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PTC 222 - Design Better Platforms Product Lines and Variants with PTC Integrity Modeler

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VP Solution Management

June 2015

Introducing Model-Based Systems Engineering

Agenda

- System Product Line Engineering Challenges
- The PTC Model-Based Product Line Engineering Solution
- Model-Based Product Line Engineering Demonstration
- Latest PTC Innovations
- Potential Model-Based Systems Product Line Engineering Benefits

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Systems Engineering Challenges - Recap

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Smart connected systems & products

- Growing complexity & functionality of systems & software
  - Allocating systems functions to many engineering disciplines
  - Larger share of a products cost & capability is software
  - System & sub-system Integration
  - Customer, certification, regulation & standards compliance needs
- Larger, more distributed & distinct discipline teams
  - Communication language barriers & collaboration
  - Implementing common, architected Goals
- Increasing time pressures
  - Shorter development cycles
  - Delivering on schedule
- Quality assurance
  - Risk of building the wrong system
  - Increased costs of later stage errors
- Cost & risk reduction demands

Challenges dealing with system platforms & families

System Platform & Family Challenges

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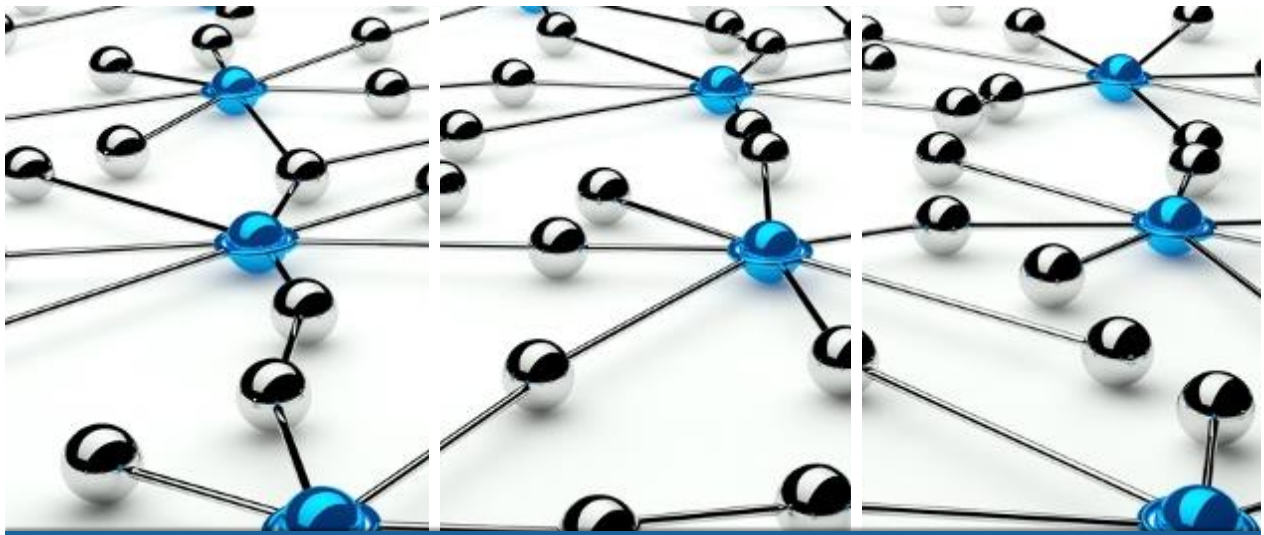
Product line explosion

- Increasing number of product families
- Increasing number of products in families
- Understanding product similarity
- Maximizing reuse
- Understanding product variations
- Deciding between options
- Development cycle time
- Commercial product needs
  - Customize existing capabilities to suit client requirements
  - Redeploy common systems & software to the Market
  - Time from requirements to cash



Challenges dealing with systems of systems?

