

INNOVATION
WITHOUT LIMITATION

Beyond ECAD (and MCAD) Connectors

Pawel Chadzynski

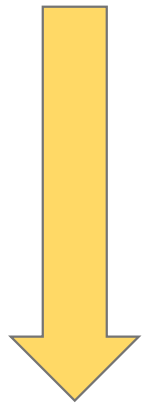
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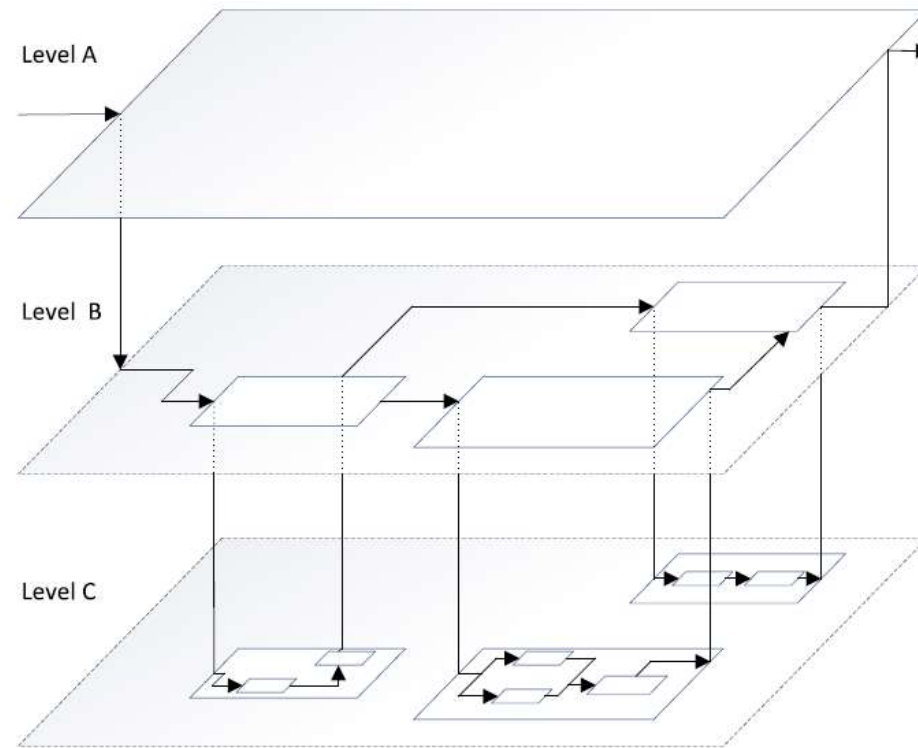
Business Of Engineering

Full lifecycle management of Complex Systems
Closing traceability gaps & preventing them from occurring

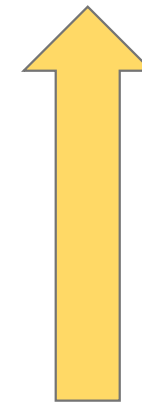
Systems Engineering
decomposition



Links to a
domain structure



Links to the
Systems Engineering
decomposition

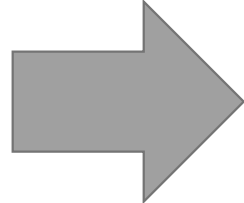


Domain
structure

Fig. 1 – Systems Engineering Abstraction levels (SE Grundlagen und Anwendung / Haberfellner et. Al.)

Old way - Passing around SE documents

Not connectable!
Not traceable!



The collage consists of five images arranged in a cluster. At the top left is a 3D model of a yellow sports car with a white label 'MCAD'. To its right is a person sitting in a car seat using a laptop, with a white label 'Testing'. Below these is a screenshot of code with a white label 'ALM'. At the bottom left is a computer monitor displaying a 3D model of a mechanical part, with a white label 'ECAD'. At the bottom right is a photograph of a factory floor with yellow robotic arms, with a white label 'Manufacture'.

New way - Connecting with MBSE models



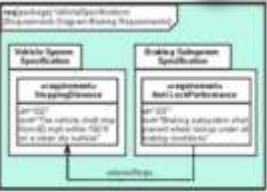
1. Structure

2. Behavior

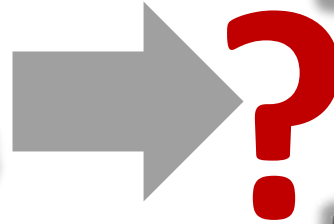


3. Requirements

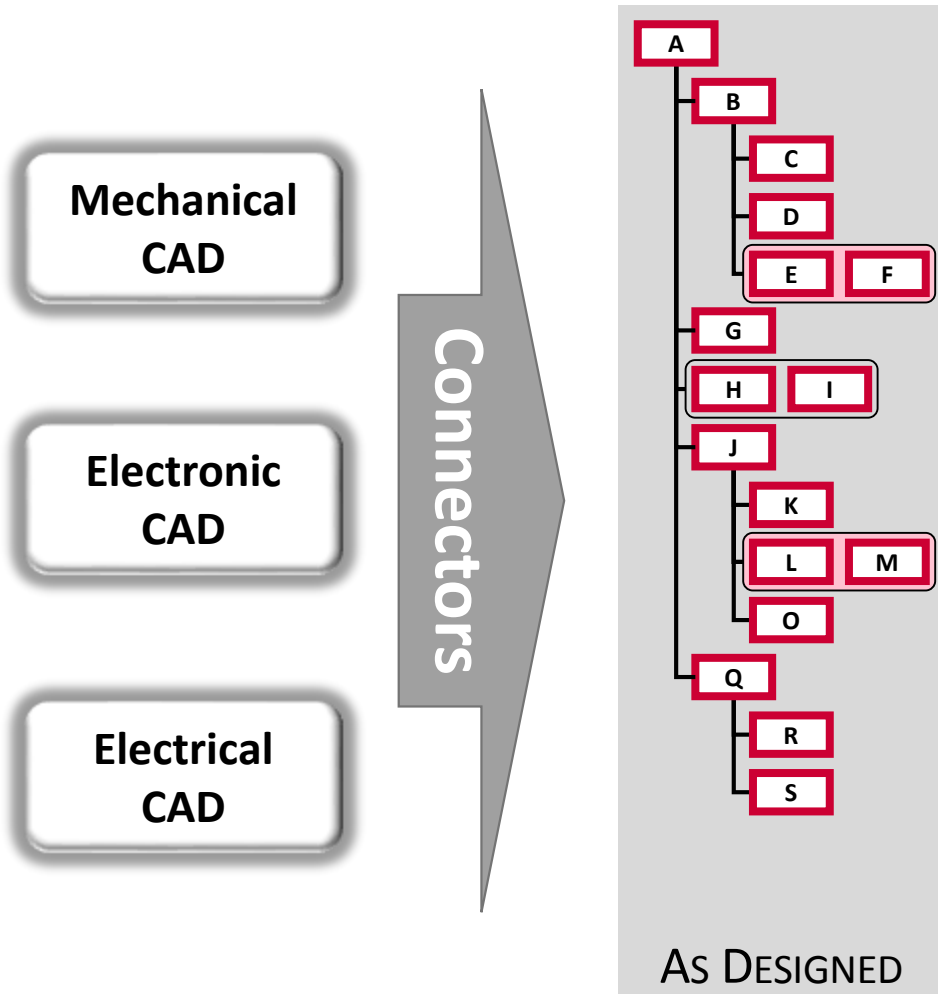
4. Parametrics



But how!

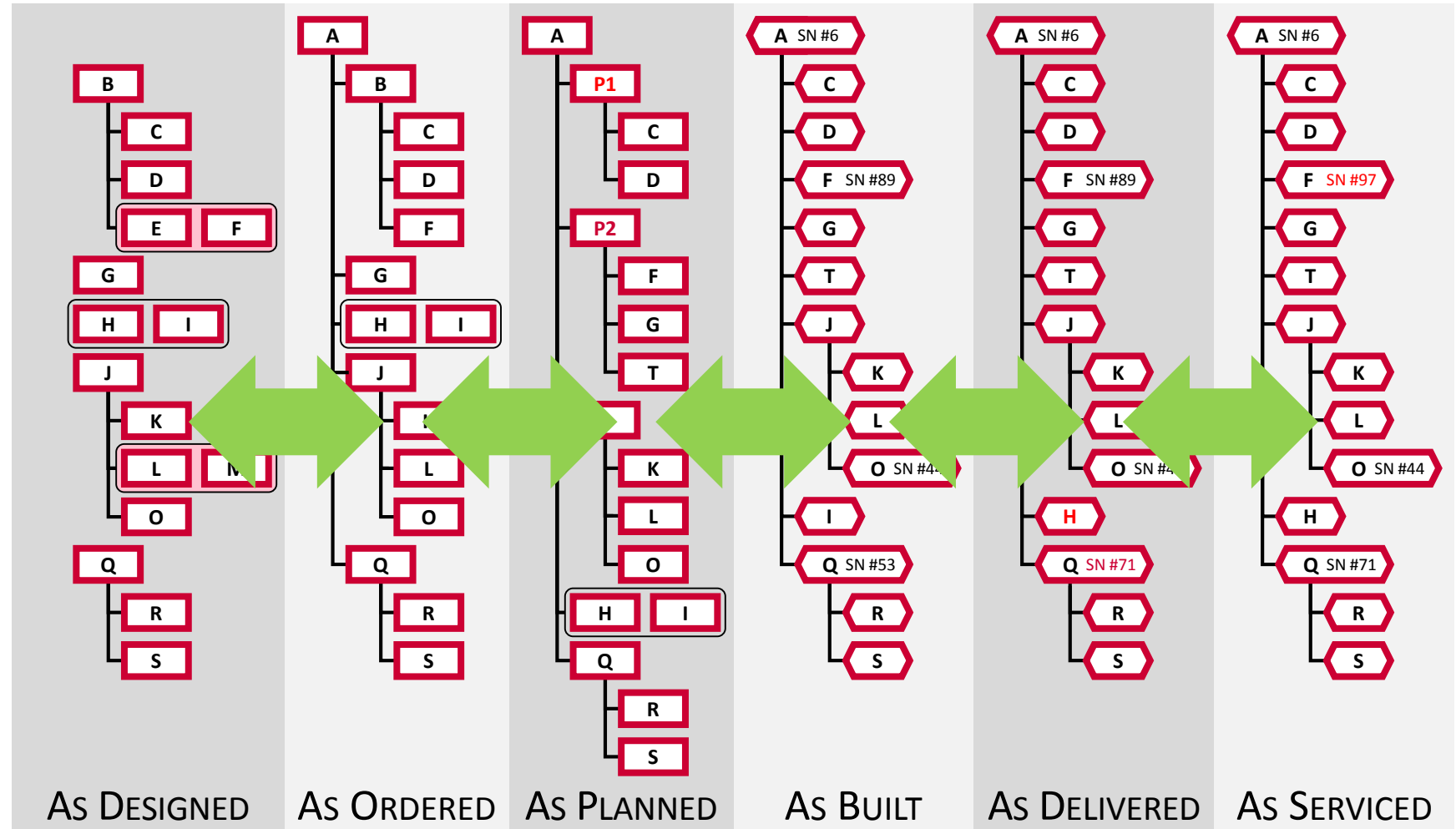


PLM Connectors

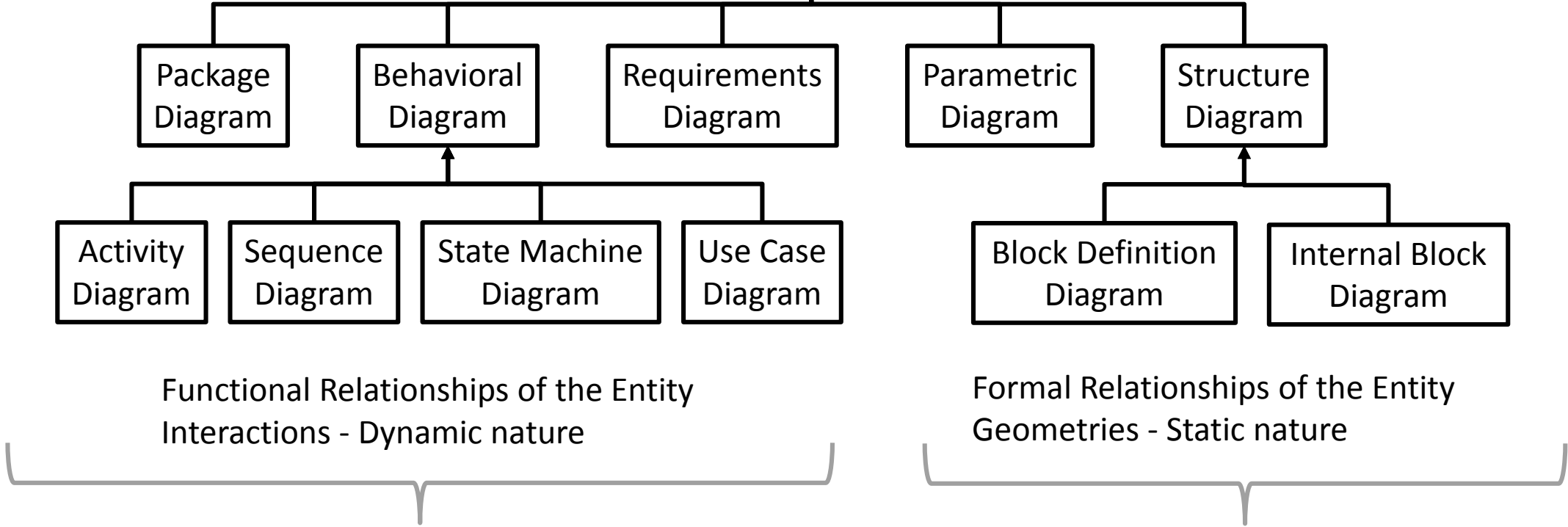


PLM Physical structures & Traceability

Physical structures already evolve and stay in today's PLM - with strong configuration and change management control



