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Enhancing Automated Trade Studies using MBSE, SysML and PLM

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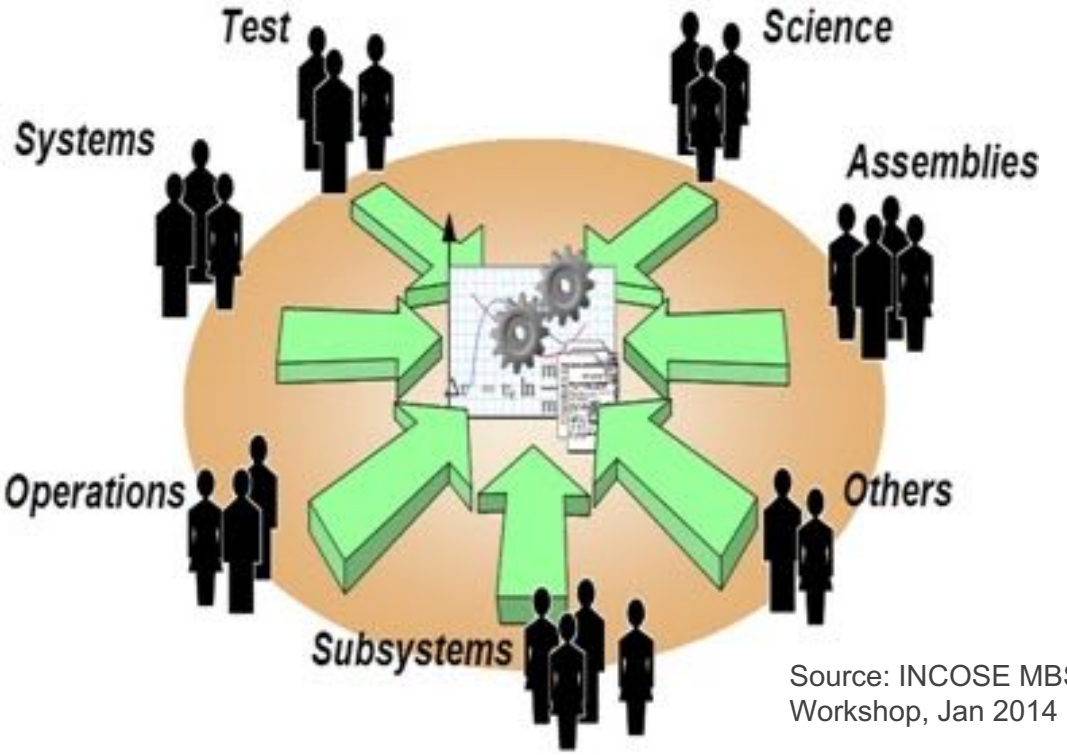
PLM and Systems Engineering

So what?
Who cares?

Quite many care – if it is enabling, practical, demonstrable



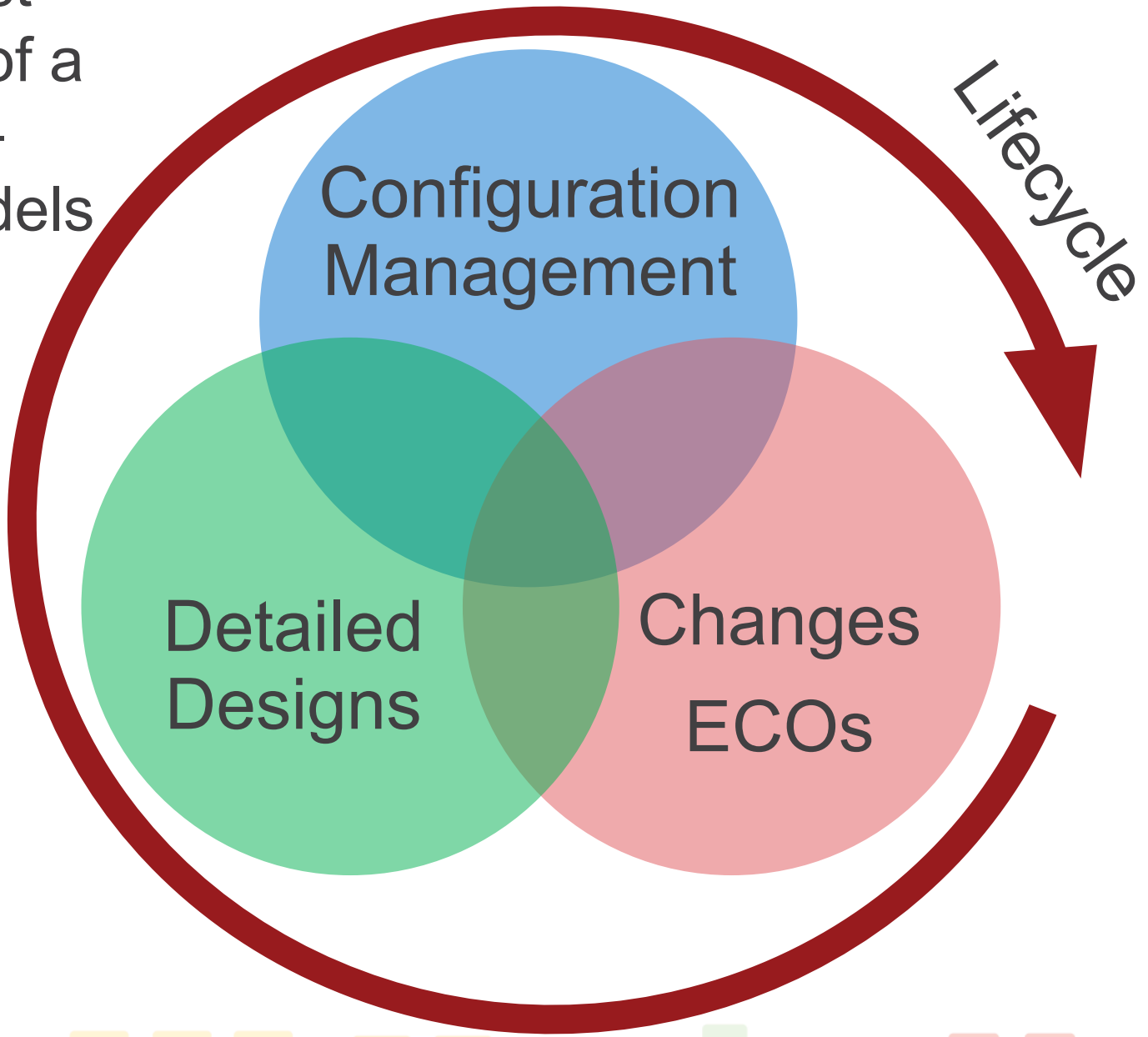
Source: INCOSE MBSE Workshop, Jan 2014

Study your use cases!!!