System of System Challenges

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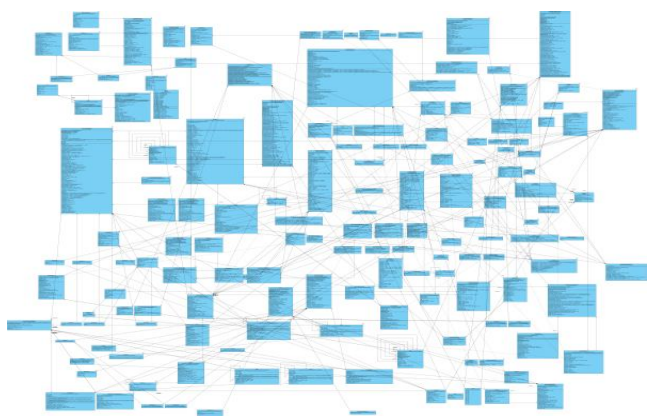
System model explosion

- Very large & complex models
- Increasing number of sub-systems in one system model
  - No separation of concerns
- Sub-system access controls
- Sub-system configuration management
- Distributes teams
  - Inside an organization
  - Between organizations



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What is PTC Integrity?

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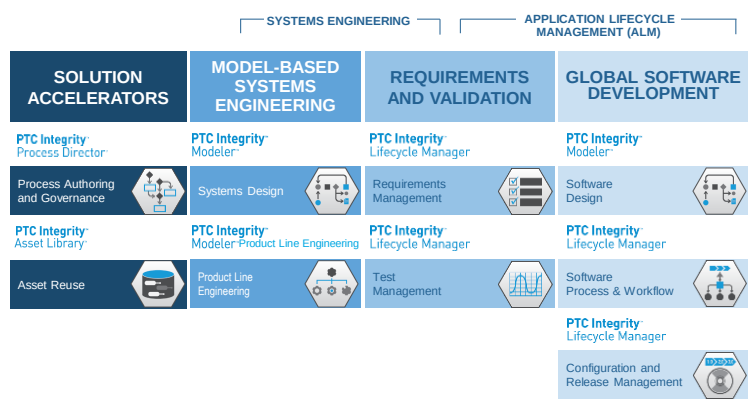
A family of **software and systems engineering** products that accelerate **product innovation.**

PTC Integrity enables a holistic software and systems engineering approach by improving collaboration, automation and reuse across teams and disciplines.



PTC's Model-Based Systems Engineering

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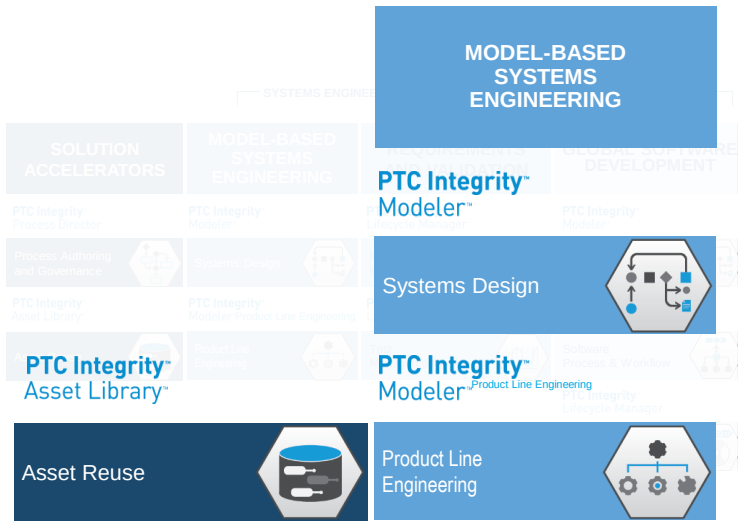

Solution … Model-Based Product Line Engineering

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Designing a single system platform rather than creating a multitude of products

- MBSE + Variation
  - Common language improves
    - Communication
    - Collaboration
    - Stakeholder buy in
  - System product lines designed up front
- Maximum commonality & minimal variation
  - Less duplicated effort with optimized reuse
  - More commonality between designs and implementations
  - Managed product line complexity

OMG SYSTEMS MODELING LANGUAGE™ (SysML)