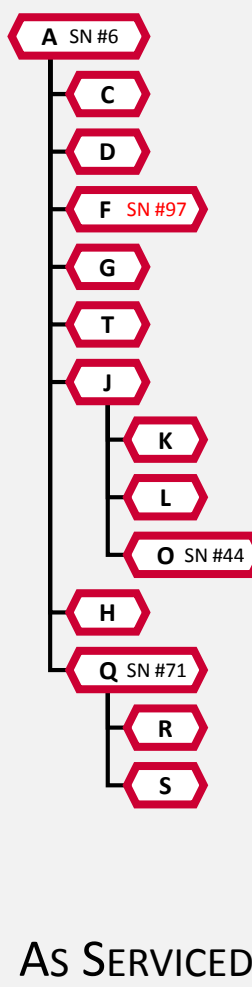
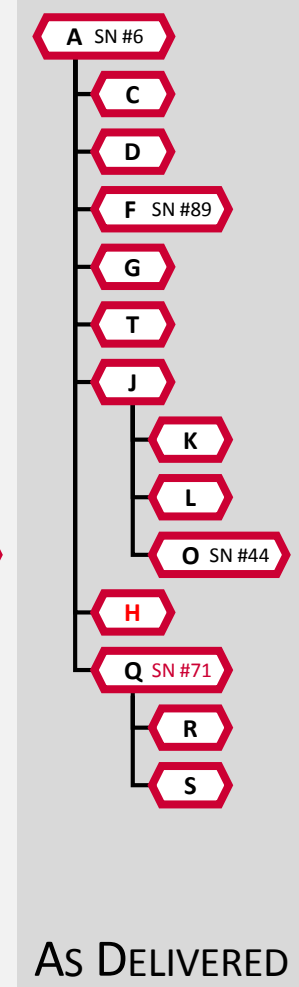
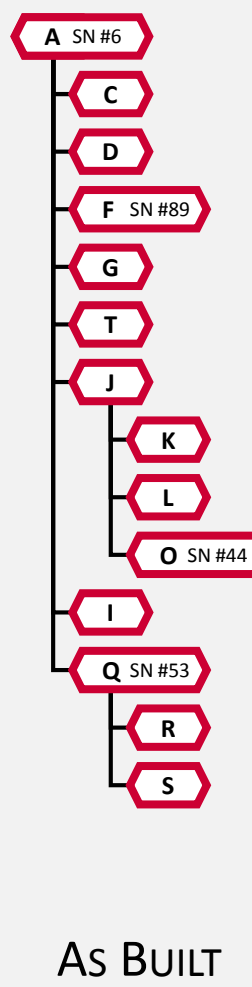
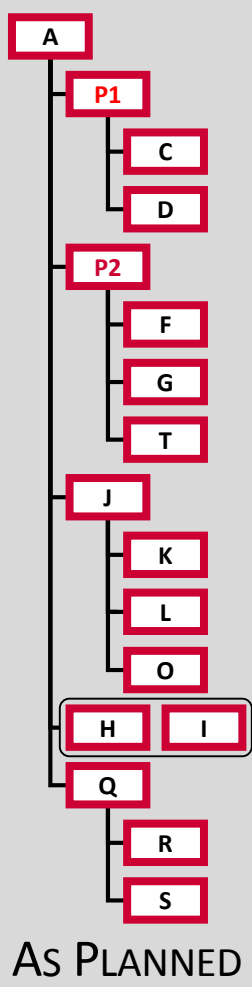
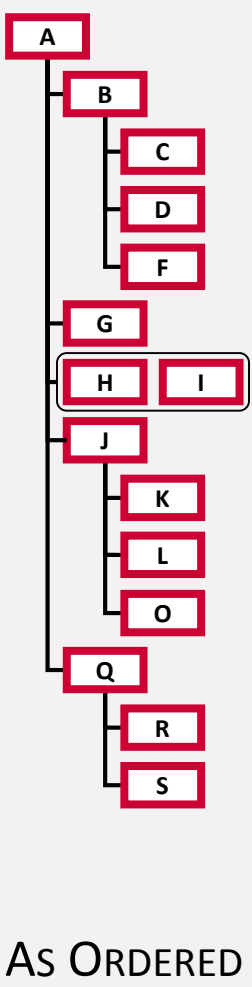
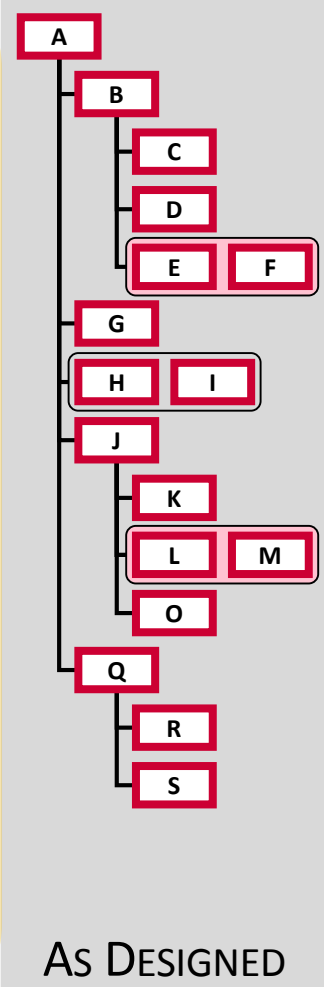
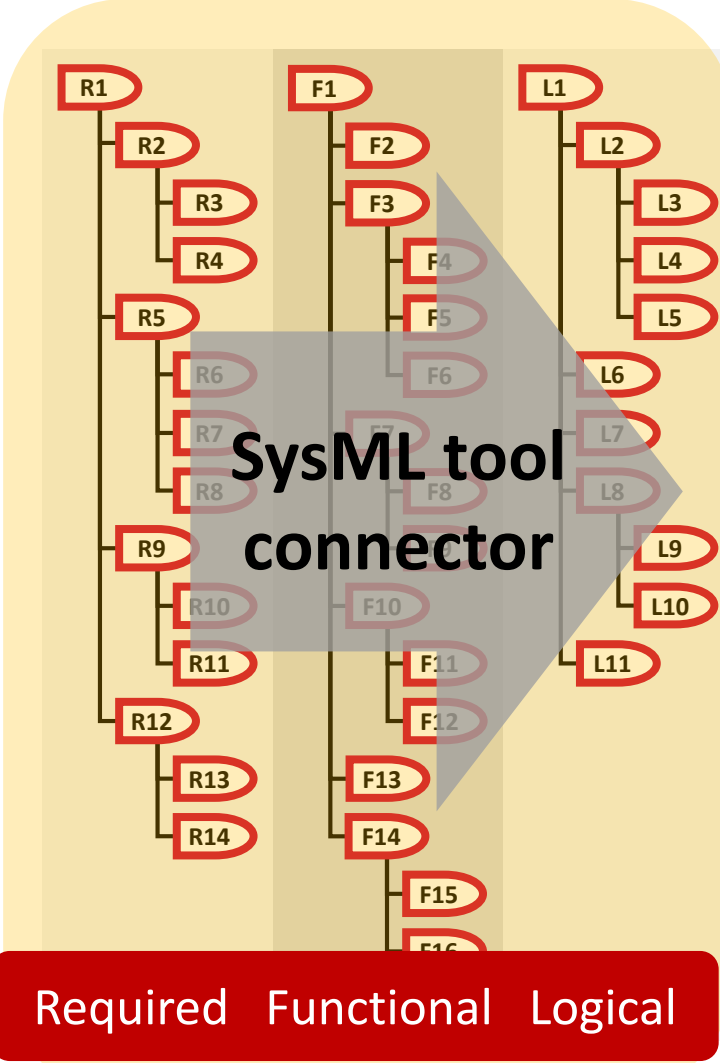
SysML structure



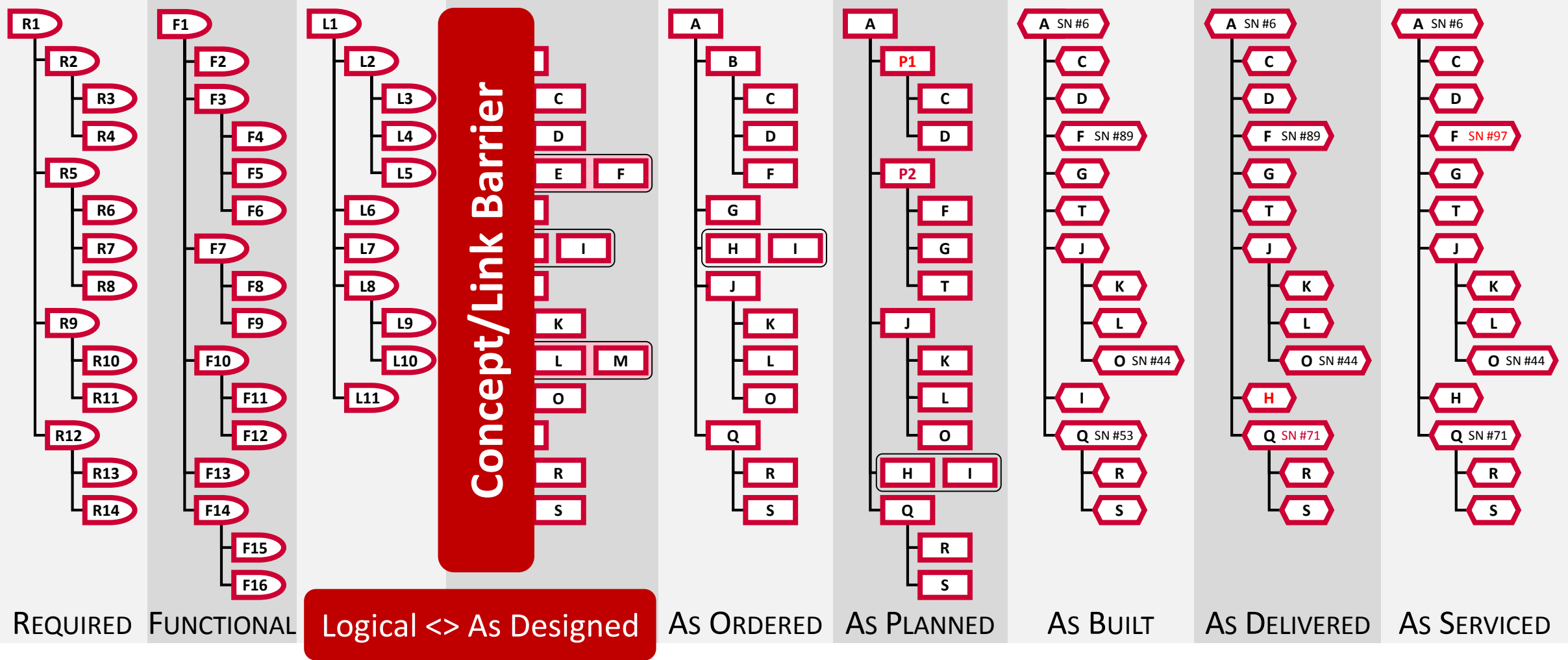
*Behavior is the System Model **driver** - Increases in importance with System complexity*

