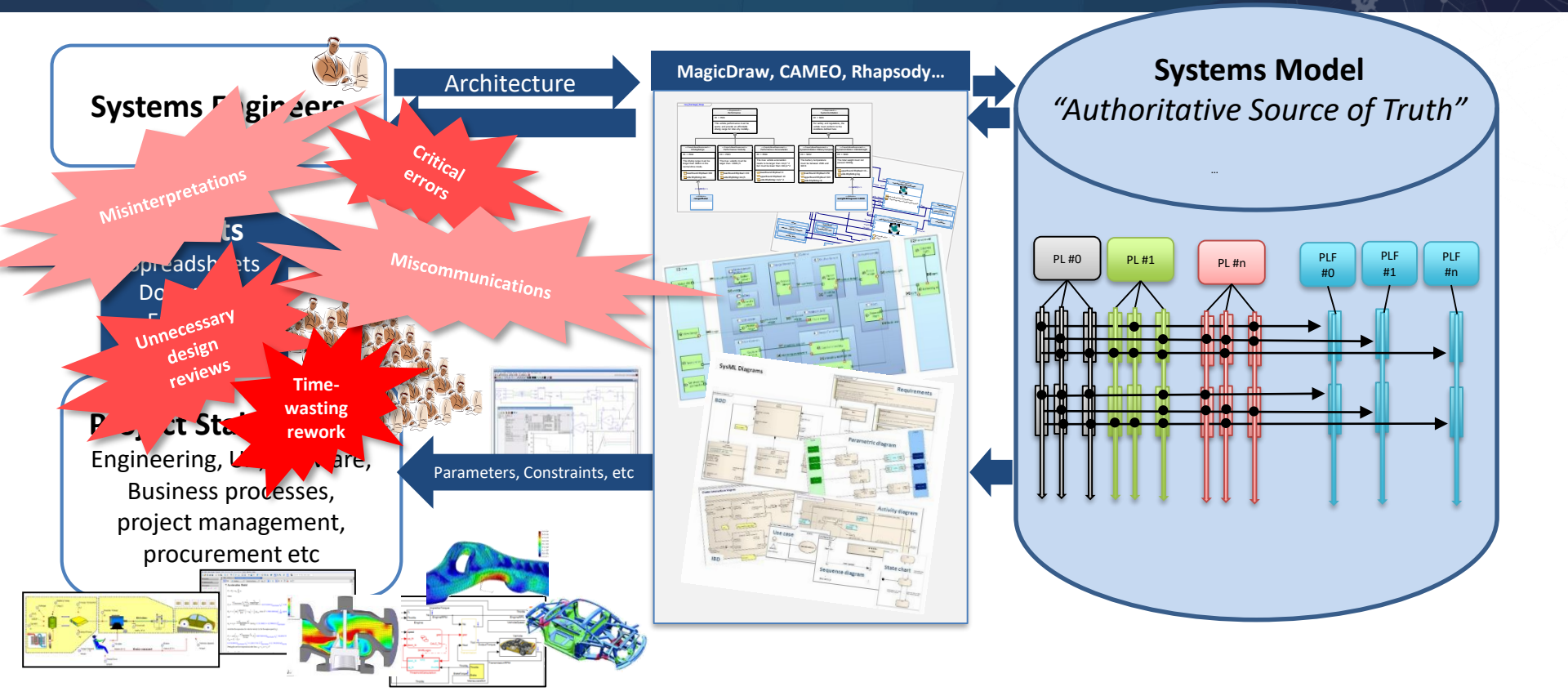
Systems Design & Development Process



MapleMBSE benefits over Product-Lines structures



How to scale Systems Engineering beyond Systems Engineers?

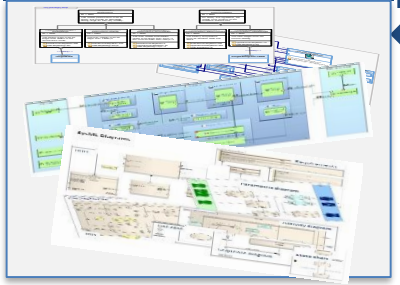


How to scale Systems Engineering beyond Systems Engineers?