+

Orthogonal
Variability
Modeling

ISO

PTC Integrity Modeler Product Line Engineering

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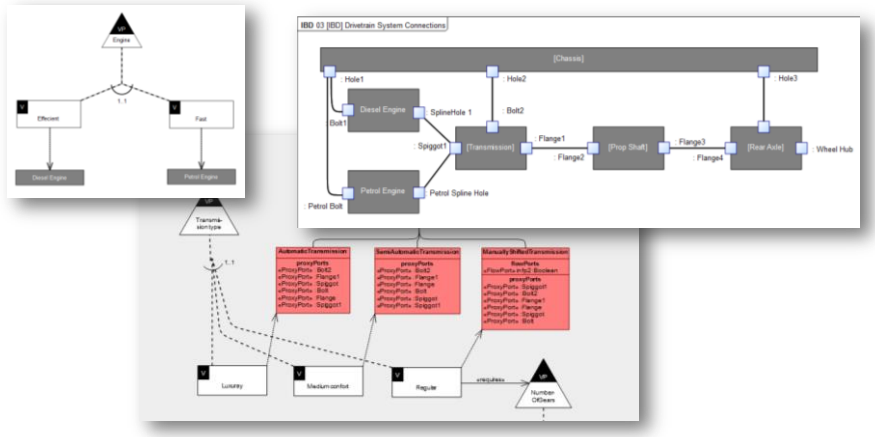
CAPABILITIES

- Design System Family Commonality & Variation
- Capture product platform definition with Structural & Functional 150% Models
- Define product line configuration logic and rules
- Auto-generation of Product Models

Design product platforms and variants quickly and efficiently, and make better trade-off decisions



BENEFITS

- System product line cost savings
- Improve product portfolio flexibility
- Improve management of configurations
- Improve reuse productivity

The Solution … Asset Based Modular Design

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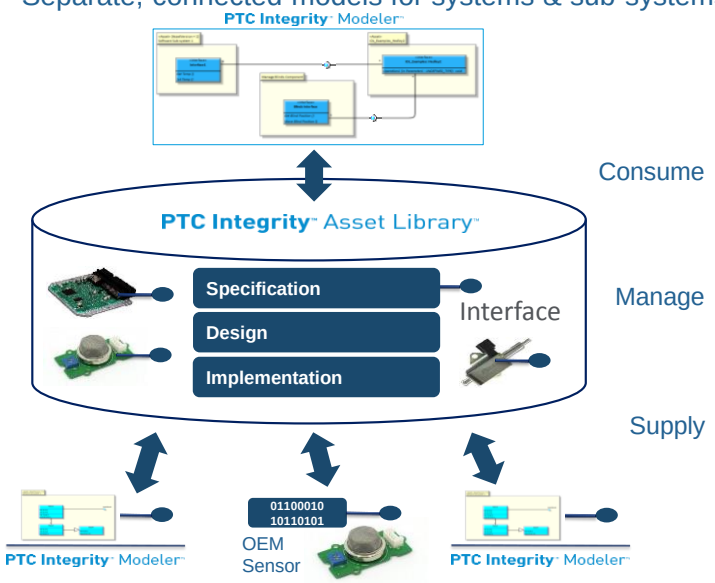
Separate, connected models for systems & sub-systems



PTC Integrity Asset Library

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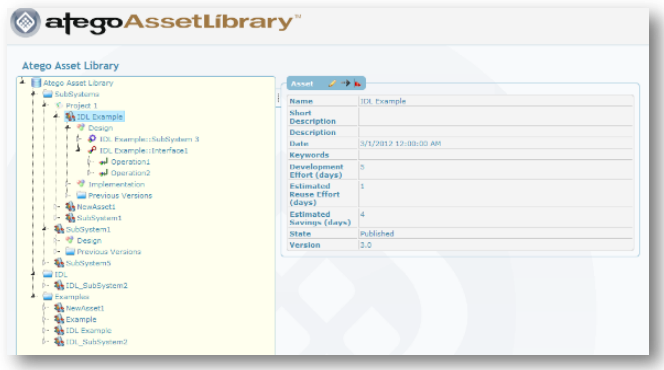
CAPABILITIES