System Model influencer – Contributes to but does not drive System Design

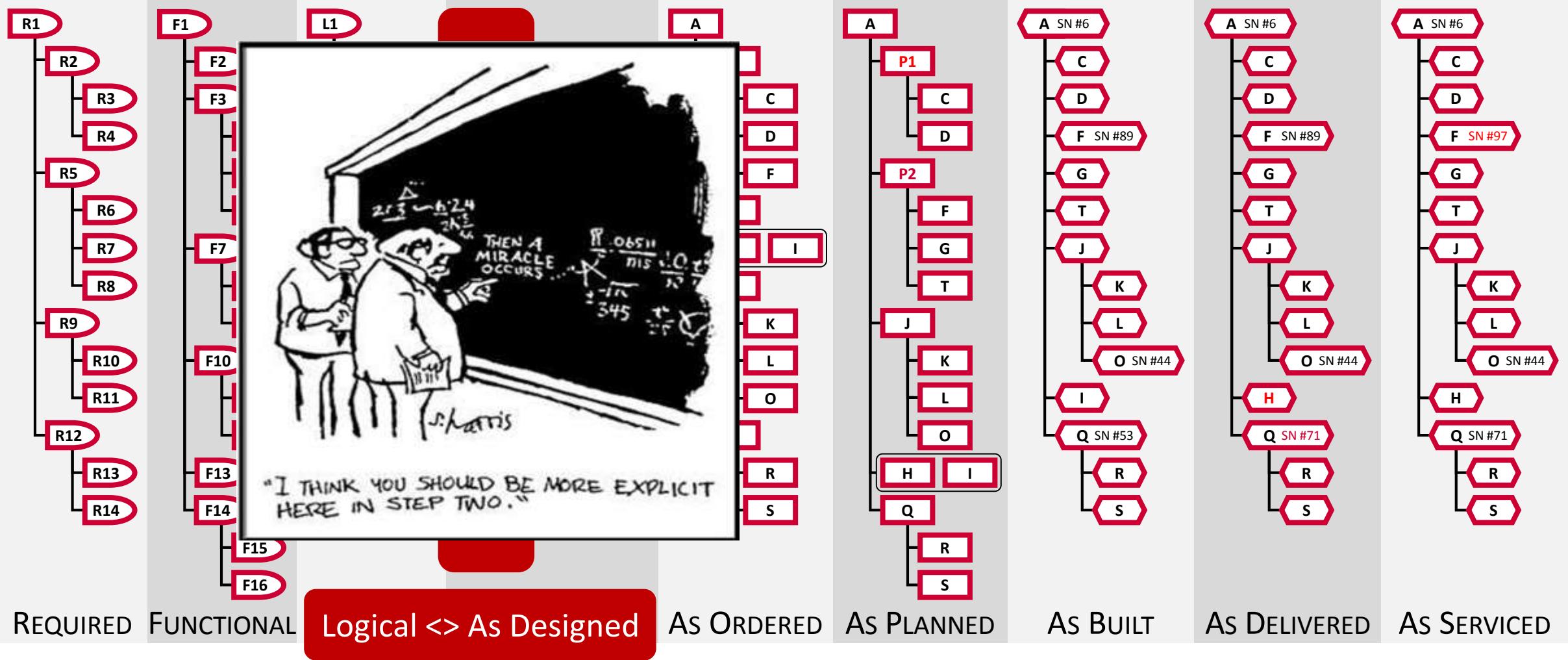
System Model structures in PLM



Traceability gap



Traceability gap

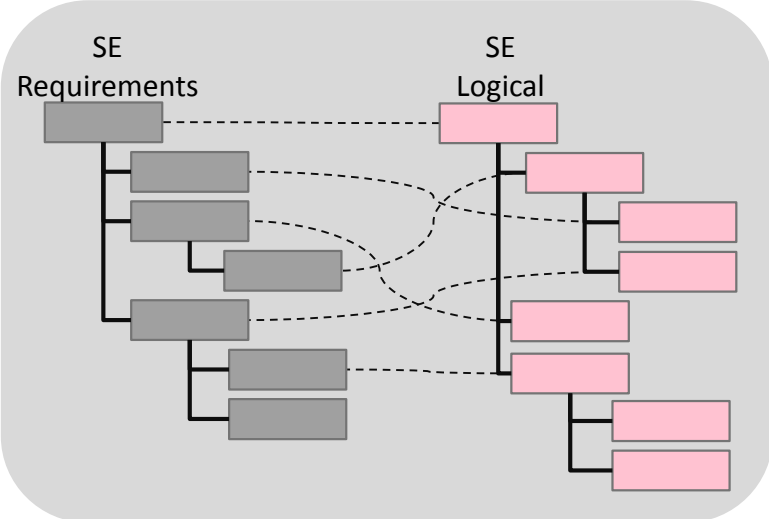
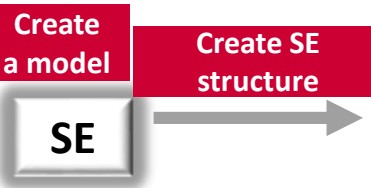


Add SysML structures

SE/MBSE

PLM –Product and MBSE

ALM/CAD/MBSE



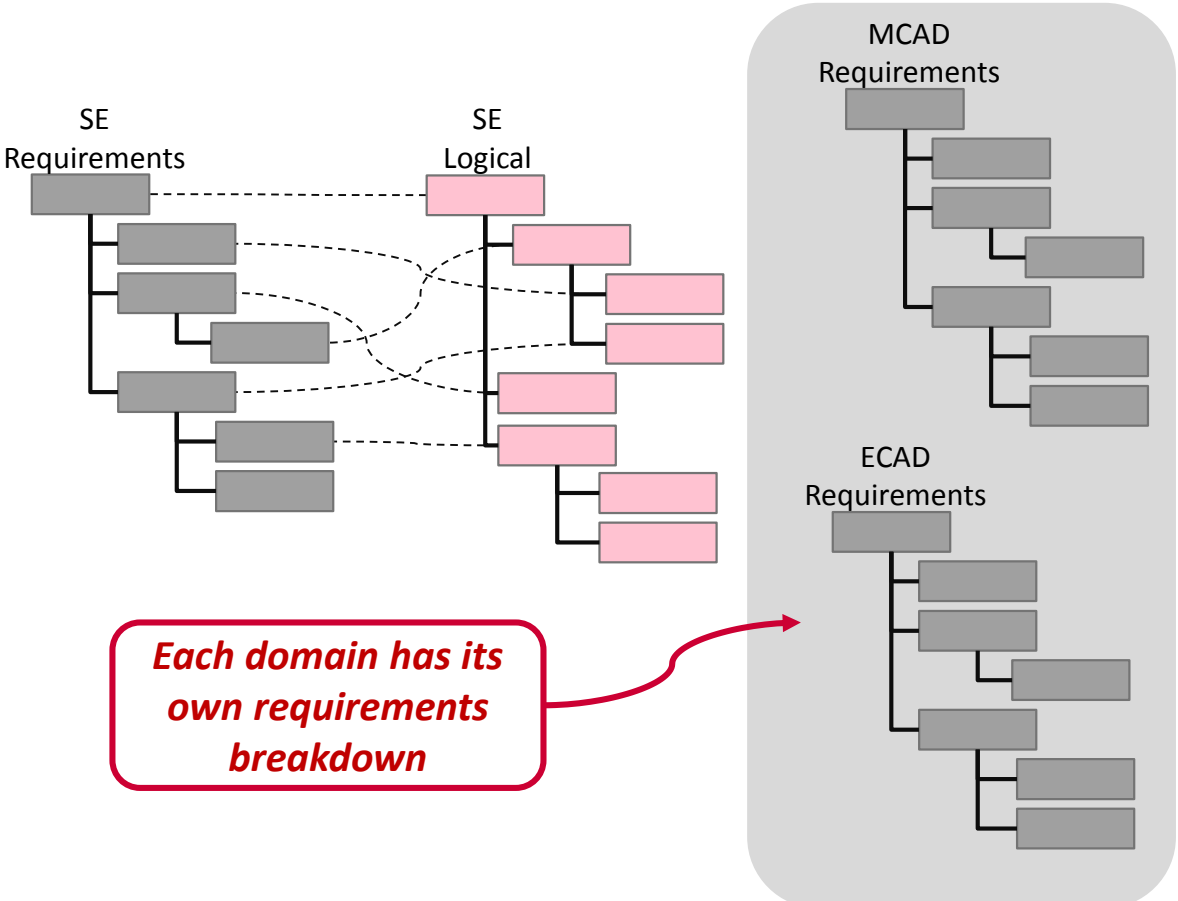
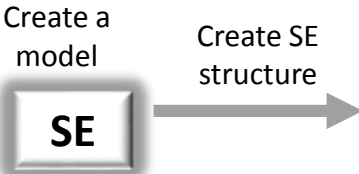
Created by connector