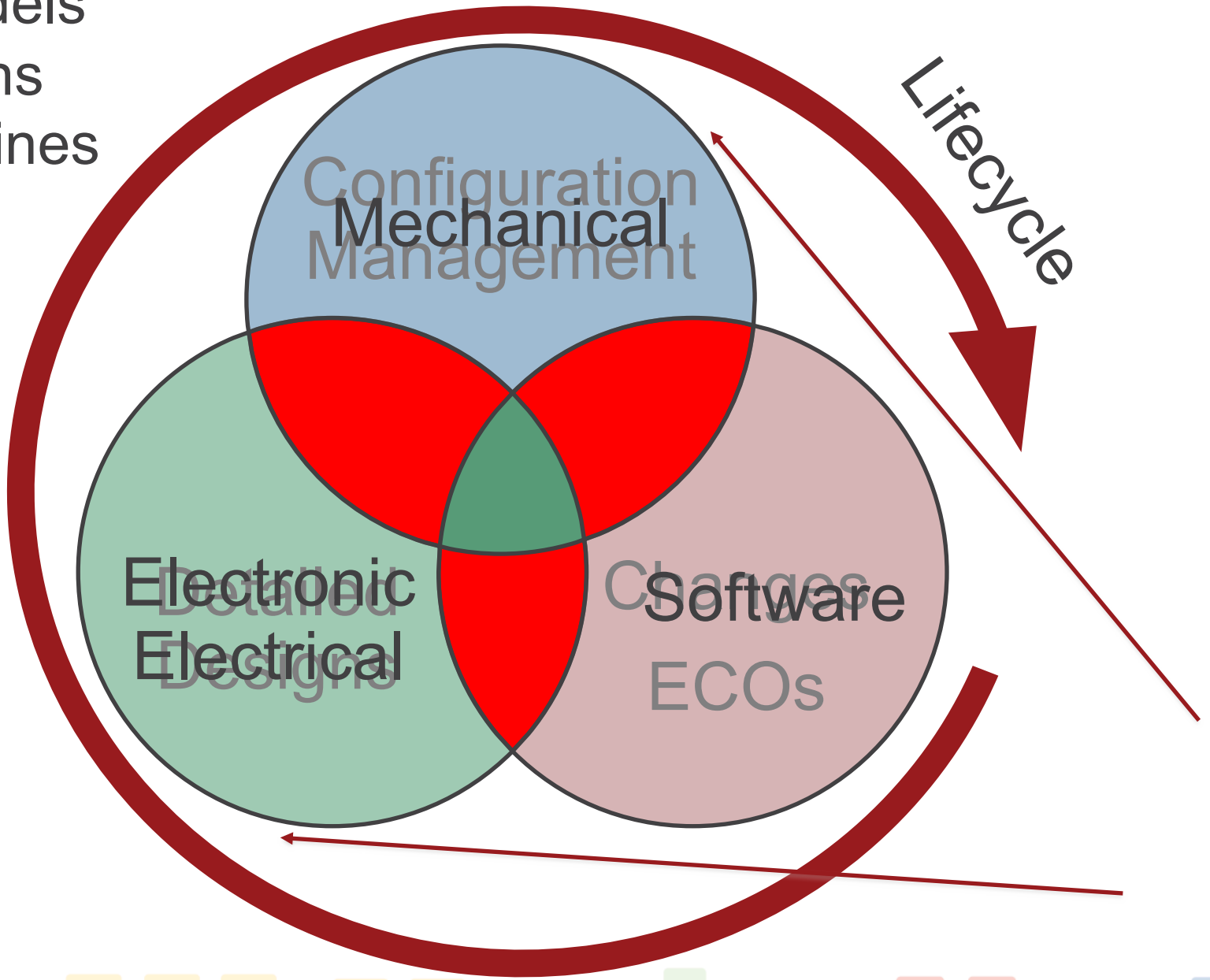
PLM platforms must manage all aspects of a product lifecycle – including system models

No - PLM is not "just" for managing mechanical assemblies

No – "manage" does not mean "contain everything"