- Standards Based
- OMG Reusable Asset Specification
- Multi-User Web Architecture
- File Type Independence
- Atego Modeler Integration
- Drag-&-Drop Publish & Reuse
- Management Reporting

Specify, publish, manage, find and reuse your organizations' systems, hardware & software assets



BENEFITS

- Improved Quality and Productivity through Reuse
- Measure the value of Assets Reuse
- Reduce Development and Support Costs

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Model-Based Product Line Engineering Demonstration

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PTC Integrity Modeler 8.2 – Variable Parameters

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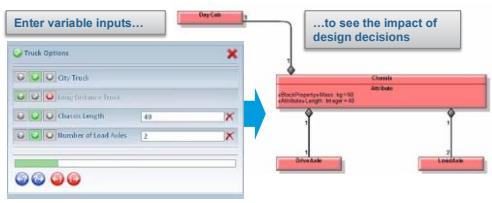
Variable Parameters for Product Line Engineerig

- Fully explore and articulate real-world choices in product lines and variants
  - Inclusion/exclusion
  - attribute values
  - Multiplicity
  - calculated variables

- Improve model quality by specifying and enforcing design constraints
- Build in design intelligence with pass-through values and powerful scripting



Model-based Product Line Engineering

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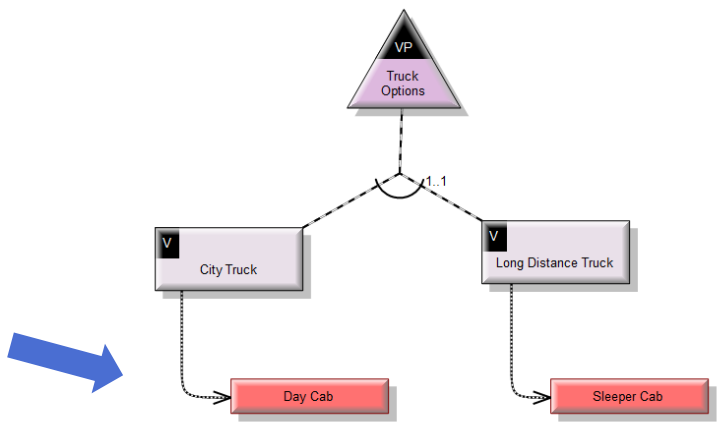
PTC Integrity Modeler 8.1