Systems Engineers

Architecture

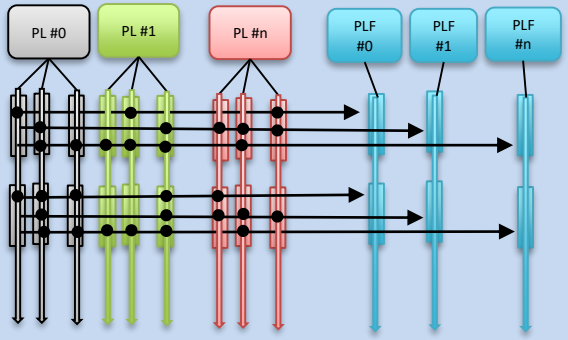
MagicDraw, CAMEO, Rhapsody…



Systems Model

"Authoritative Source of Truth"

…



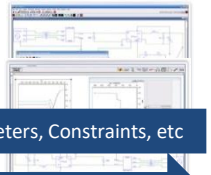
Results

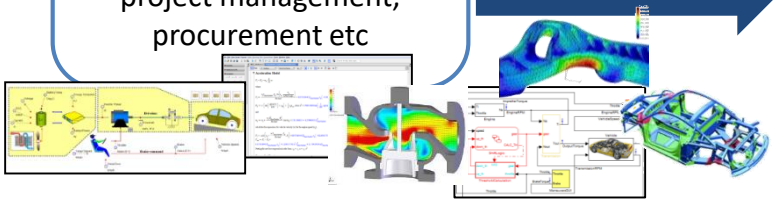
Spreadsheets
Documents
Email, etc

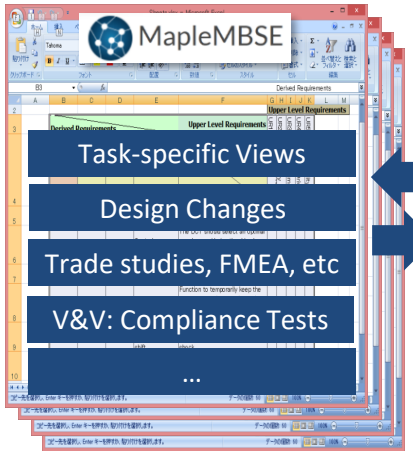
Project Stakeholders

Engineering, UX, software, Business processes, project management, procurement etc