Add Requirements decomposition

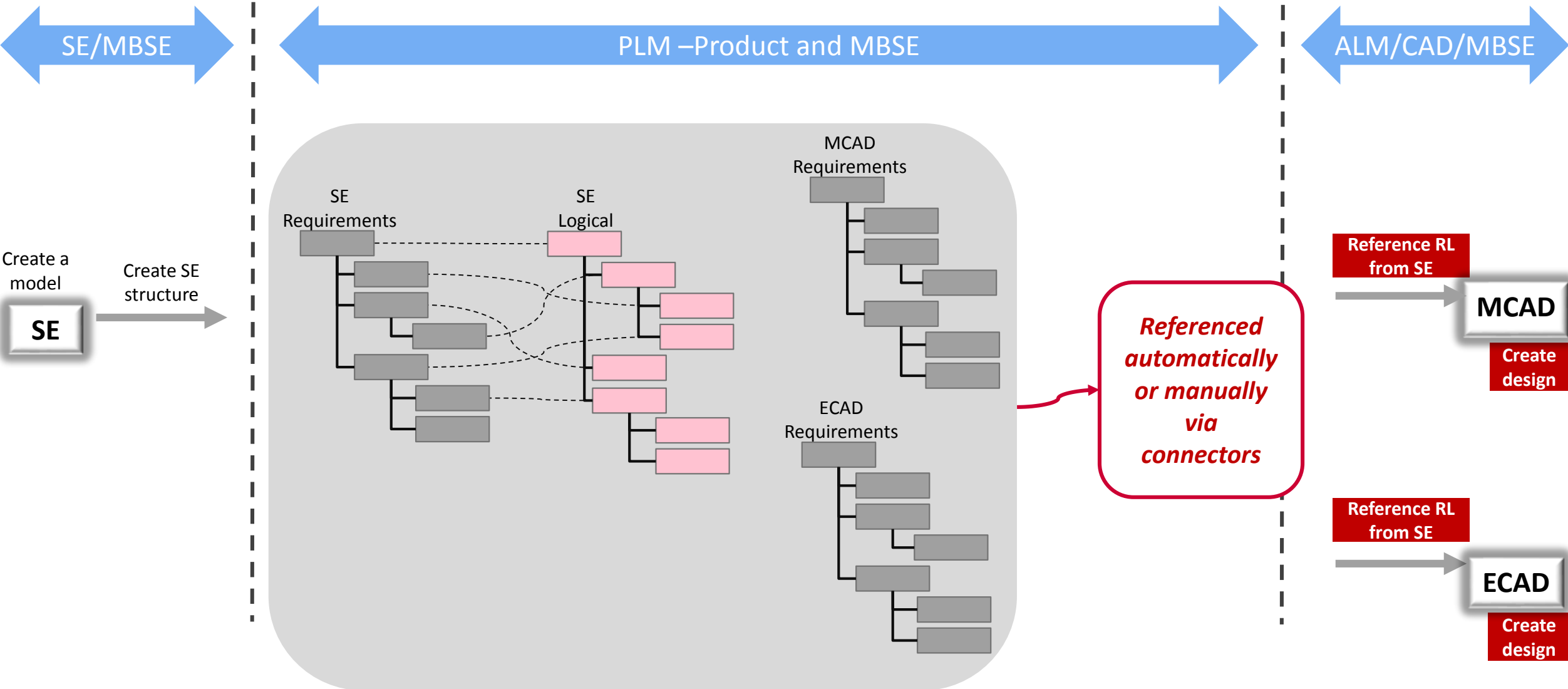
SE/MBSE

PLM –Product and MBSE

ALM/CAD/MBSE



Drive detailed designs



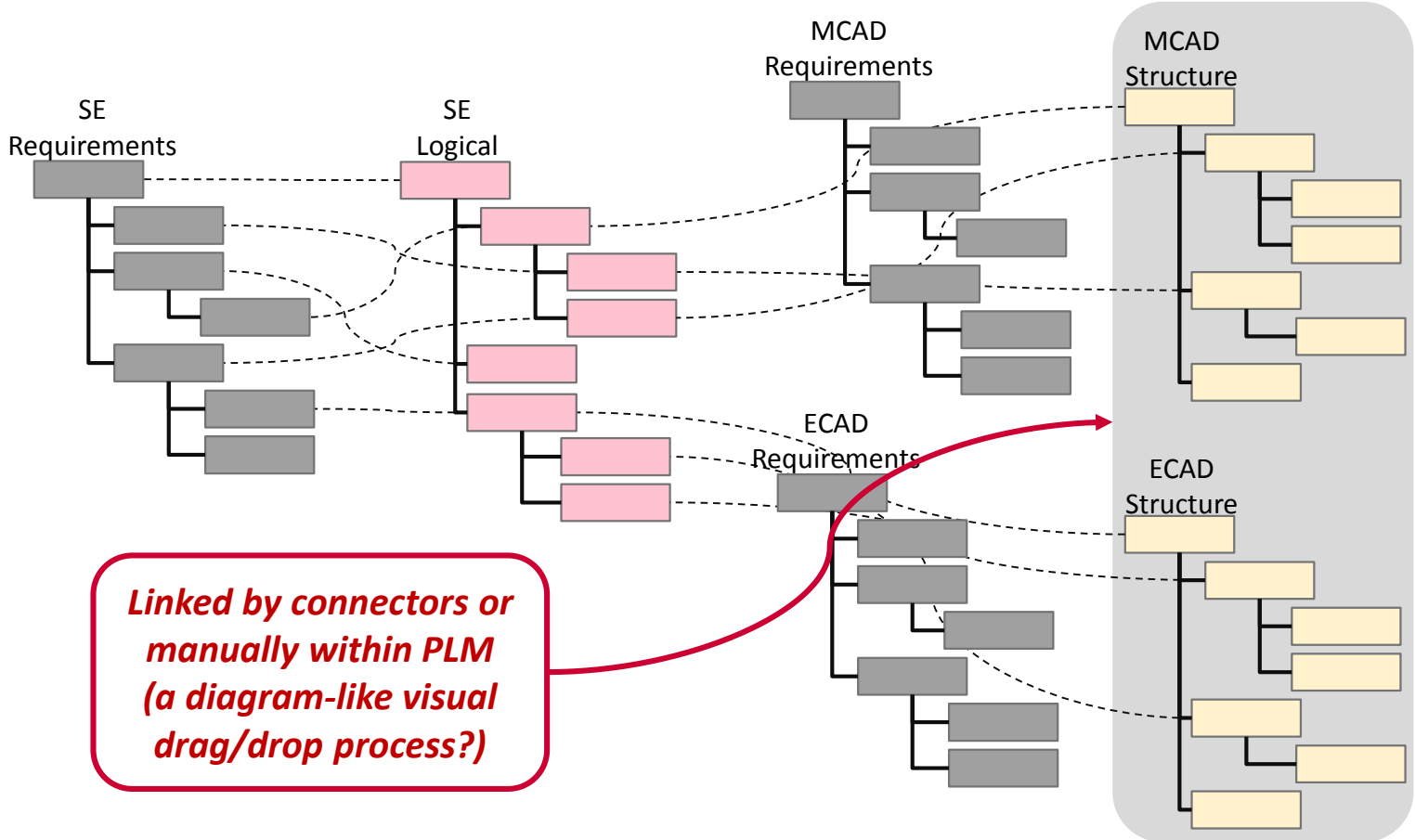
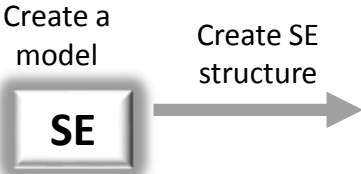
Add Logical to Physical



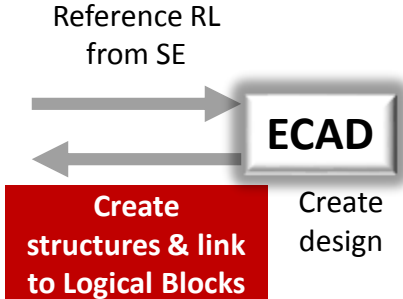
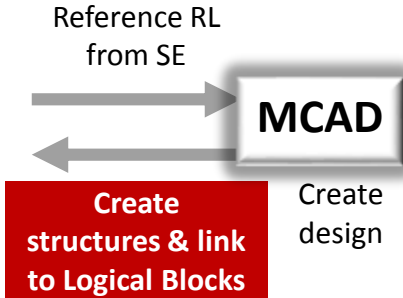
SE/MBSE

PLM –Product and MBSE

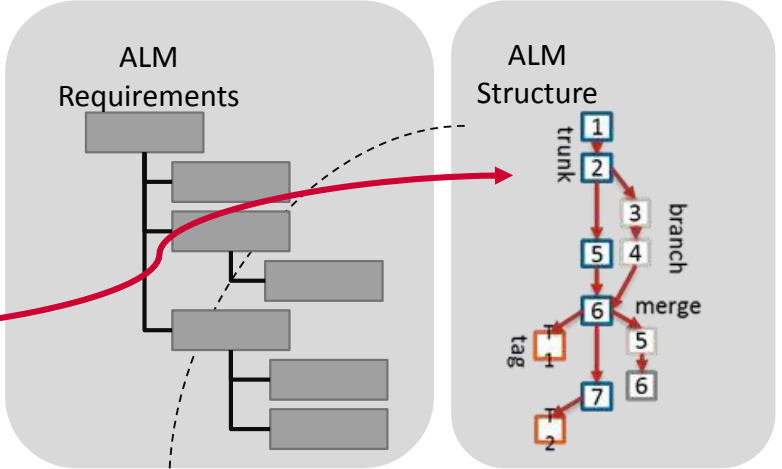
ALM/CAD/MBSE



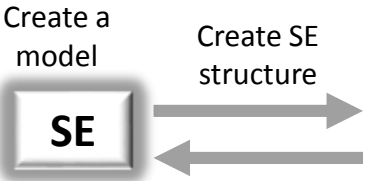
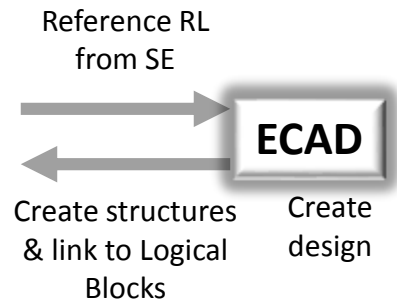
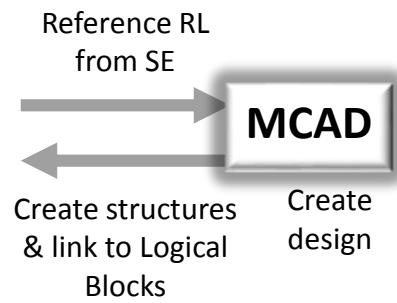
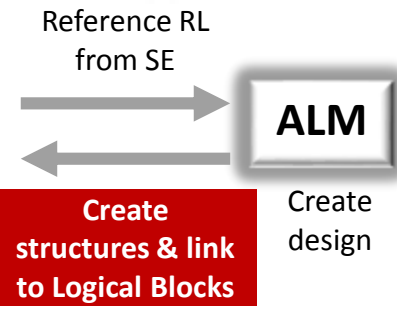
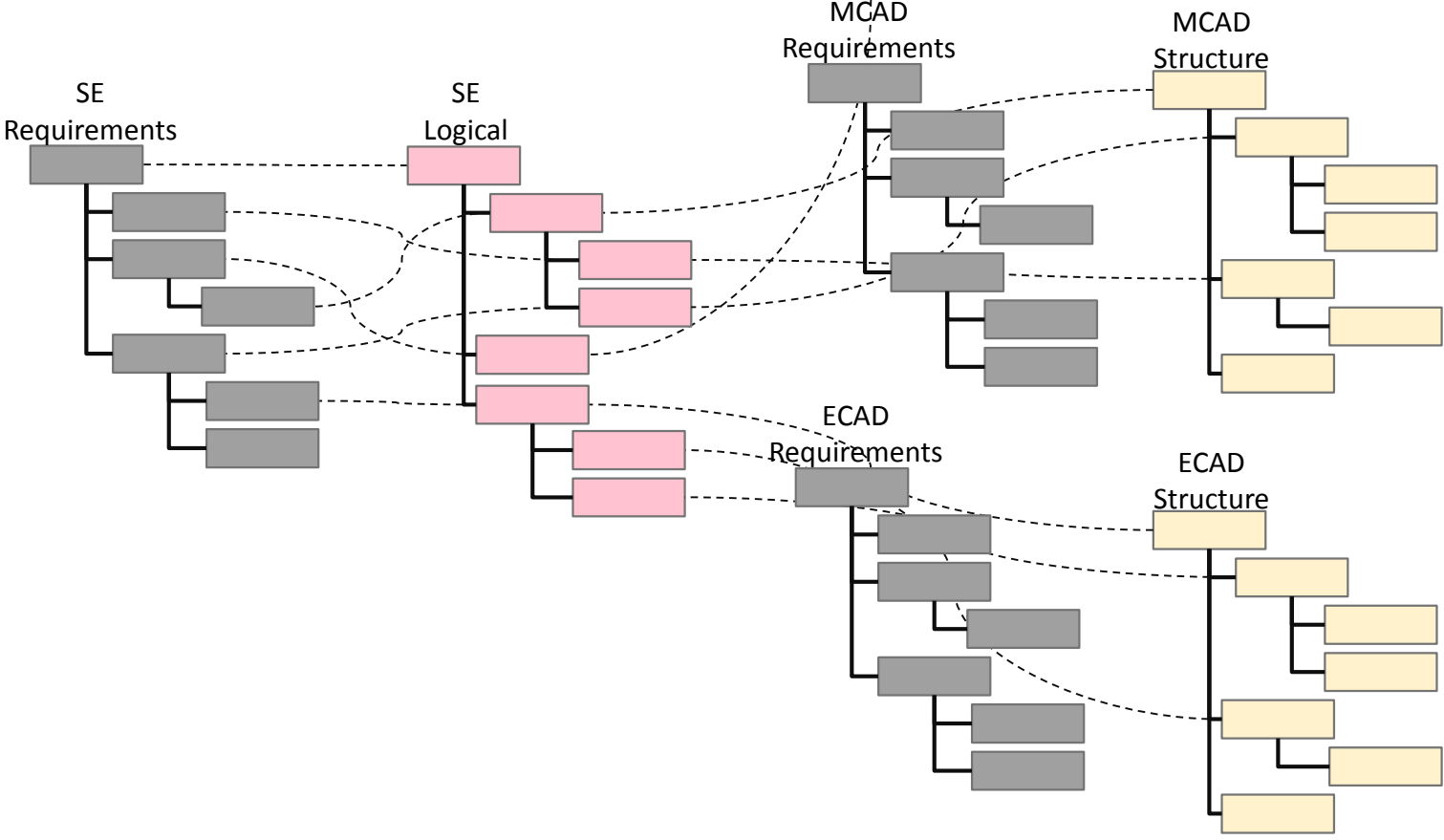
Linked by connectors or manually within PLM (a diagram-like visual drag/drop process?)