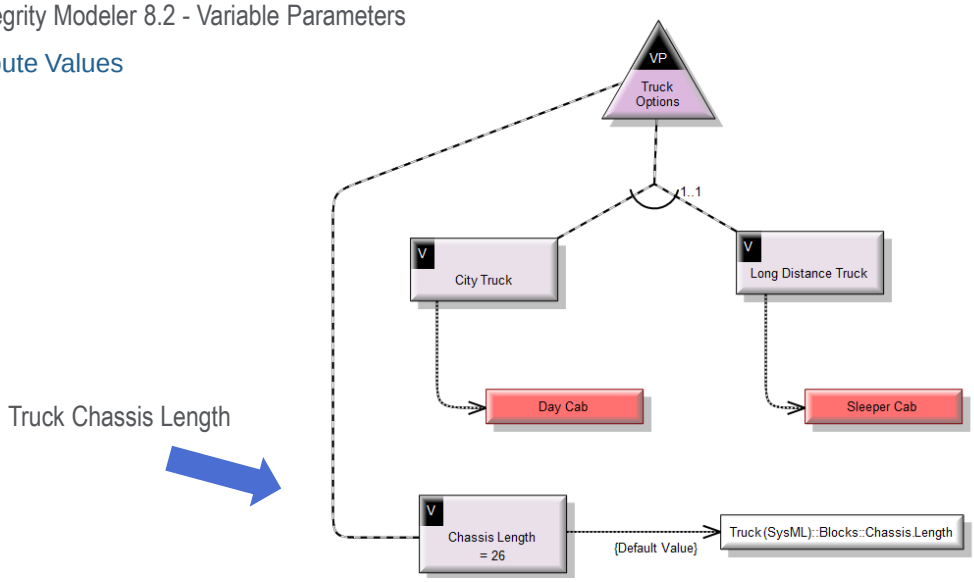
- Inclusion / Exclusion

Cab Inclusion



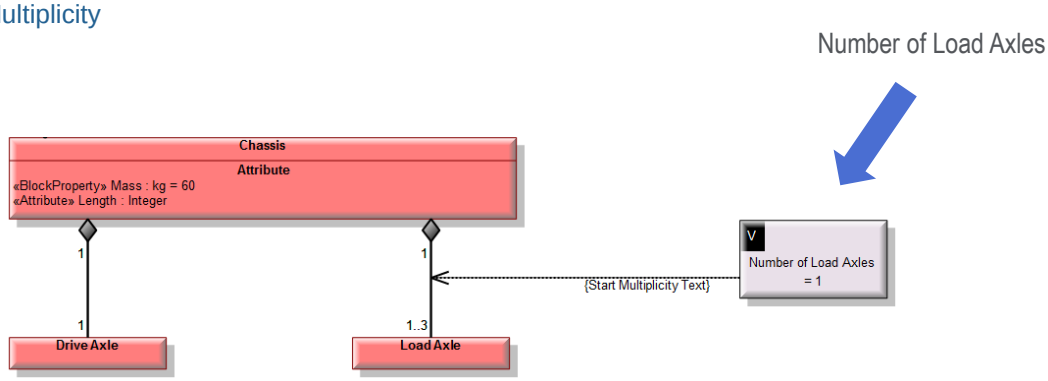
PTC Integrity Modeler 8.2 - Variable Parameters

- Attribute Values



PTC Integrity Modeler 8.2 - Variable Parameters

- Multiplicity



PTC Integrity Modeler 8.2 - Variable Parameters

- Variant Selector

- Decision Set Editor

Name	Decision	Value	Status	Included By
Truck Options			Included	Truck (SysML).Number of Load Axles, Truck (SysML).Chassis Length, Truck (SysML).City Truck
City Truck	Include		Included	
Long Distance Truck	Undecided		Excluded	ruck (SysML).Truck Options.Alternative Choice1
Chassis Length	Include	30	Included	
Number of Load Axles	Include	3		

Variable Parameters

Model-based Product Line Engineering

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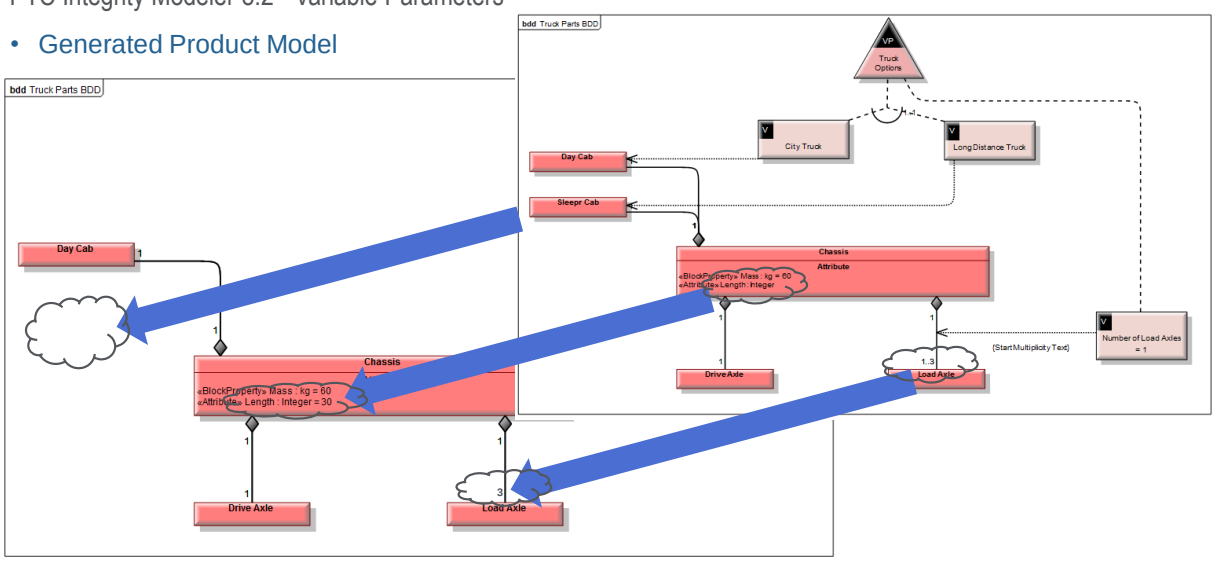
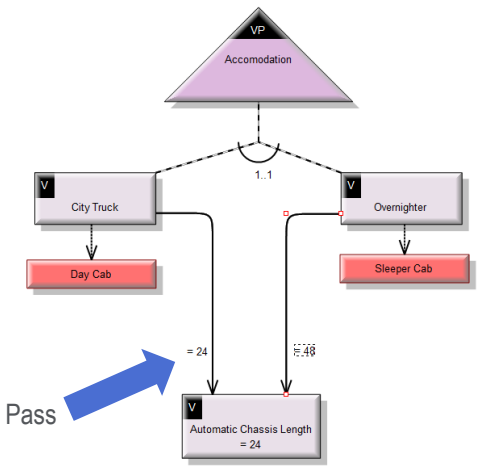
PTC Integrity Modeler 8.2 - Variable Parameters