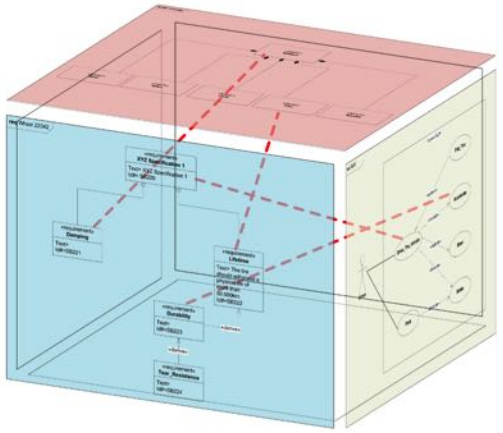


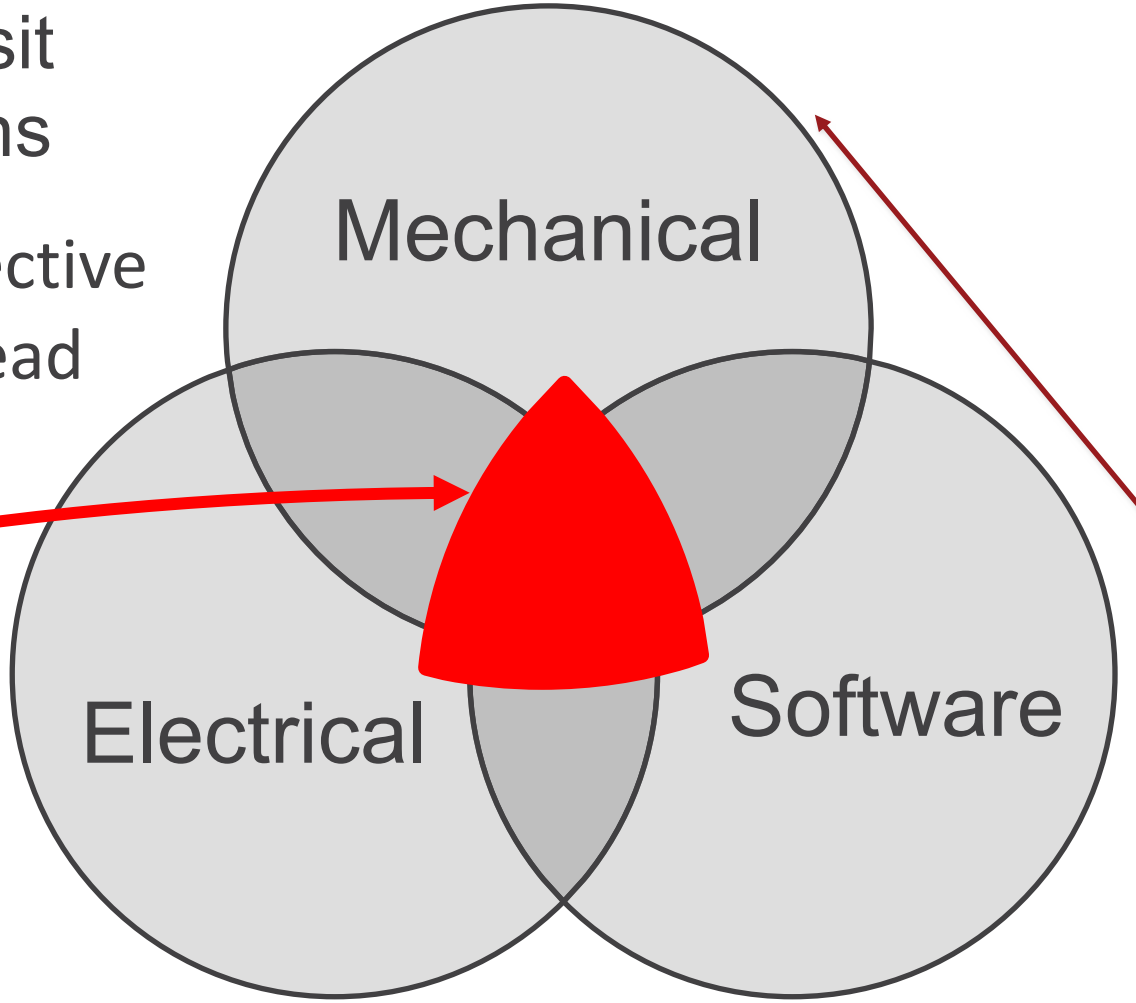
Without system models
Digital Thread runs
only between disciplines



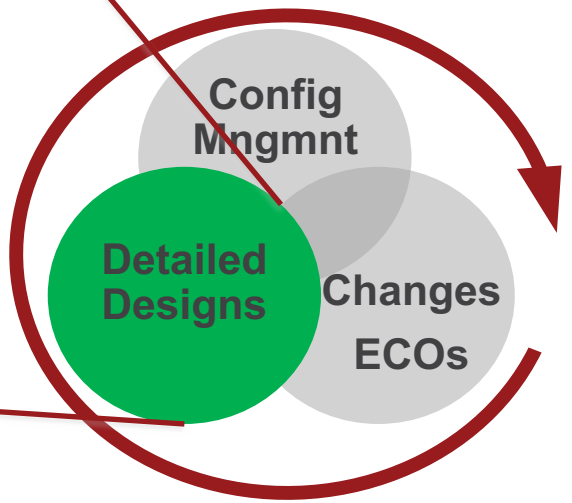
When system models and related requirements sit at the center of designs