Parameters, Constraints, etc







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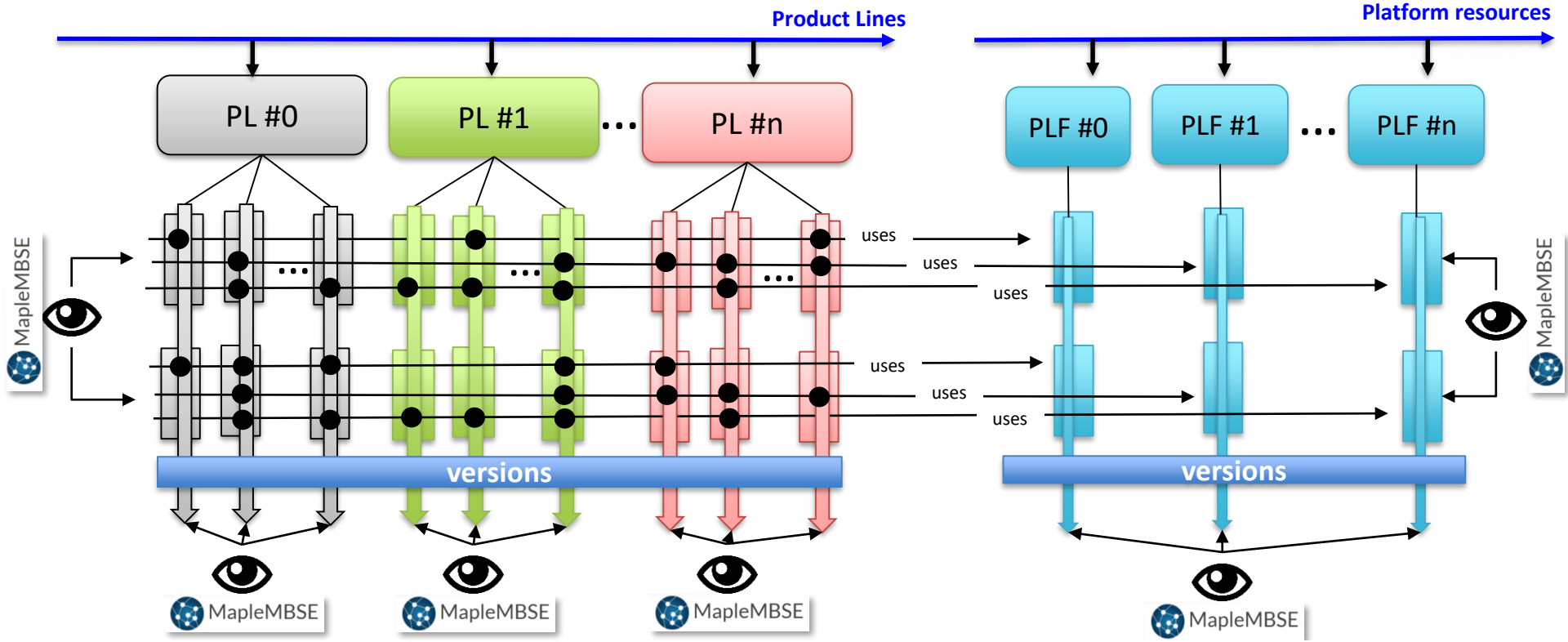
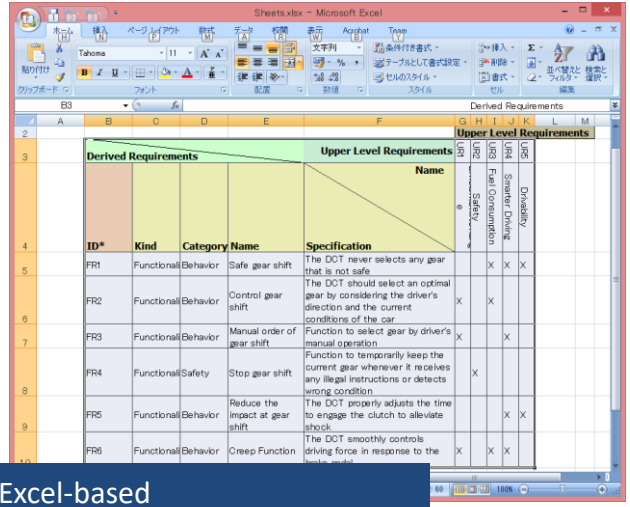