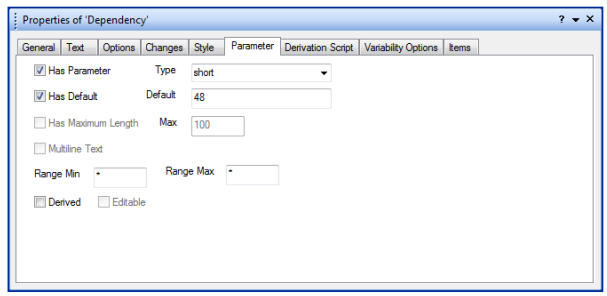
- Generated Product Model



PTC Integrity Modeler 8.2 - Variable Parameters

- Variable Parameter Passing





Model-based Product Line Engineering
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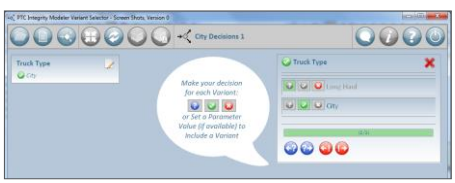
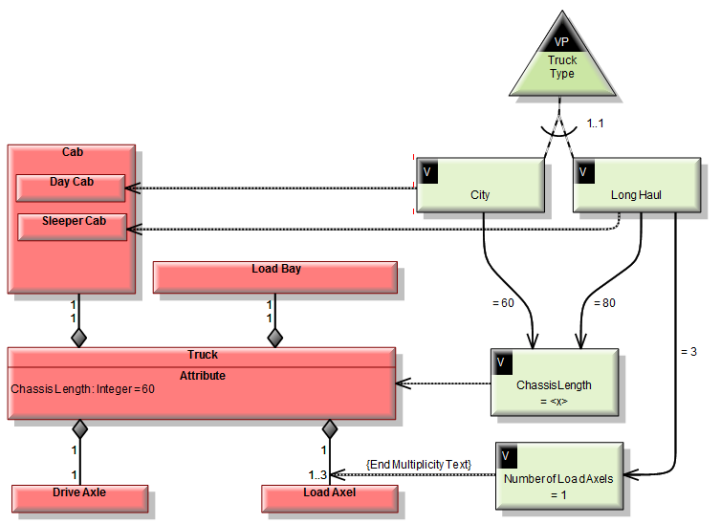
PTC Integrity Modeler 8.2 - Variable Parameters