… they become the connective tissue – and Digital Thread runs ***through*** them





PLM platform

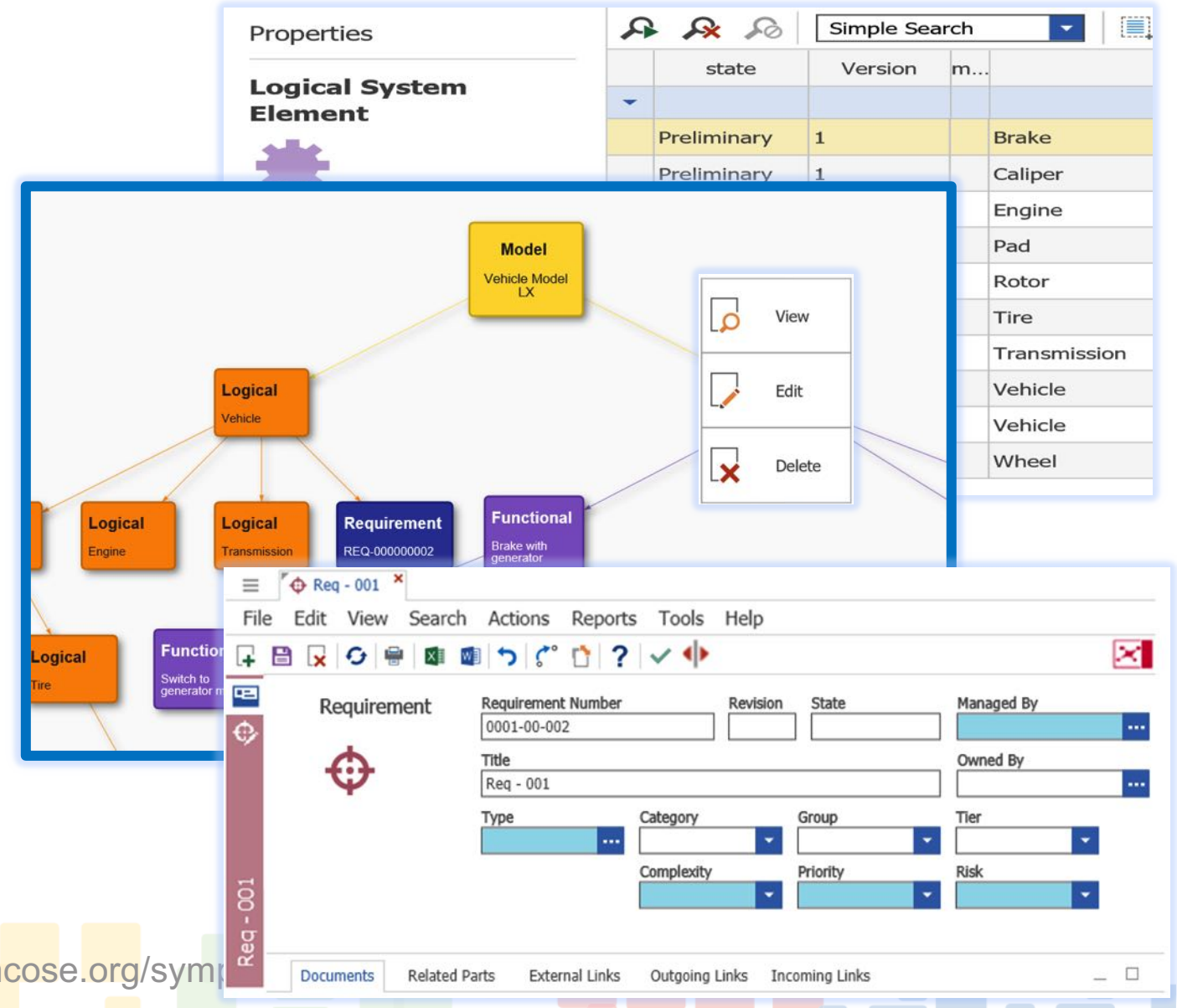


PLM and Systems Engineering

- Trade study and optimization of brake assembly
- Based on Aras Innovator PLM platform and No Magic MagicDraw SysML authoring tool
- Applicable to any SysML authoring tool like IBM Rhapsody or Vitech GENESYS

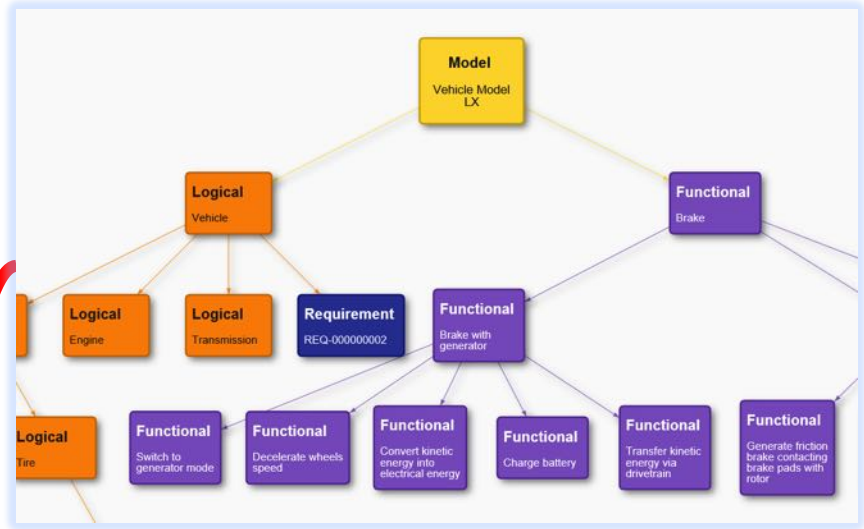
Early system definition in PLM

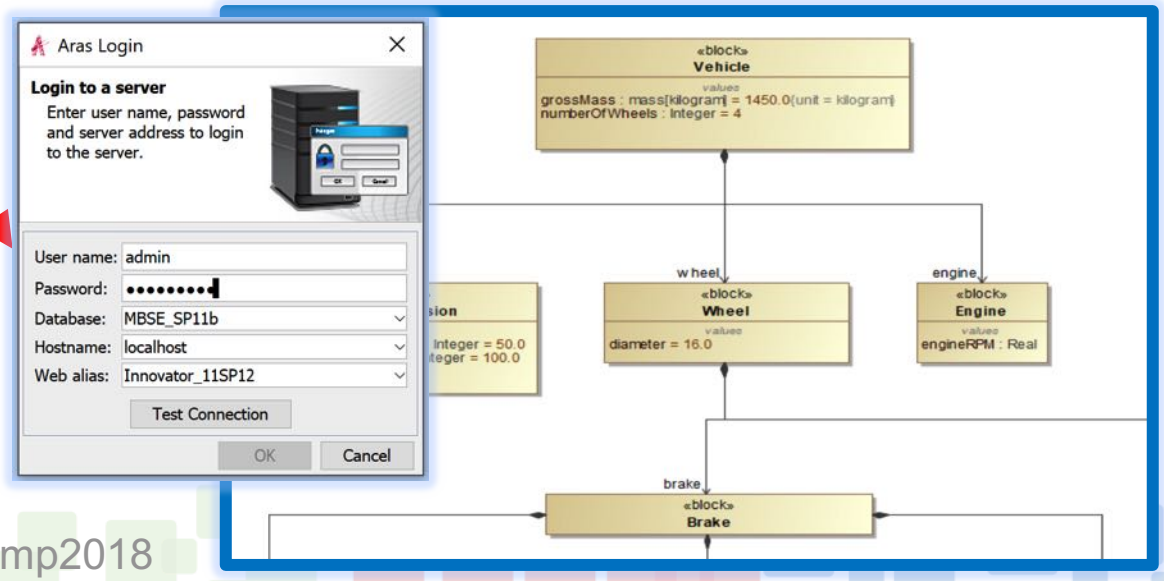
- Reuse of revision controlled system model elements
- Simple functional and logical break down
- Configuration and revision controlled data model
- Replaces simple documents like napkins, power point, and visio