MapleMBSE

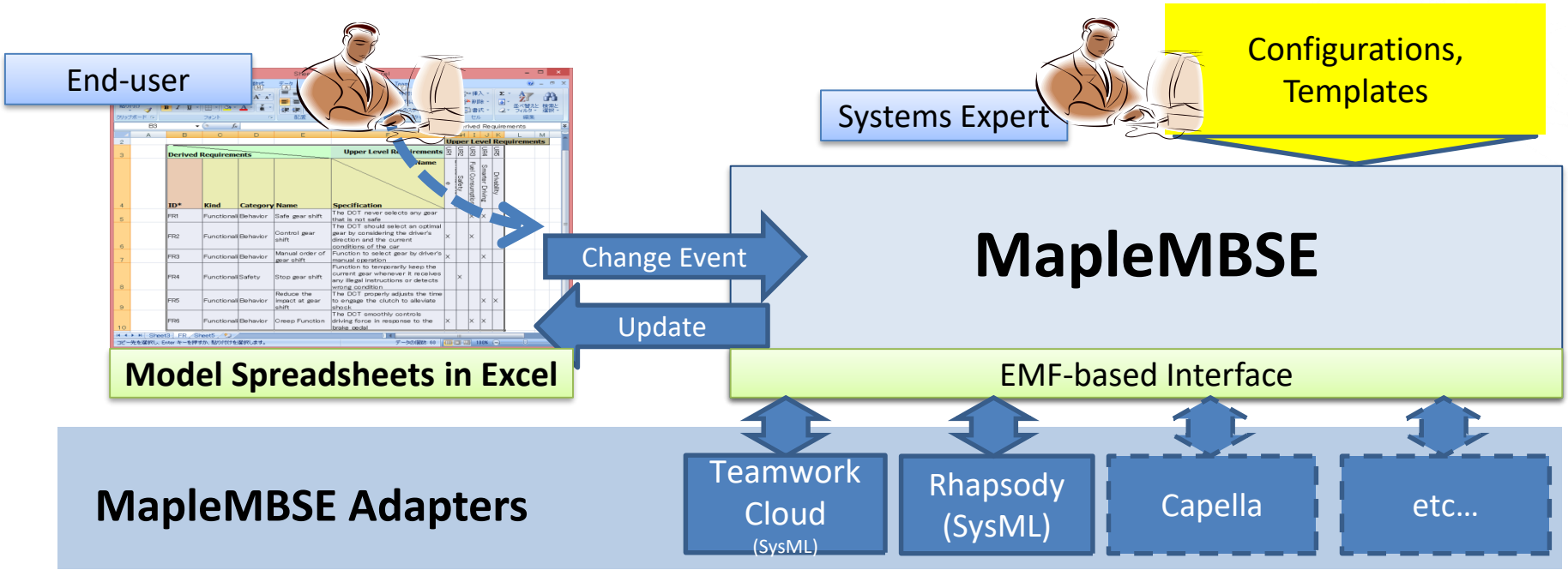


Excel-based development of system designs

- Intuitive, Excel-based UI for viewing, entering, and modifying system design information
- Synchronized updates between Excel and system model
  - Add new structures or modify existing ones
  - Instant impact analysis of design changes, eg conflicting requirements.
  - Perform FMEA, trade-studies, dependency analysis etc
- Customizable UI for task-specific views and analyses
- Integration with standard SE platforms, such as Rhapsody and MagicDraw/Teamwork Cloud (SysML)
- Interfaces and tools for rapid integration with other SE and PLM platforms

MapleMBSE Architecture Overview

MapleMBSE enables systems-model development in Excel.
Since it is built on top of EMF, we can integrate many modeling tools by providing Adapters



MapleMBSE Case Studies

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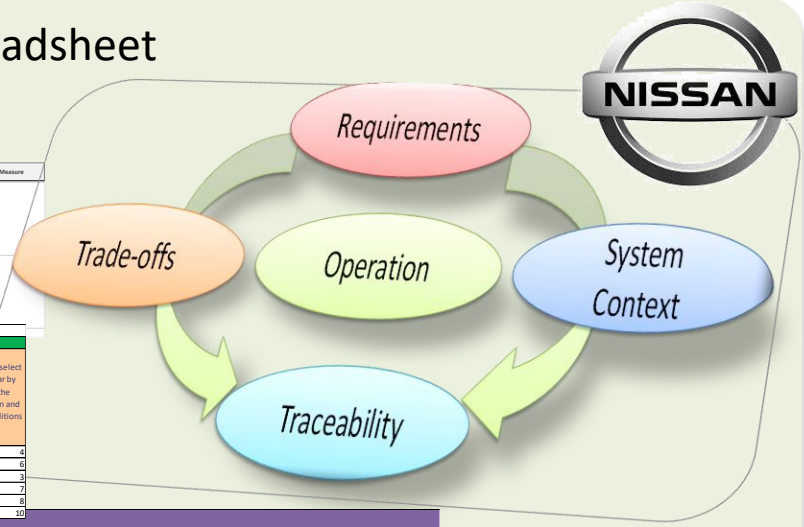
Case Study: Nissan — Overview

Integration of MapleMBSE with Nissan7 Systems Engineering Process

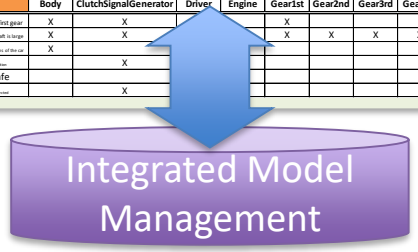
Nissan7 Modeling with Spreadsheet through MapleMBSE