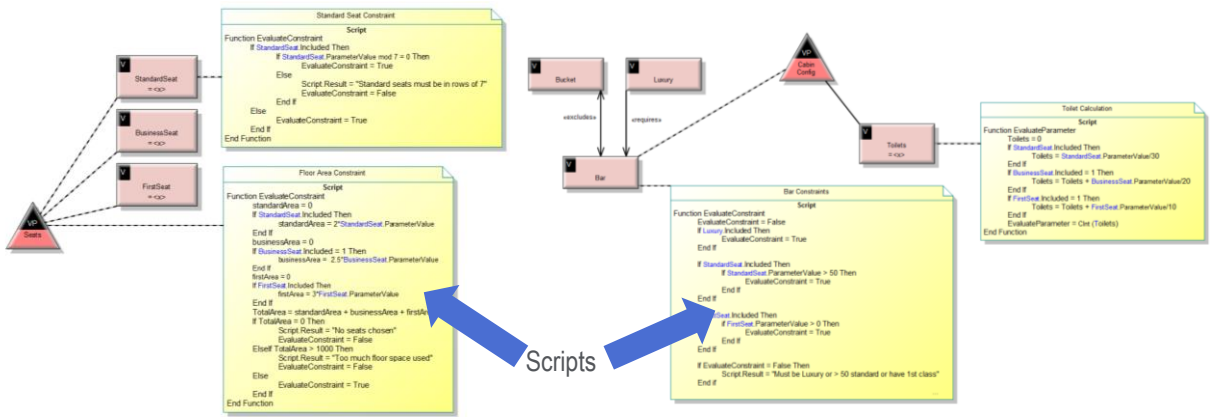
- Variable Parameter Passing





PTC Integrity Modeler 8.2 - Variable Parameters

- Derivation & Validation Scripts



Benefits

- Better system & software product line alignment with customer and business needs
  - Full control over system & software Variability Design;
    - Inclusion
    - Attribute Values
    - Multiplicity of sub-Systems
- Improved Productivity
  - Variable parameter dissemination
  - Automatic variable parameter value calculation
- Better system & software product line designs
  - Powerful constraints based on variable parameters
  - Error checking during variation decision making process

PTC Integrity Asset Library 2.0

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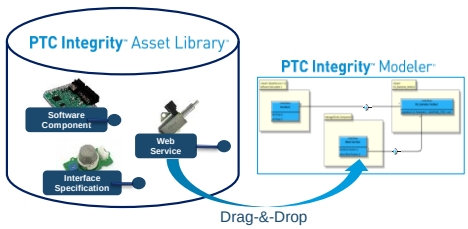
Intuitive Asset Cataloging, Management and Reuse

Drag-and-drop Web service cataloging and reuse

Industry FIRST

- Auto-document and reuse Web Services
- Easily design Internet of Things (IoT) systems from a palette of reusable services
- Make reuse practical and time-saving



- **Open Services for Lifecycle Collaboration (OSLC) Extensibility**
  - Catalog, publish, search and reuse assets of any OSLC-compliant lifecycle tool
  - Drag-&-drop modular SoS design with PTC Integrity Modeler
- **Pure::Variants Integration**
  - Publish & Reuse Variable Assets
  - Extend into Model-based Product Line Engineering

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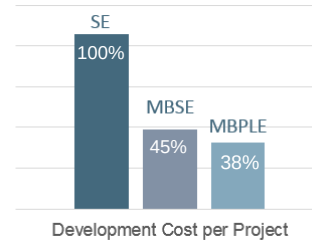
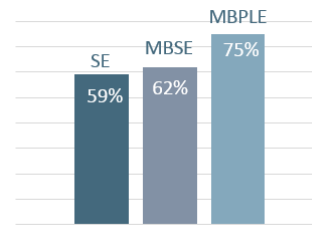
Potential Model-Based Systems Engineering Benefits

- Design the way you Build
- Early, architected reuse to maximize cost savings
- Planned product lines, increasing productivity
- Better alignment with customer and market needs
- Maximum commonality & minimum variation



Development Cost per Project



On Time Delivery

* EMF Survey, based on 667 respondents

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PTC® PRODUCT & SERVICE ADVANTAGE®