Initiating detailed SysML model

- SysML tool user authenticates in PLM
- SysML authoring tool reads system structures from PLM
- Unique global IDs are on all model elements managed by PLM
- Systems Engineer continues developing a detailed SysML model
- SysML tool remains connected to PLM

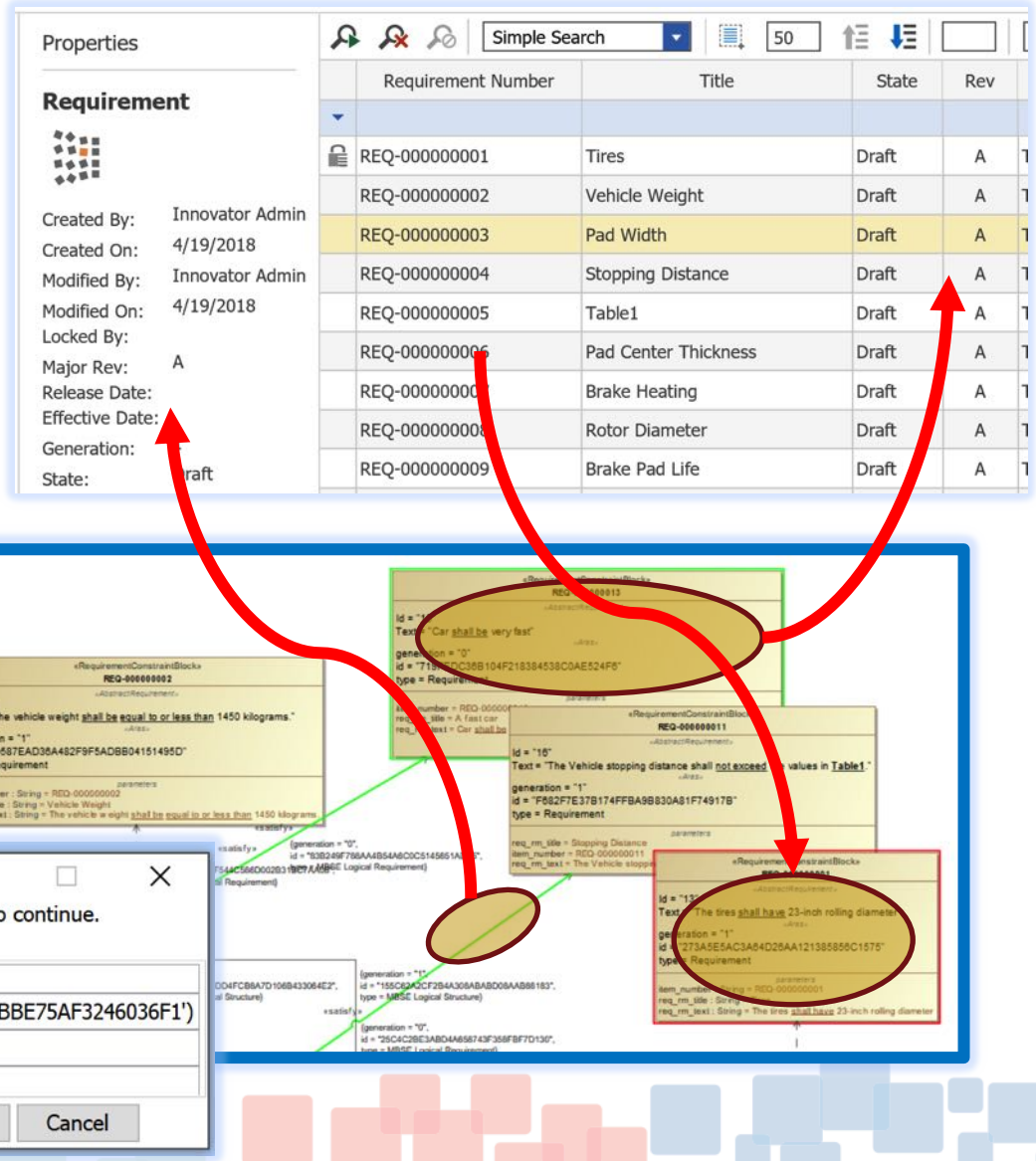




Synchronization of requirements

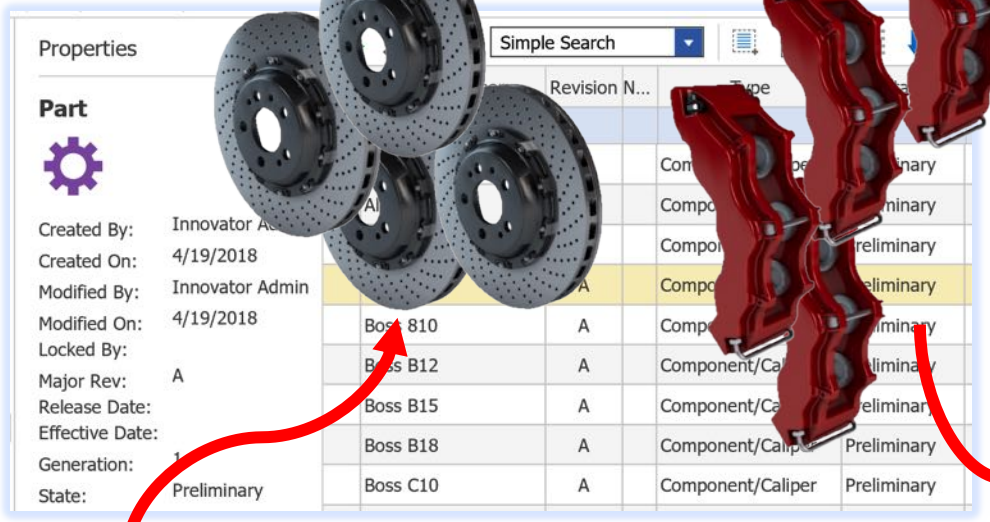
- SysML user manipulates parametrically-driven requirements at will
- Integration provides visual feedback regarding PLM status of SysML changes
  - Red -> modified from PLM (change)
  - Green -> not in PLM (create)
  - No color -> query from PLM (add)