FMEA No.	Target: Component	Target: Function	Failure Mode: Guide Word	Failure Mode: Timing	Failure Mode: Description	Cause	Effect (Hazard Analysis): System	Effect (Hazard Analysis): Vehicle	Effect (Hazard Analysis): Severity	Counter Measure
F1	Engine	Reduce the engine rpm at shift-up to adjust the rotation difference between drive shaft and counter shaft to be selected								
F1	Engine	Reduce the engine rpm at shift-up to adjust the rotation difference between drive shaft and counter shaft to be selected	[illegible] Not_Provided		Do not reduce or increase engine rpm even if the [illegible]	Engine ECU bug ECU malfunction Engine Safety [illegible]	Clutch may be [illegible]	Unintended [illegible]	[illegible]	

		Score	223	320	308
		Adopted	TRUE		TRUE
Criterion	Weight		Reduce the engine rpm at shift-up to adjust the rotation difference between drive shaft and counter shaft to be selected	The DCT properly adjusts the time to engage the clutch to alleviate shock	The DCT should select an optimal gear by considering the drivers direction and the current conditions of the car
Good efficiency at low rpm	8		1	3	4
Good efficiency at mid rpm	7		3	6	6
Good efficiency at high rpm	6		4	3	3
Low heat emission	8		7	8	7
Cost	10		5	10	8
Robustness	8		9	8	10

Requirements		Function	Physical Means							
1st	2nd		Body	ClutchSignalGenerator	Driver	Engine	Gear1st	Gear2nd	Gear3rd	Gear4th	ShiftController	Tire
Drivability	Keeping up of creeping	Keep slowly letting in and out the clutch when the car starts slowly in the first gear	X	X			X				X	X
		slowly engage the clutch when the rotation difference between crank shaft and drive shaft is large	X	X			X	X	X	X		X
Performance	T shifts gears to reduce fuel consur	the DCT should select an optimal gear by considering the drivers direction and the current conditions of the car	X								X	X
Safety	The DCT must assure the safety	[illegible]		X								
		The DCT never selects any gear that is not safe									X	
Drivability	The DCT shoud shift smoothly	Reduce the engine rpm at shift-up to adjust the rotation difference between drive shaft and counter shaft to be selected		X								

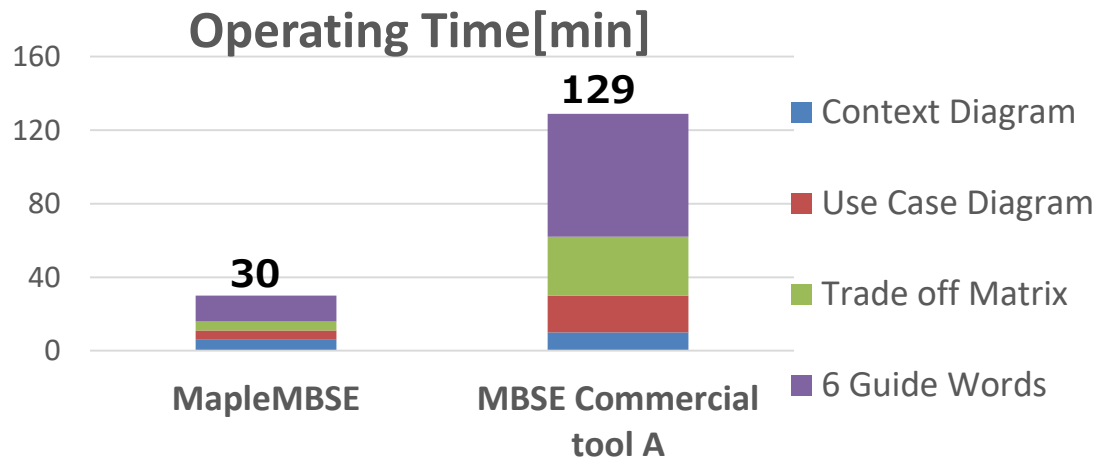


Source: Miyashita, Hisashi, Hideki Tai, and Shunichi Amano, IBM Research - Tokyo, "Controlled modeling environment using flexibly-formatted spreadsheets." in ICSE 2014, ACM

Case Study: Nissan — Productivity

MapleMBSE is proven to be effective for many engineers to develop the design of a vehicle system collaboratively, which leads to significant improvement in design performance for Nissan