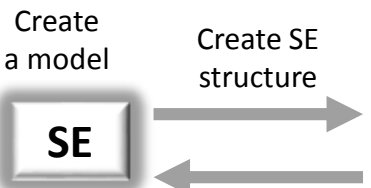
Add AML/Software



Not really "physical"



Add multiple models

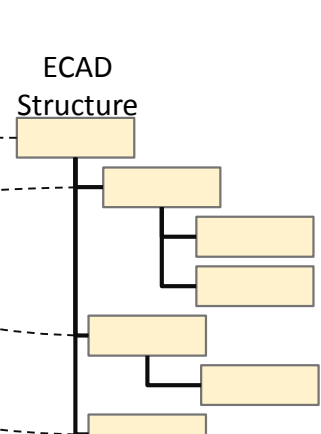
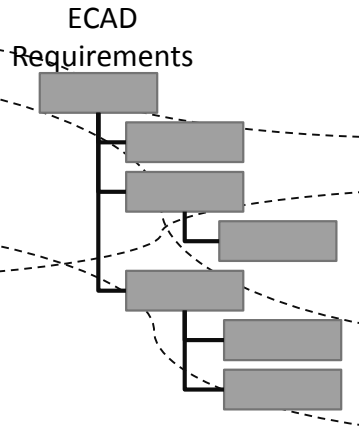
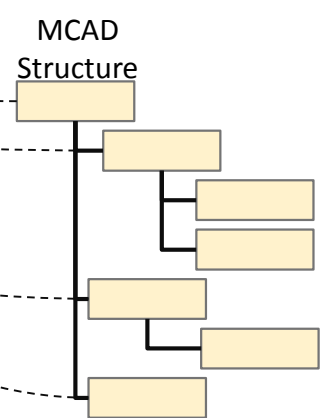
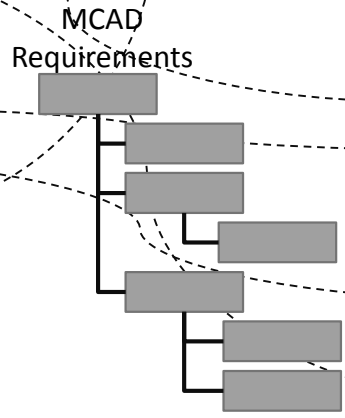
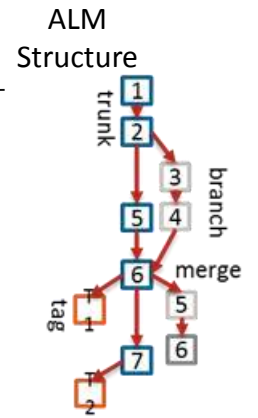
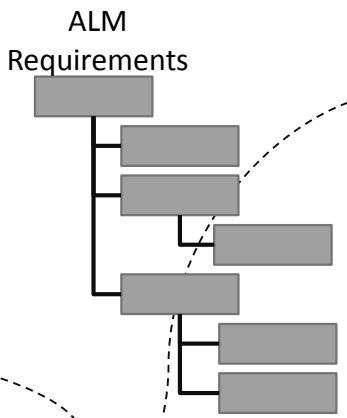
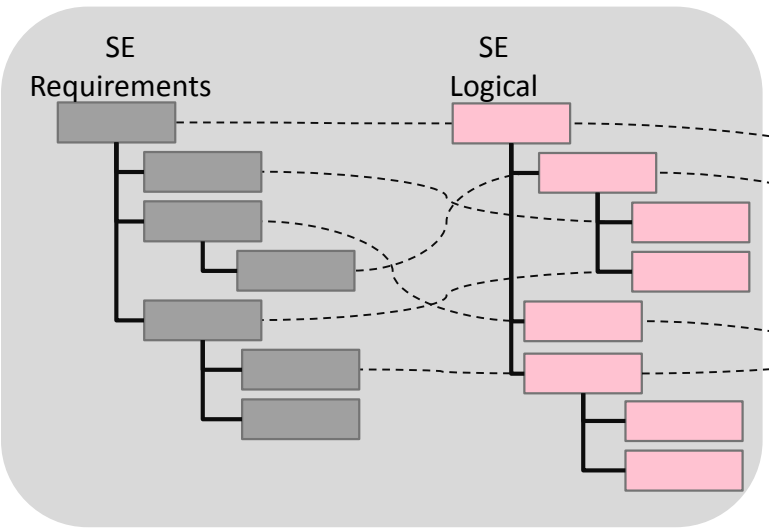
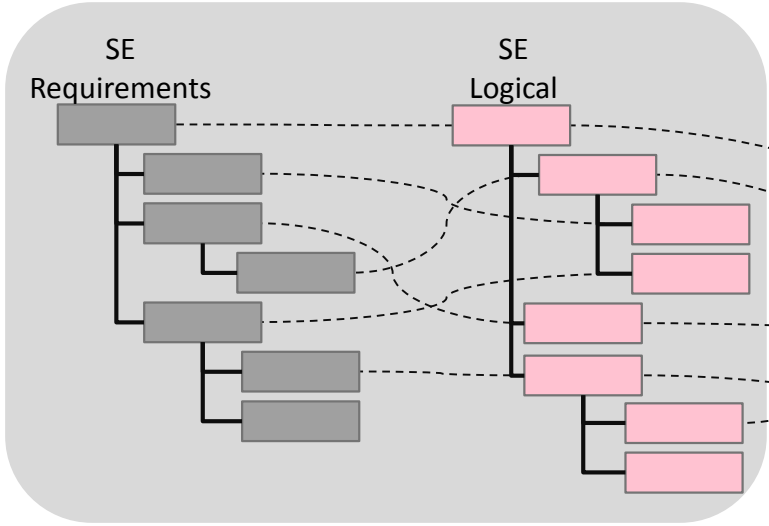


Reference domains

Multiplicity of SE models as part of the same PLM structure



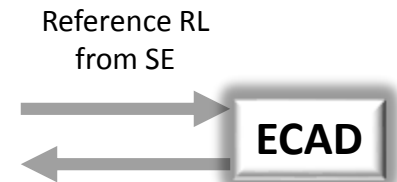
Reference domains



Create structures & link to Logical Blocks

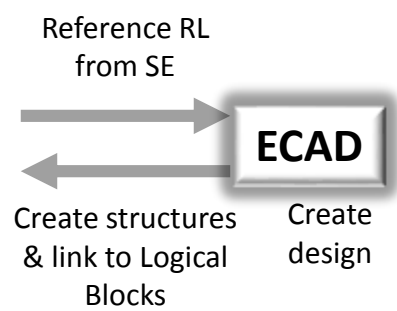
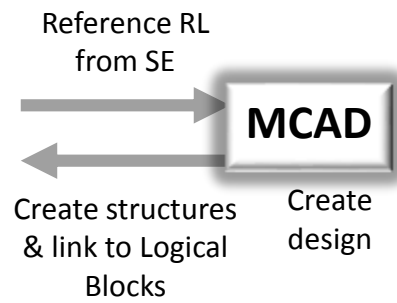
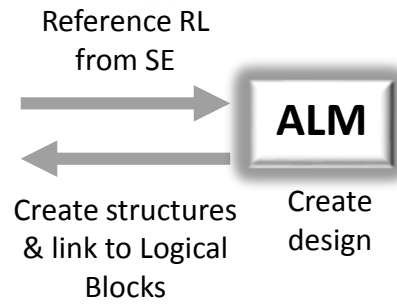
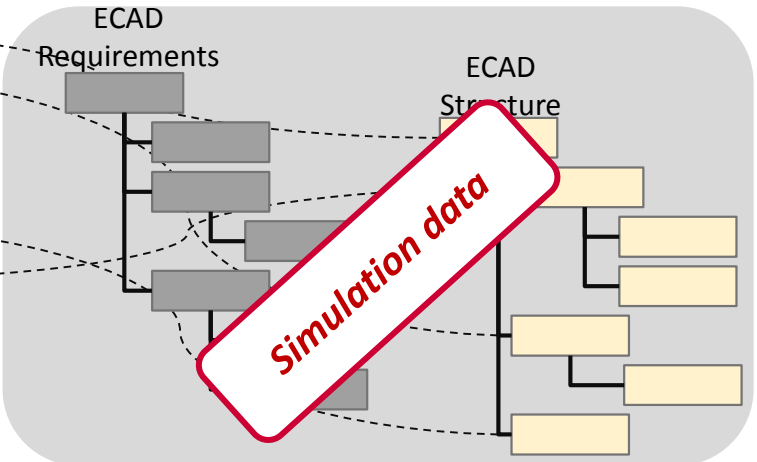
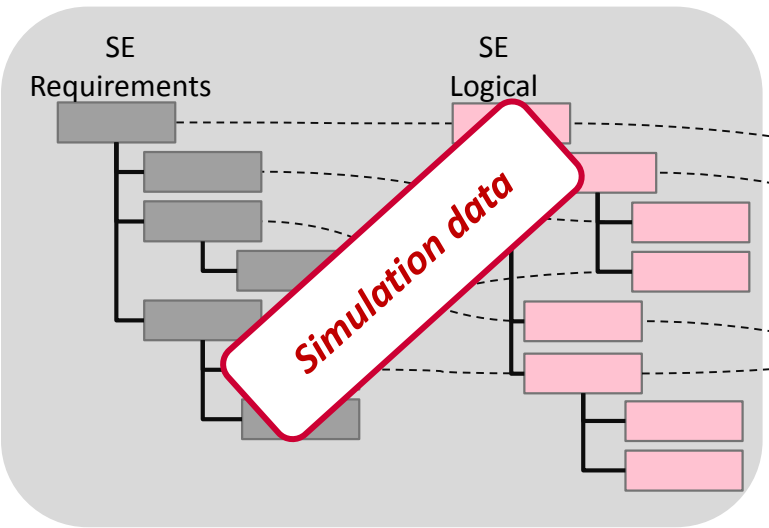
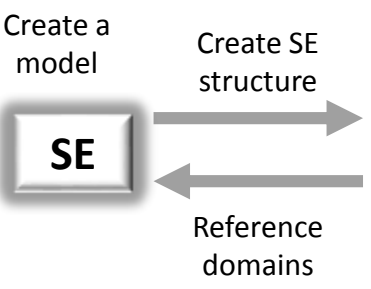
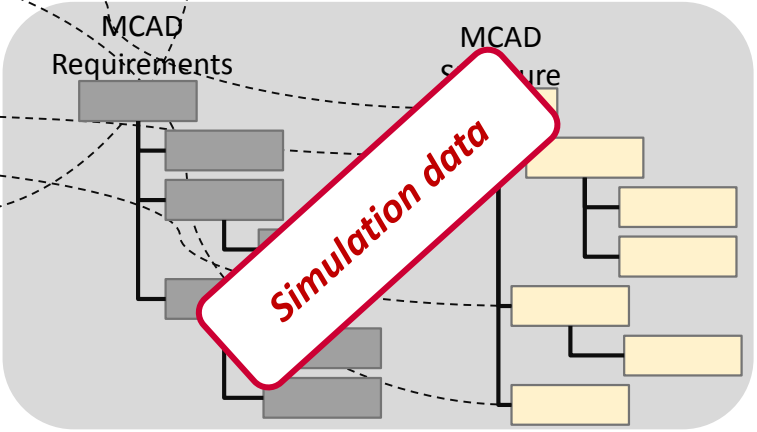
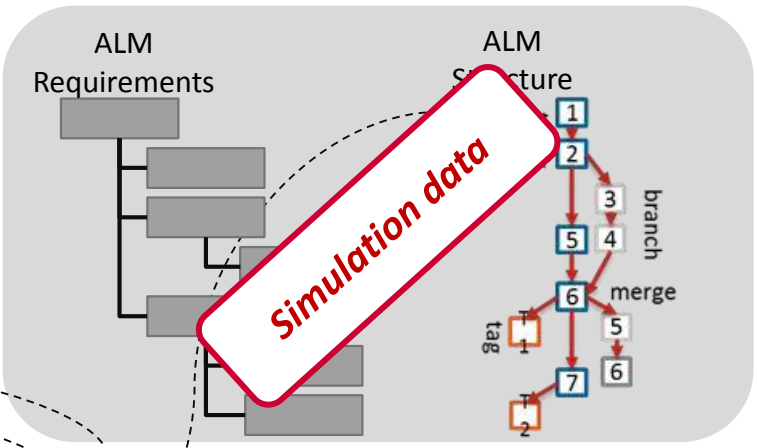
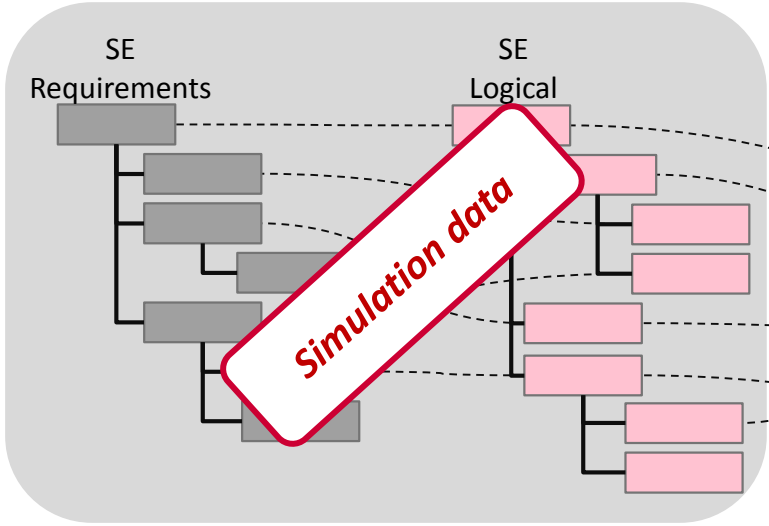
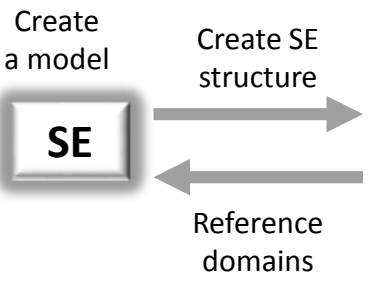