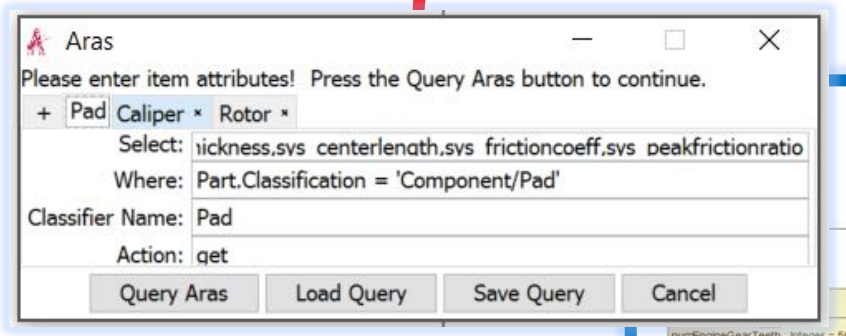
Step not in the published paper

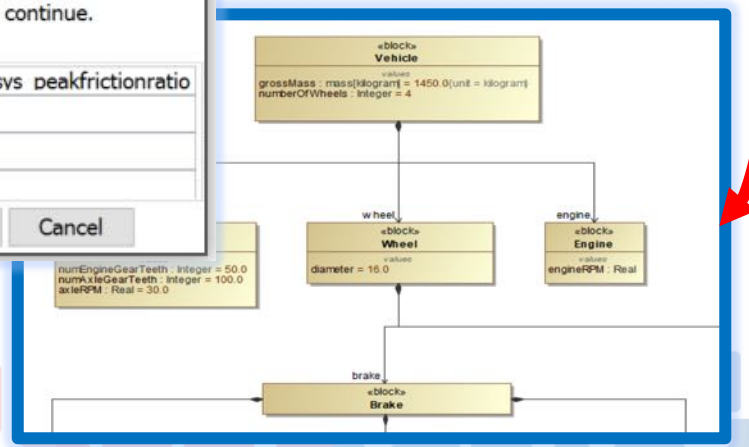


Reuse of PLM managed parts

- SysML interacts with PLM to find existing physical implementations
- Query is based on SysML defined parameters
- PLM provides SysML with physical implementation choices for a 150% system model
- Parts are added but not connected