	Context Diagram	Use Case Diagram	Trade off Matrix	6 Guide Words	Total	
MapleMBSE	6	5	5	14	30	[min]
MBSE tool A	10	20	32	67	129	[min]



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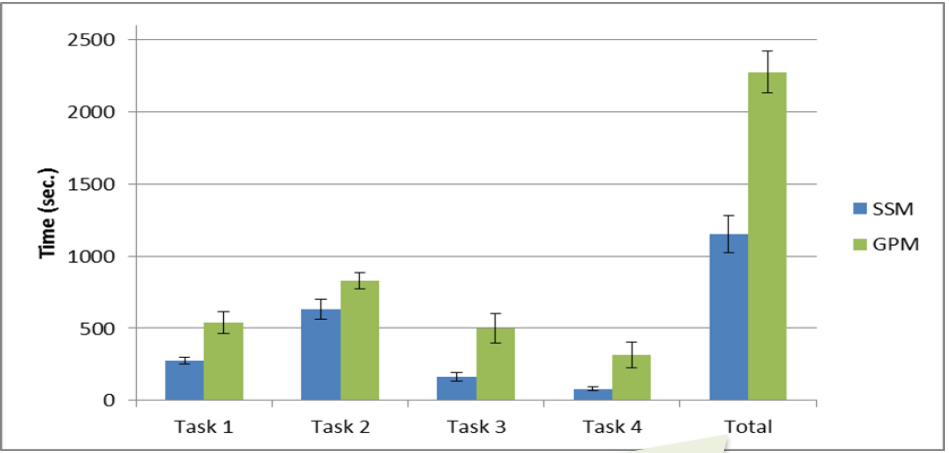
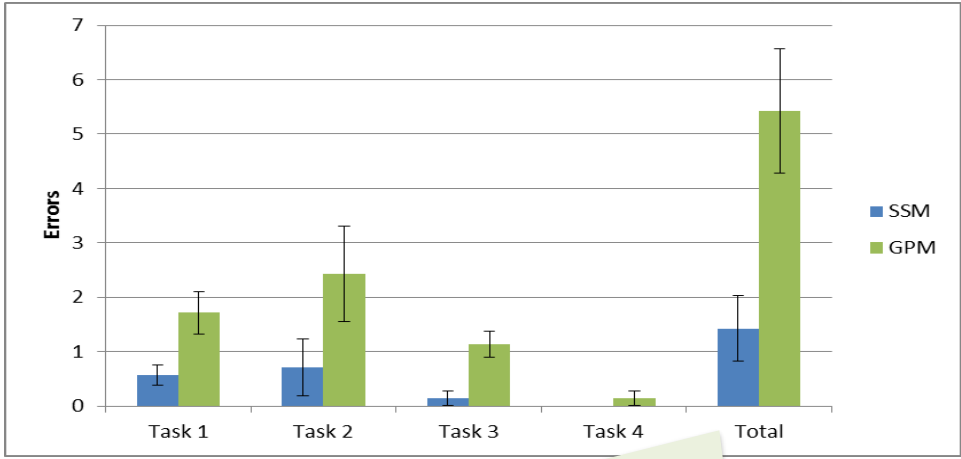
Case Study: Nissan — Effectiveness

According to our experiments of Automotive SysML modeling,
MapleMBSE greatly improves productivity across all system-design tasks

SSM SpreadSheet-based Modeling
GPM General-Purpose-tool-based Modeling



MapleMBSE almost halves the time!



MapleMBSE reduced the errors to 1/4!