Create structures & link to Logical Blocks

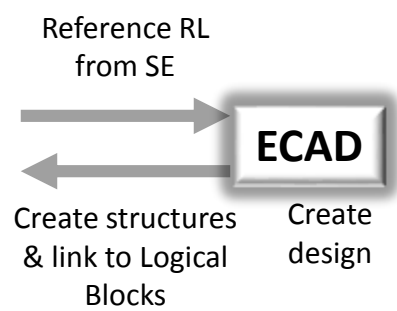
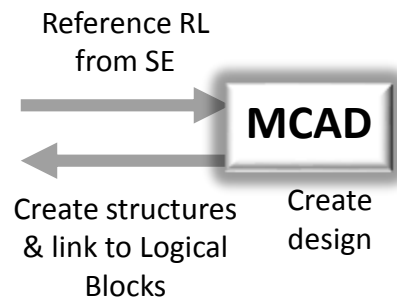
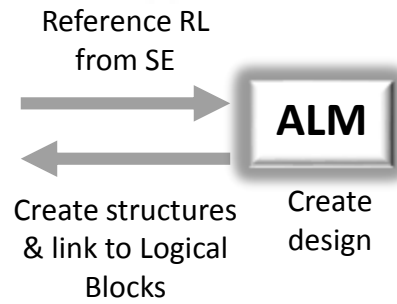
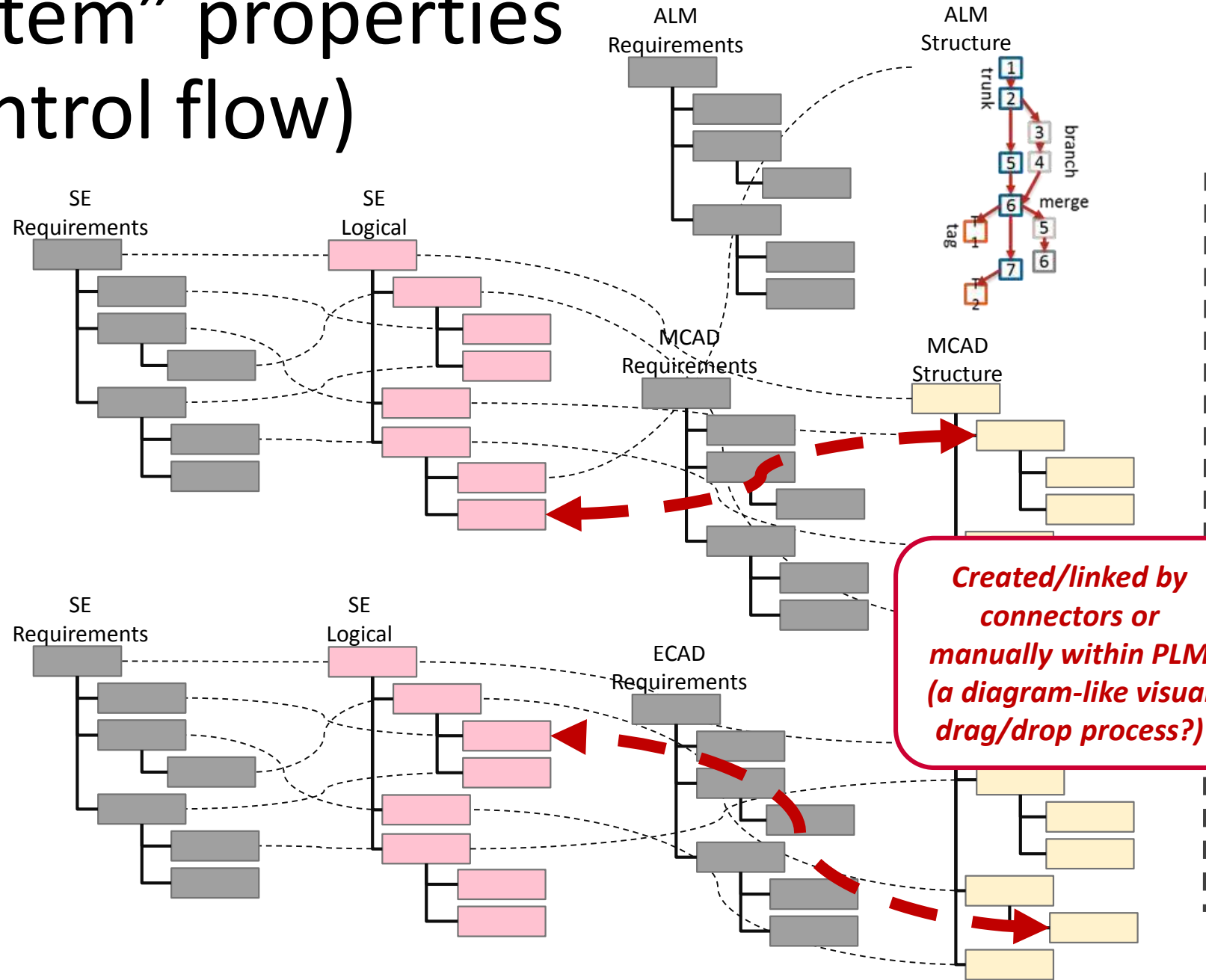
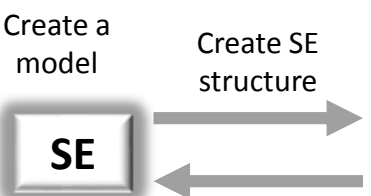
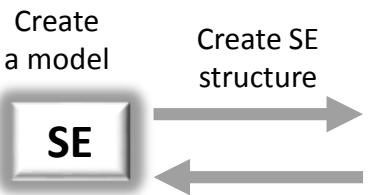


Create structures & link to Logical Blocks

Add simulation data



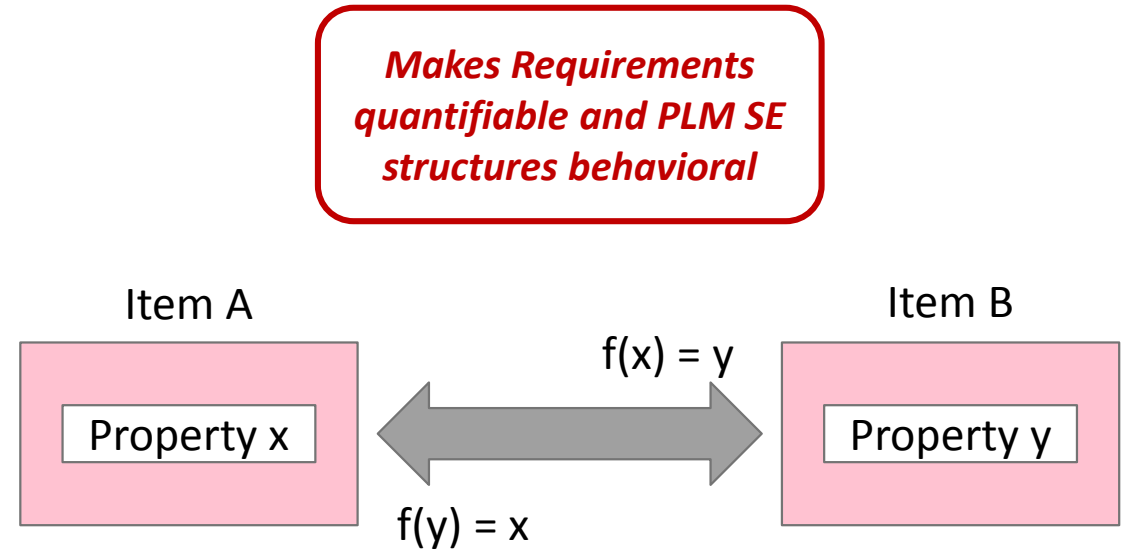
Add "System" properties (data/control flow)



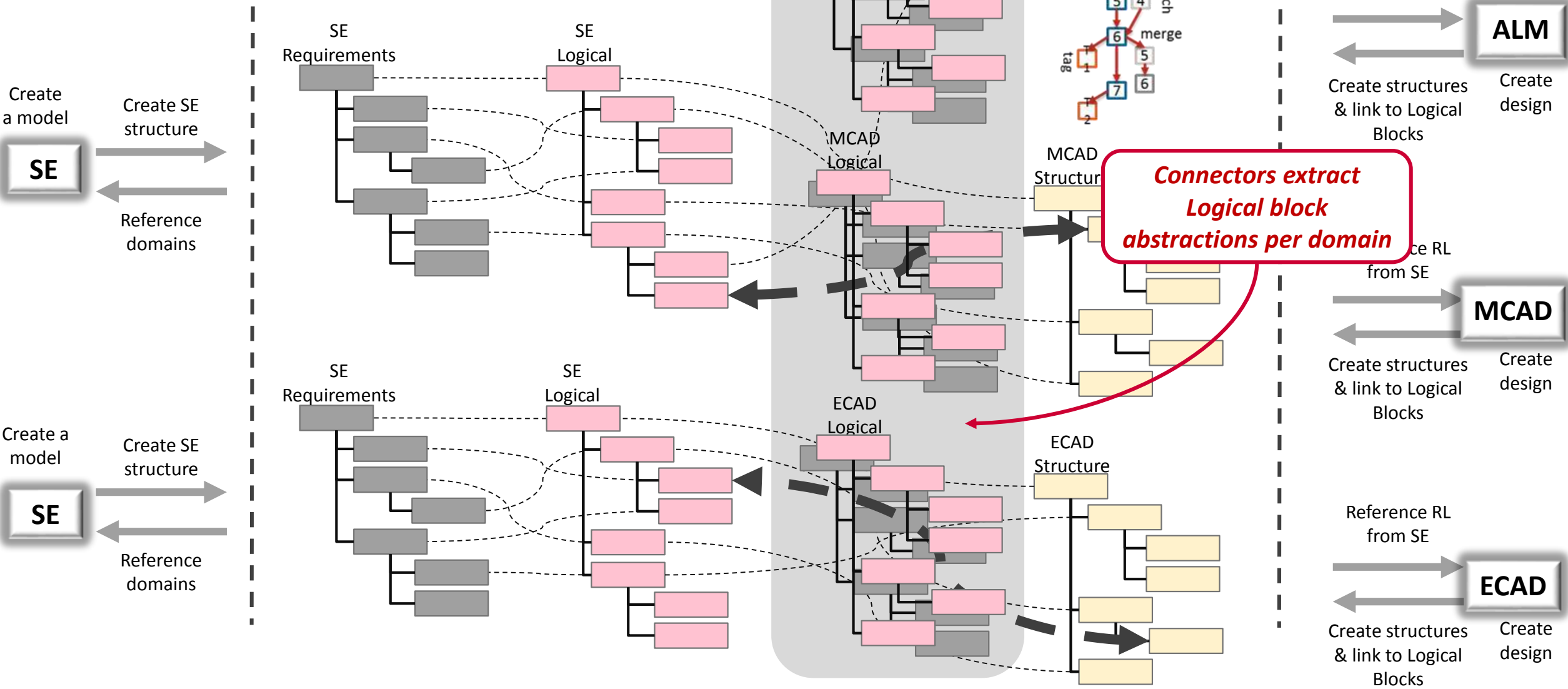
Properties are cross-domain negotiable

“Contracts”