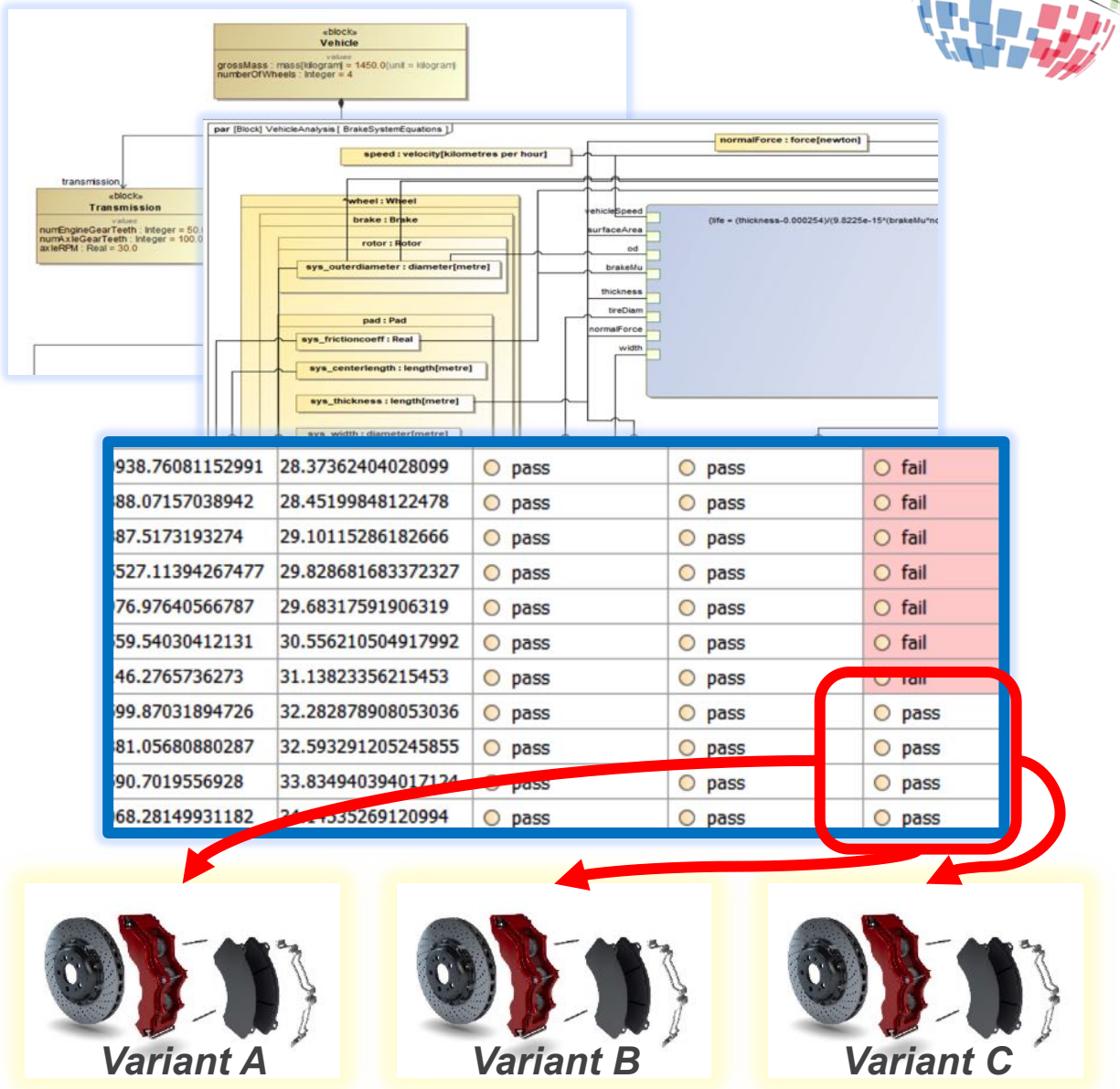




Trade Study

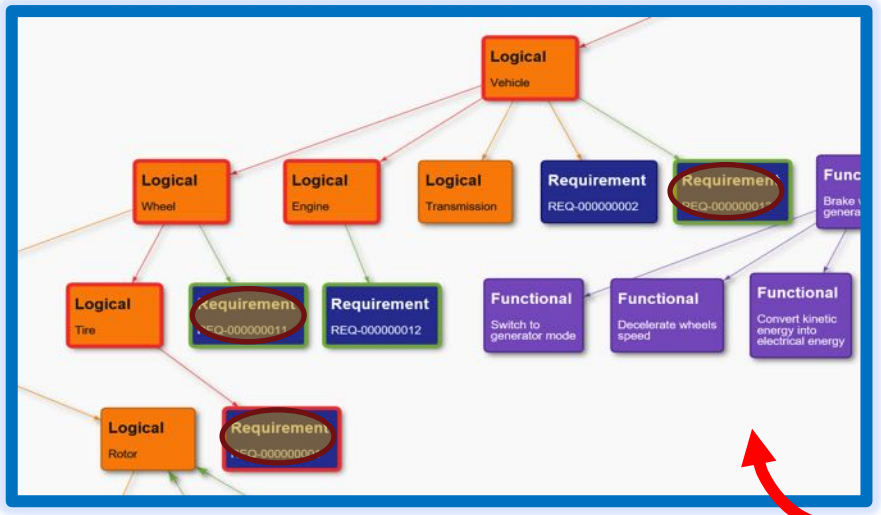
- Part variant table is auto-generated
- SysML runs various parametric studies on the model
- Results are based on reusable parts dynamically identified in PLM
- Studies identify valid implementation variants for the 150% SysML model

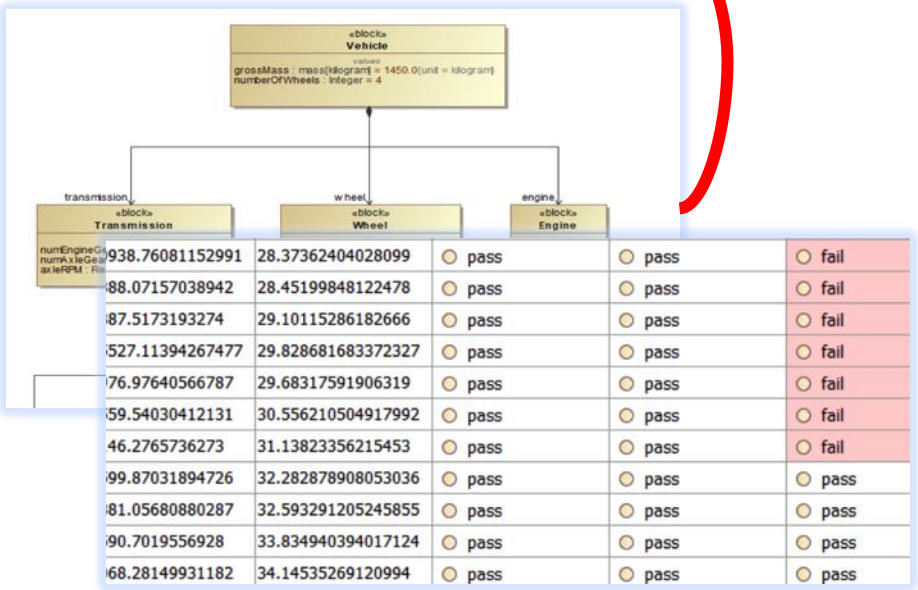
*) MagicDraw tool can stage auto execution of trade studies from SysML parametric diagrams