Source: Miyashita, Hisashi, Hideki Tai, and Shunichi Amano, IBM Research - Tokyo,
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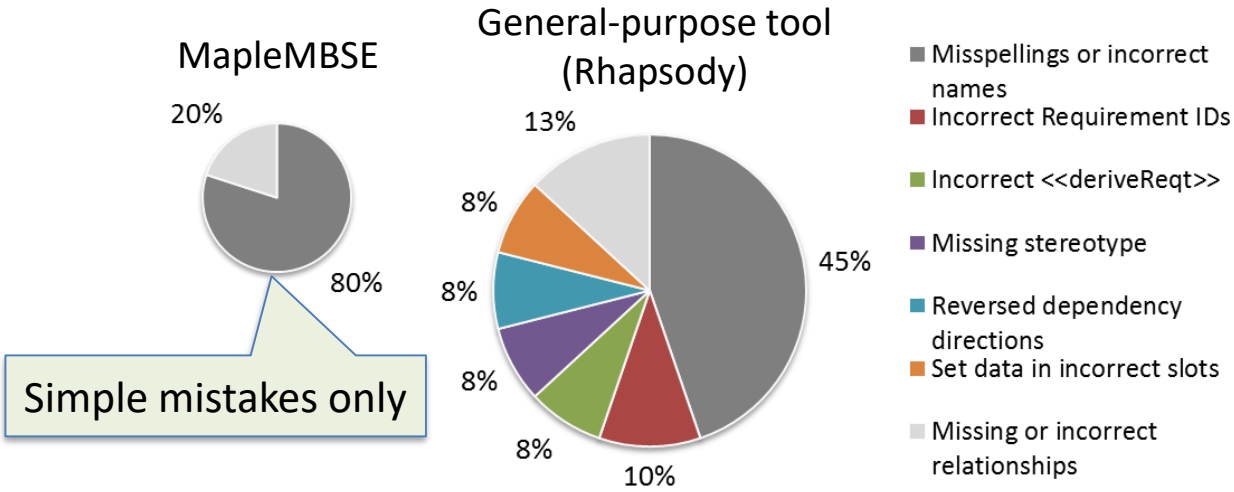
Case Study: Nissan — Error Analysis

Result suggest that typical modeling tools impose unfamiliar UI and complexities of SysML on users

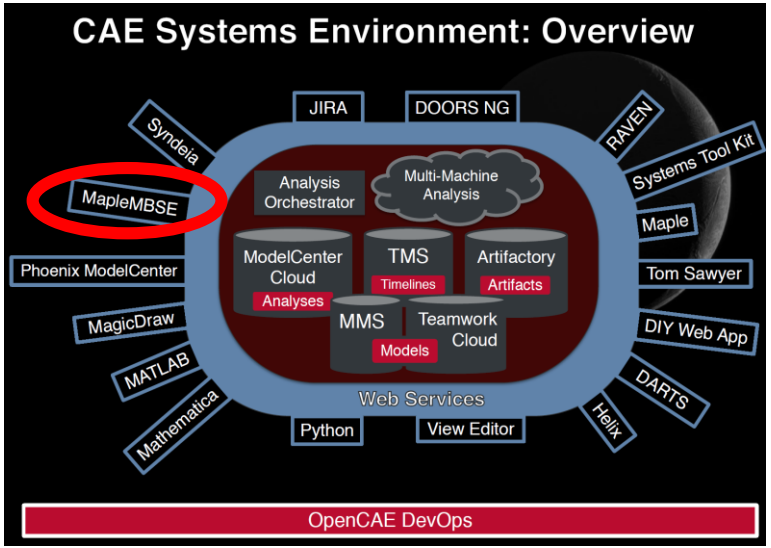


- Familiar, intuitive Excel user interface
- Spreadsheets optimized to do the tasks
- No need for deep knowledge of the modeling language (SysML)

Source: Miyashita, Hisashi, Hideki Tai, and Shunichi Amano, IBM Research - Tokyo, "Controlled modeling environment using flexibly-formatted spreadsheets." in ICSE 2014, ACM

Case Study: NASA-JPL

Jet Propulsion Laboratory
California Institute of Technology



"MapleMBSE is one of the key enablers for effectively viewing and editing systems models"

- Edit components of Master equipment list with MapleMBSE
- Expose assembled structure in MapleMBSE
- Control Mass roll up using MapleMBSE
- Audit all connections in table view using MapleMBSE
- Expose powered components in MapleMBSE / Power roll up

Summary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Summary

- MapleMBSE provides easy-to-use Excel-based Systems Engineering modeling environment for system definition throughout the design cycle
- Offers the power to “democratize” the Systems Engineering process by allowing a broader range of stakeholders to contribute to it without learning graphical MBSE tools
- Proven to accelerate the system-definition process by simplifying the information-entry and reducing the risk of errors
- Adapted to do collaborative modifications on Product Line Engineering

Questions ?

www.maplembse.com

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