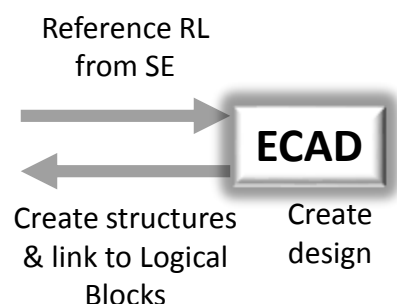
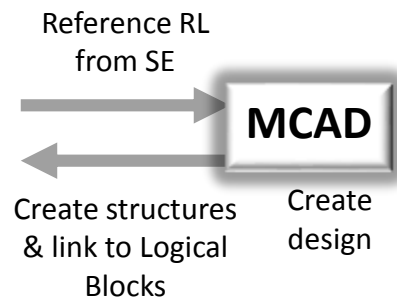
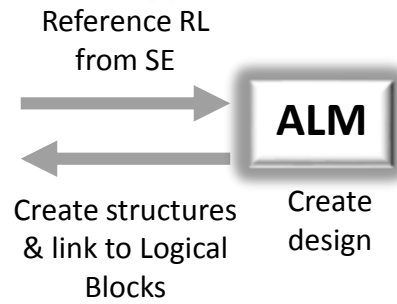
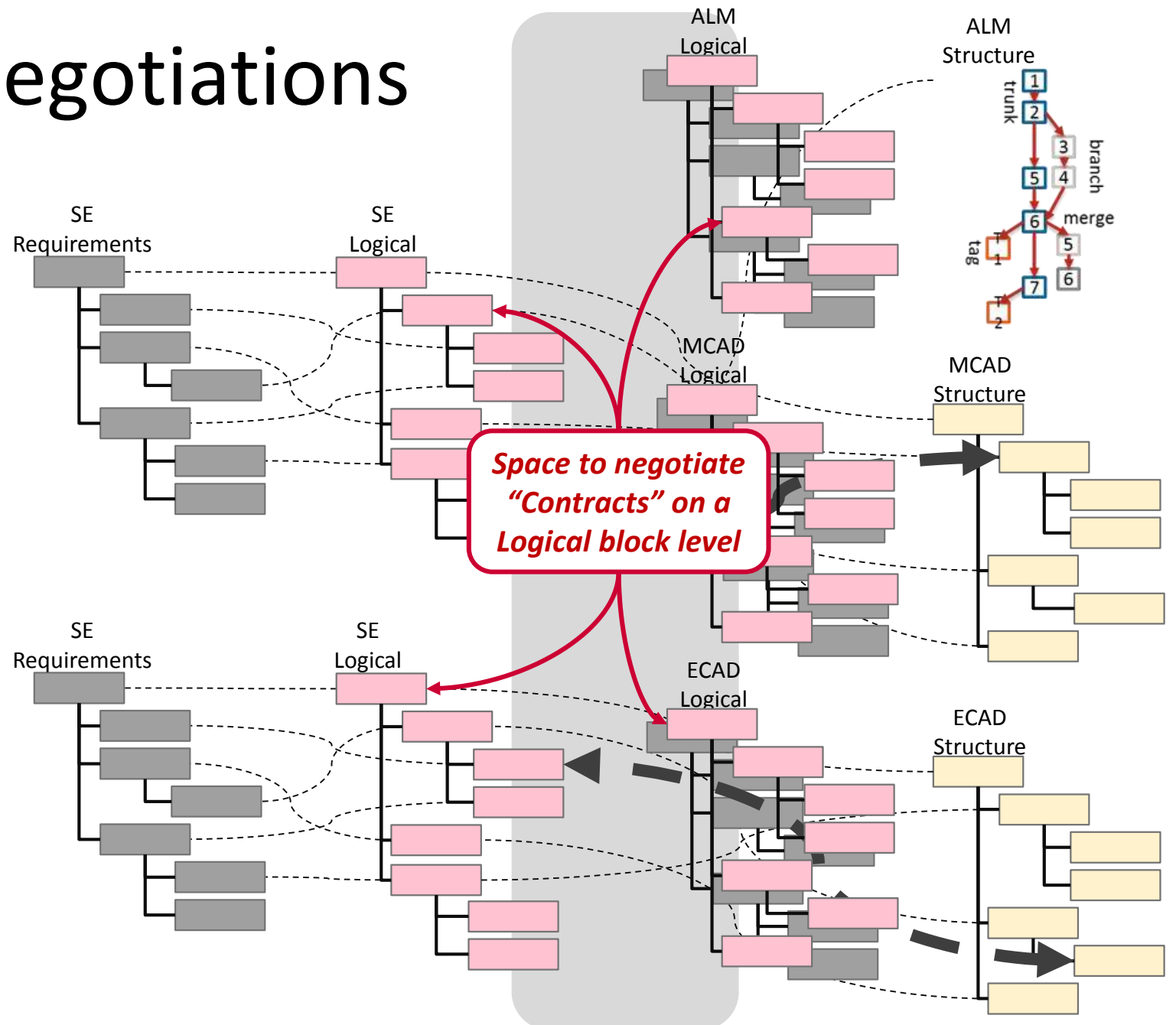
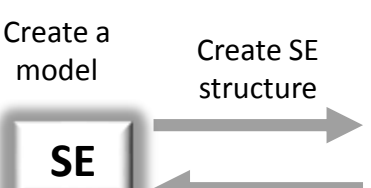
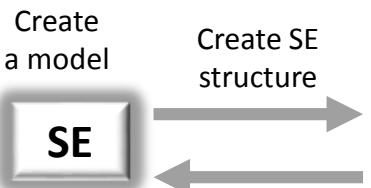
- Linked between any two structural items
- Value, range, enumerated list
- Units
- Fixed or a target (a budget)
- A domain owner
- On a structural item or accumulative for an assembly
- Transformation function on a property link
- Created/linked by connectors or manually (a diagram-like visual drag/drop process within PLM?)



Add Logical to Logical



Enable Negotiations



Cross-domain Logical Blocks challenge

- MCAD – explicit

- MCAD file = PLM Part/Assembly (BOM)
- MCAD files mapped to PLM Parts



Natural fit with PLM

- ECAD – extractable

- ECAD file \neq PLM Part/Assembly (BOM)
- Components mapped to PLM Parts



Challenge with mapping files to PLM parts

- Embedded Software – indirect

- IDE files \neq PLM Part/Assembly (BOM)
- Build process? Released binary?



Not a happy fit with PLM product configuration

- System – TBD

- Requirements?
- Block diagrams (functional & logical)?
- Models as input, Reports as outputs?

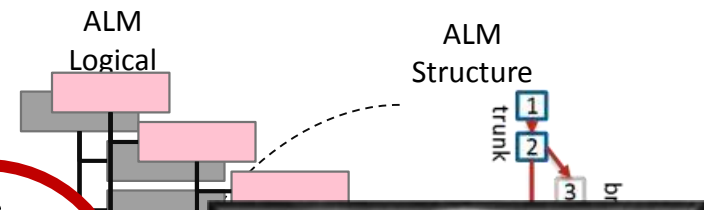
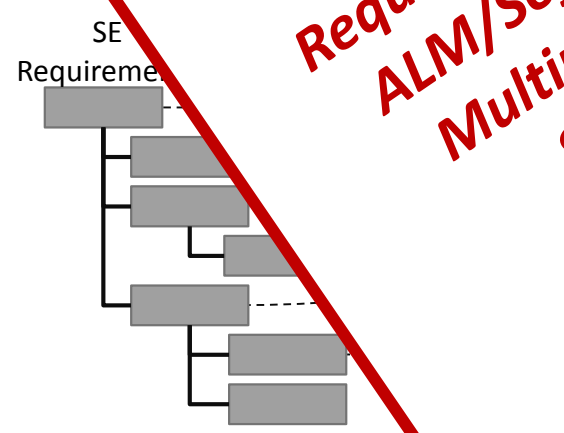
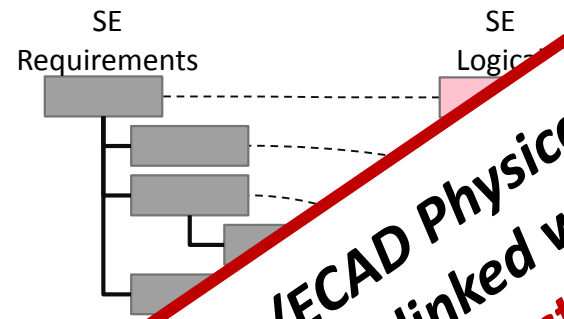
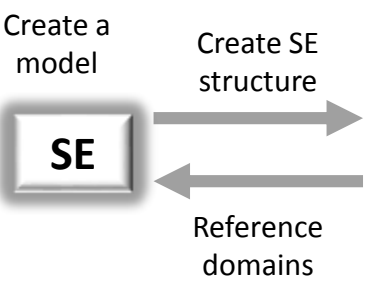
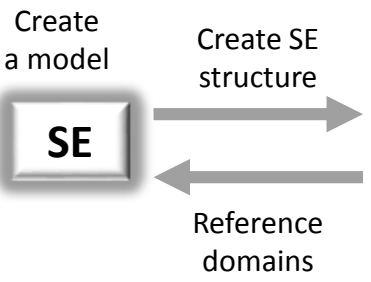


*Similar to ECAD schematics?
Explicit SysML data model?*

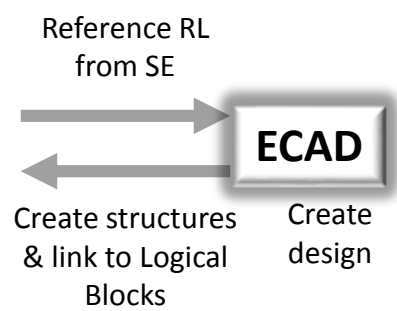
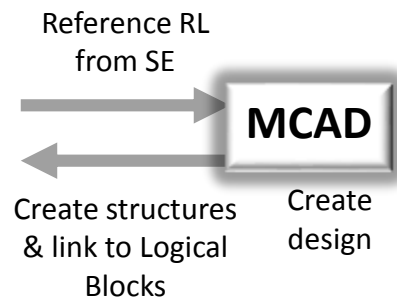
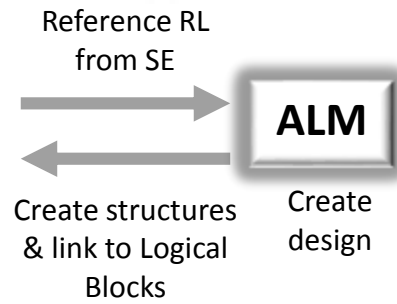
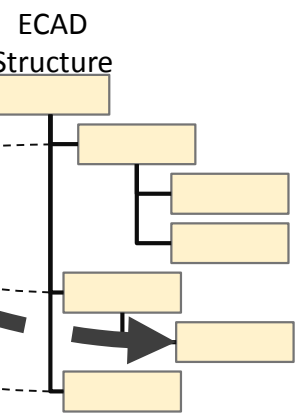
It will take more finesse than this!



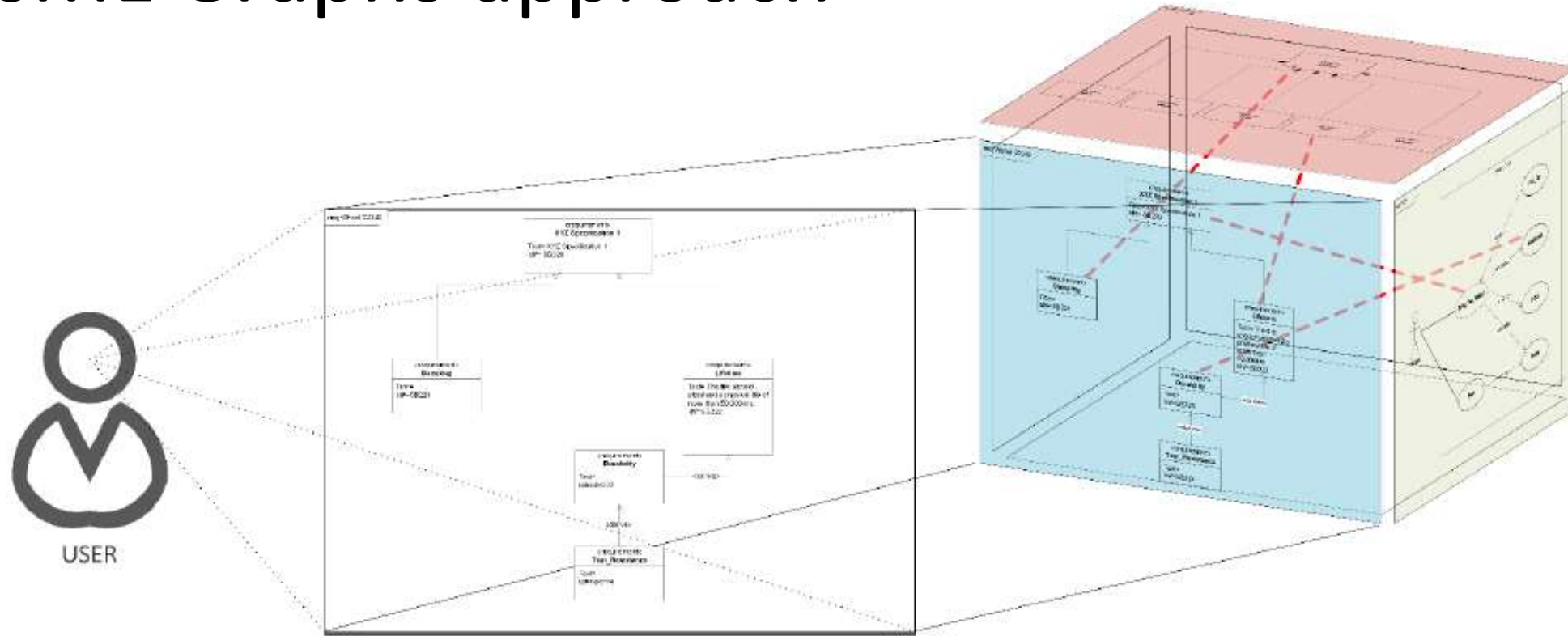
Result: Complex & Overwhelming



MCAD/ECAD Physical structures
... linked with ...
Logical structures
Requirement decomposition
ALM/Software structures
Multiple SysML models
Simulation data
Control/Data Flows
... plus ...
MPP, QP, V&V, Docs, etc.