Updating PLM

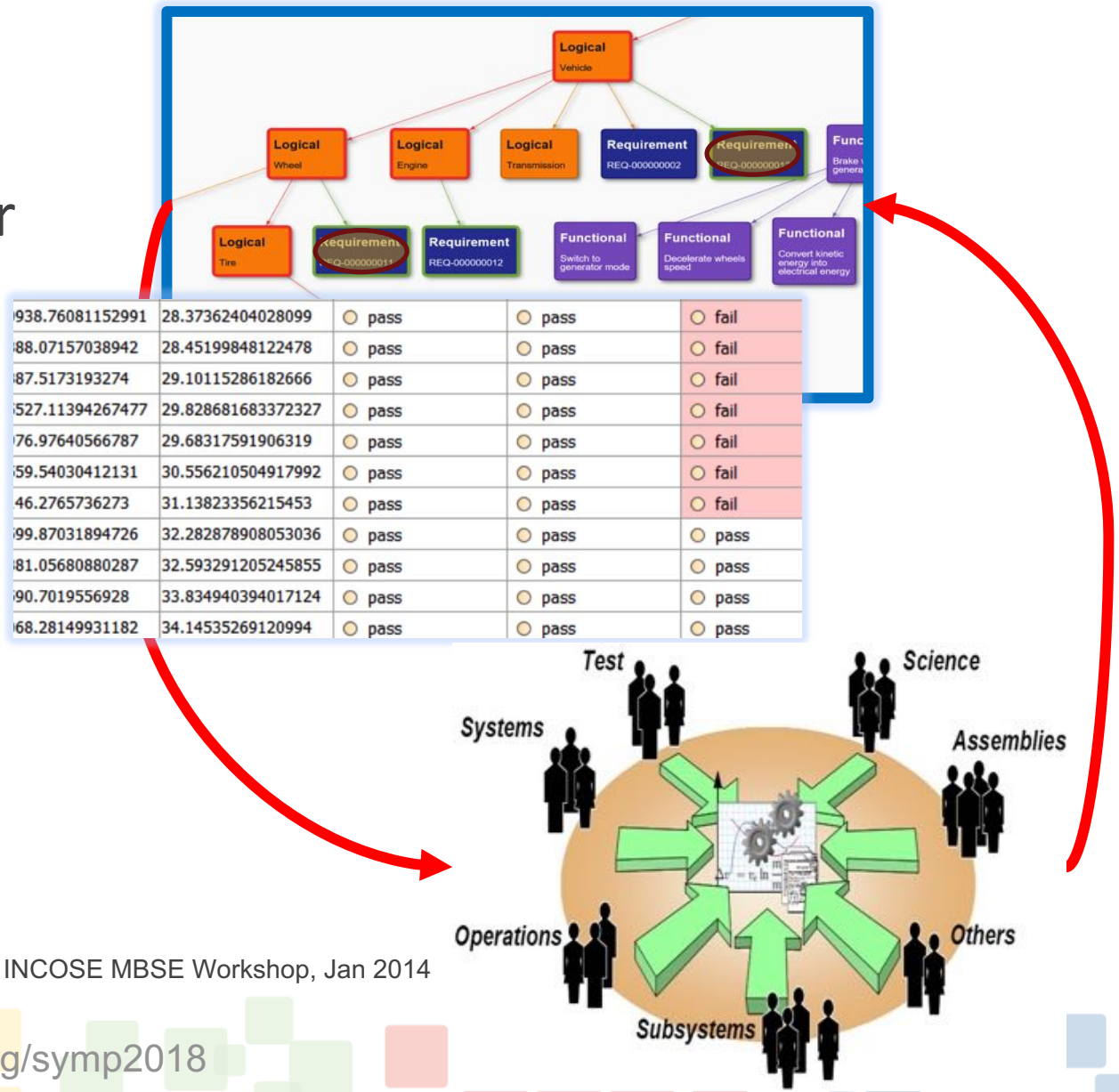
- Evolved SysML model updates system models managed by PLM
- Global IDs allow revision control of the model and model elements





Collaborating in PLM

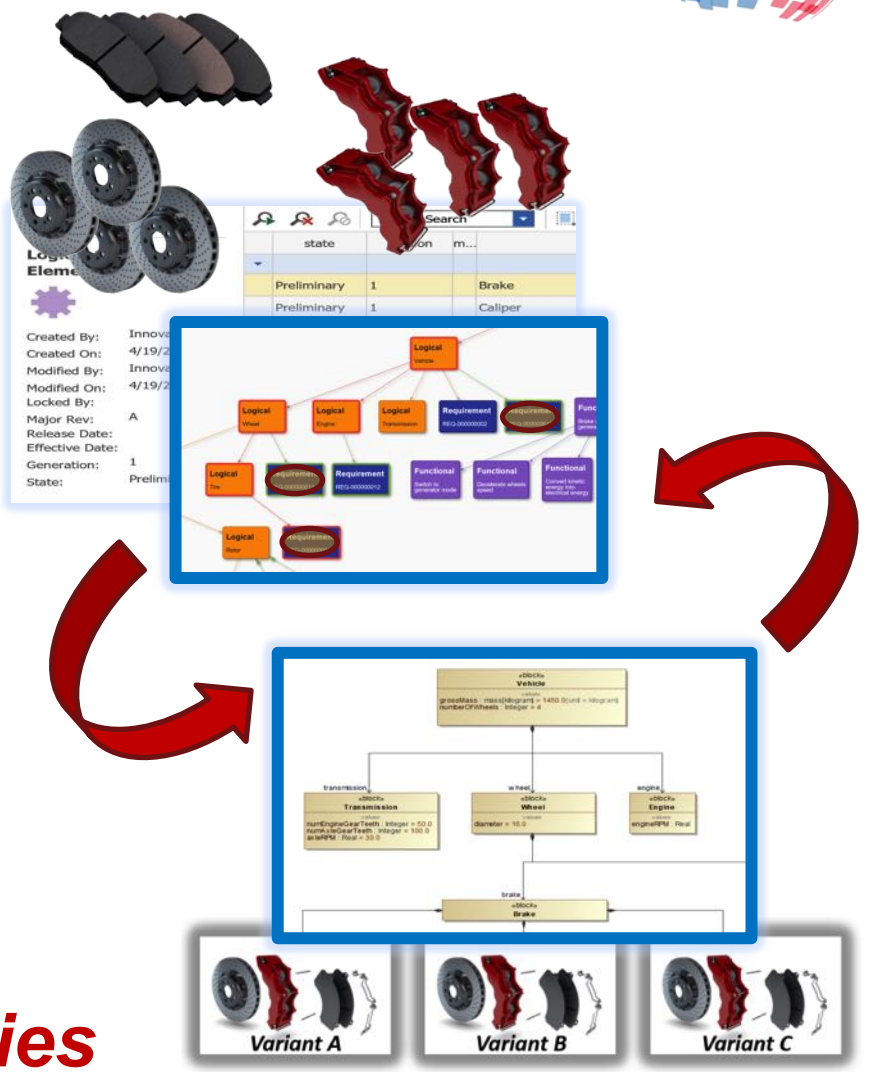
- PLM is a platform for exposing latest versions of the system model to a larger team of engineers
- Collaboration can involve discussion threads, visual annotations, and selection of implementation variants
- SysML trade study drives definition of PLE (Product Line Engineering) rules



Source: INCOSE MBSE Workshop, Jan 2014

Key Take-Aways

1. Making system model part of PLM traceability
2. Initiating SysML model from PLM managed system models
3. Sync of SysML parameter driven requirements with PLM
4. Dynamic reuse of PLM parts in SysML
5. Deriving physical PLM variants from a 150% SysML model
6. Revision control of selected SysML structures in PLM
7. Collaborating on model-driven PLE solutions (Product Line Engineering) in PLM



Without constraining SysML authoring activities

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Questions?

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Video: https://youtu.be/HPIWyS0vgr0