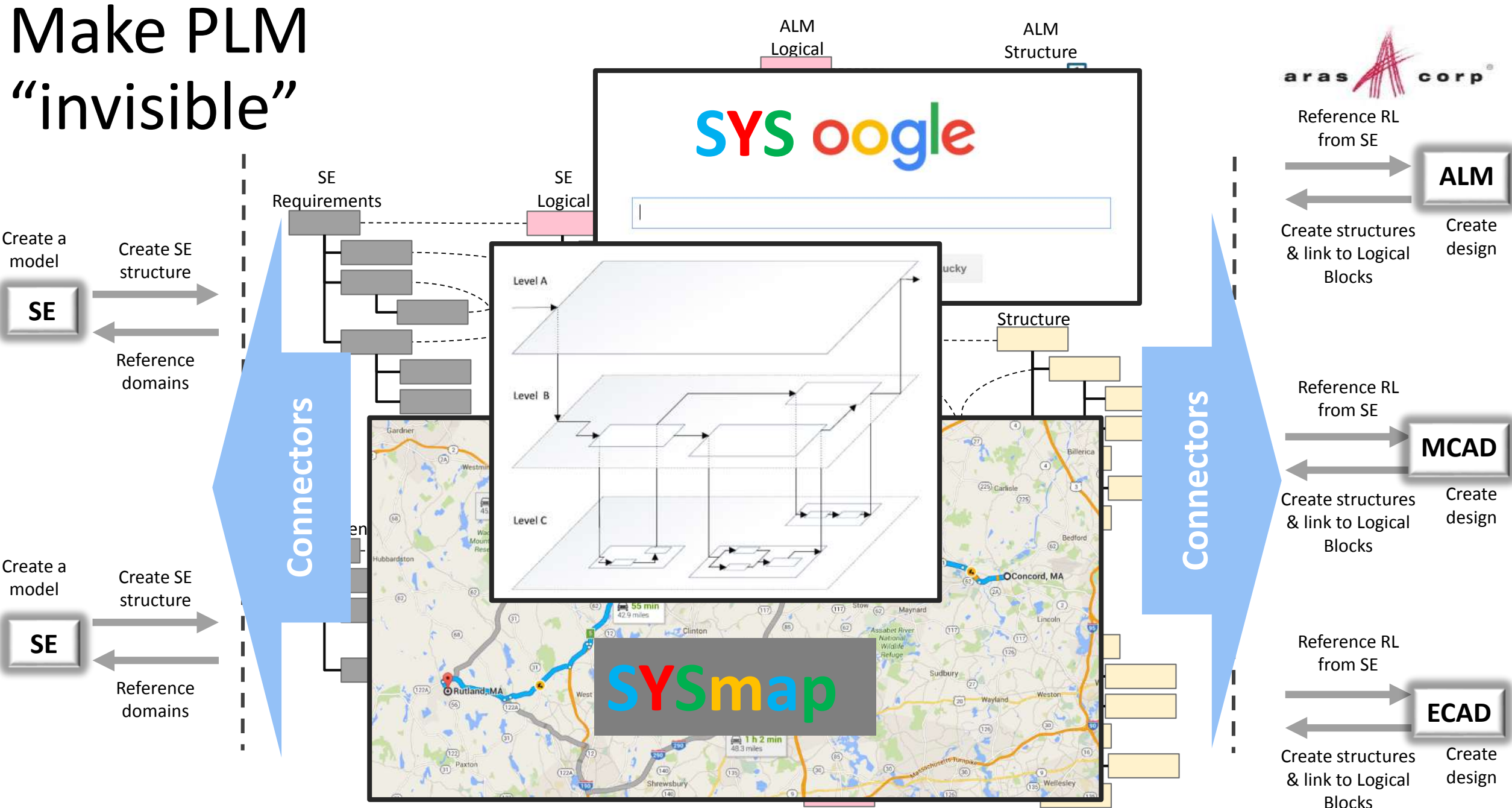


SysML Graphs approach



Complex relationships via comprehensible views in context

Make PLM "invisible"



Reinvent PLM Traceability & Navigation

ALM Logical

ALM Structure



SYS oogle

A System Model in its own right with SysML intelligence in Aras (separate from the one on the left)

SE Requirements

SE Logic

Level A

Level B

Level C

SYSmap

Connectors

Connectors

Reference RL from SE

ALM

Create structures & link to Logical Blocks

Create design

Reference RL from SE

MCAD

Create structures & link to Logical Blocks

Create design

Reference RL from SE

ECAD

Create structures & link to Logical Blocks

Create design

Create a model

SE

Create SE structure

Reference domains

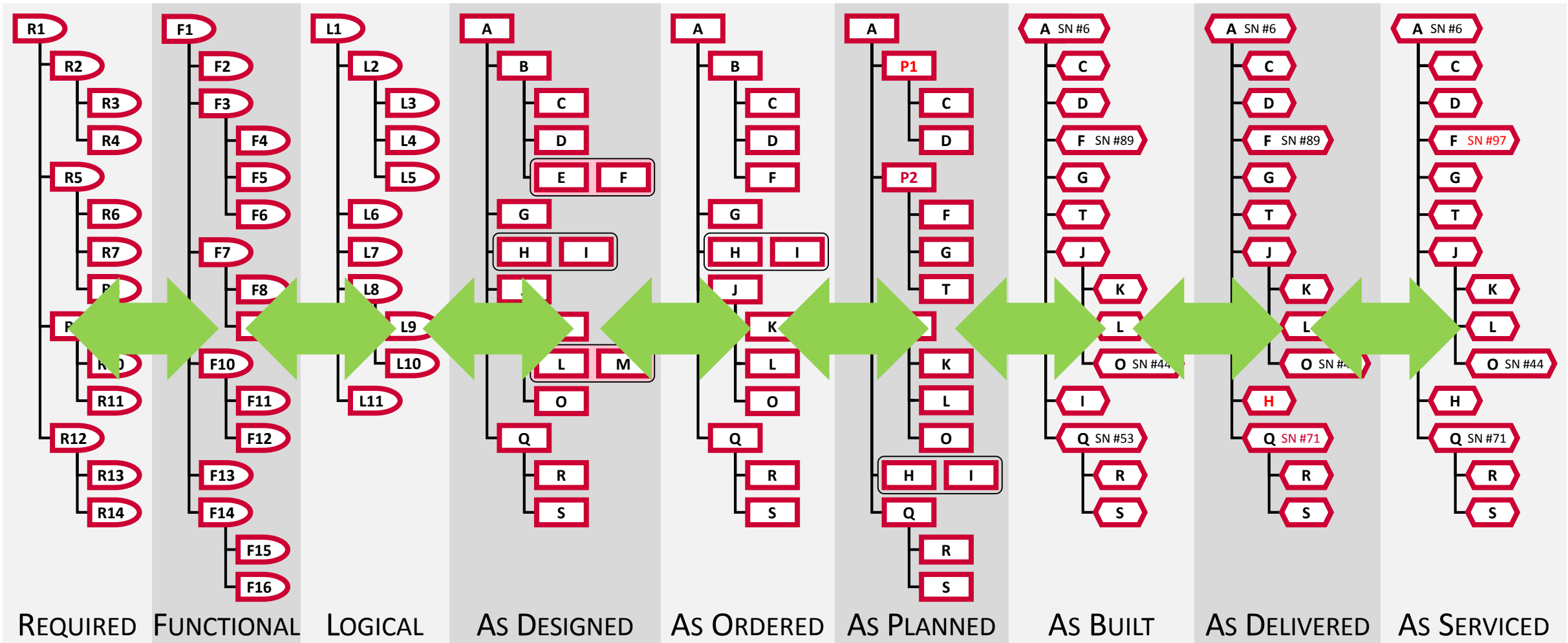
Create a model

SE

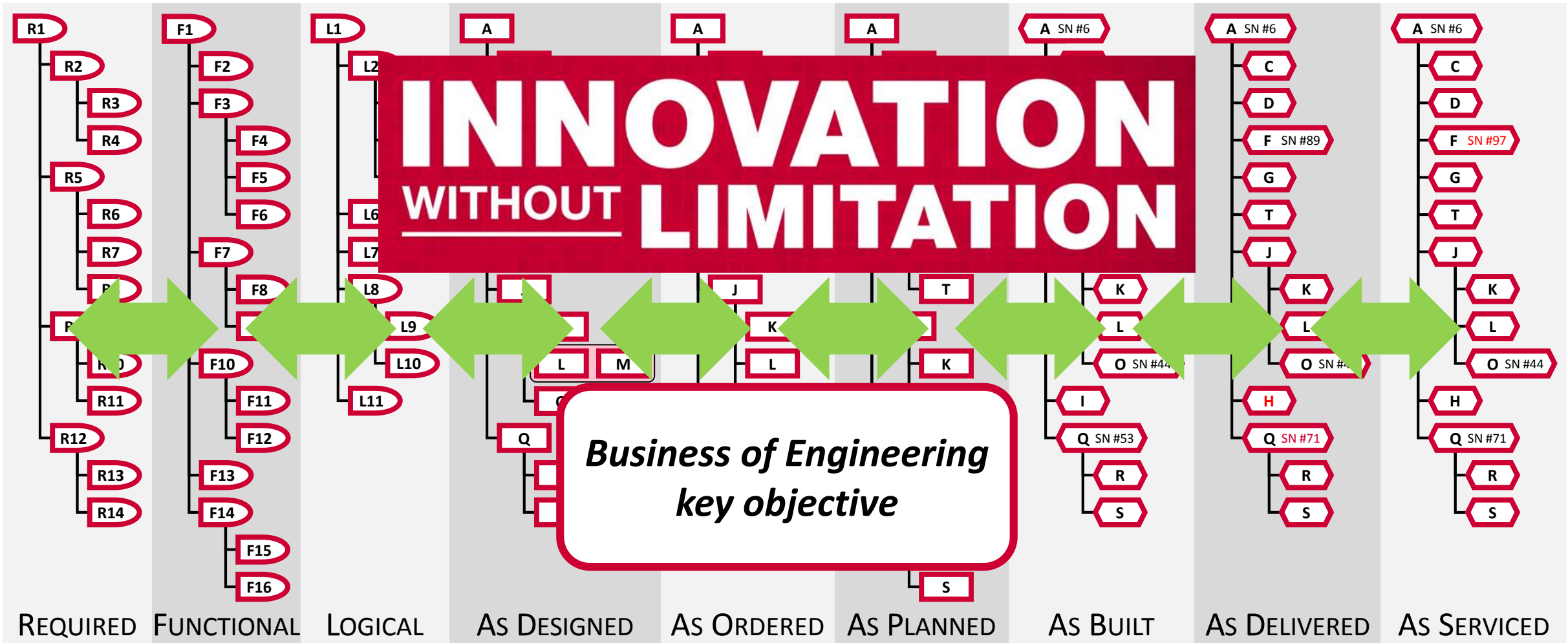
Create SE structure

Reference domains

PLM System Traceability architecture



PLM System Traceability architecture



**Aras PLM architecture provides
Future Proof Enterprise PLM with industry leading CM
capability**

Partnering with



- TU Kaiserslautern: Proof of Concept (MagicDraw)
- Airbus/IBM/Aras: OSLC-based ALM/PLM integration
- XPLM/No Magic: MagicDraw integration
- Aras/Altium: Bringing ECAD into MBSE



Acknowledgements



- Airbus
- IBM
- Dr. Eigner, TU Kaiserslautern
- Dr. Zhang, AVIC
- Altium
- No Magic
- ProSTEP
- INCOSE
- OMG
- OASIS
- XPLM



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WITHOUT LIMITATION