

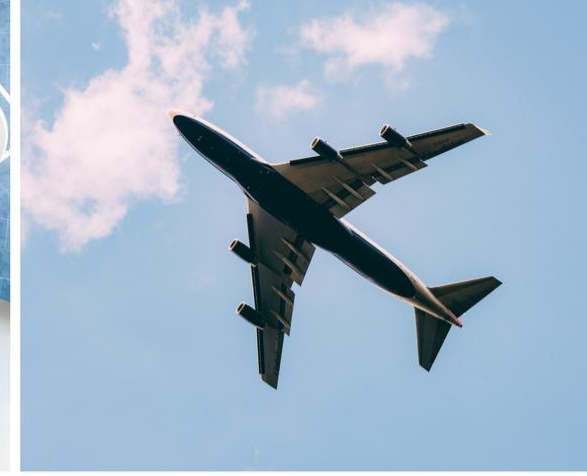


# Model-Based Systems Engineering

## *Weaving a Digital Blueprint for Modern Products & Systems*

*SysML, MBSE, and Interoperability*

Manas Bajaj, PhD  
Chief Systems Officer  
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- Georgia Tech spin-off 2008
- Atlanta, US (HQ) and Pune, India
- **Focus:** Software for MBE/MBSE
  - **Syndeia** – MBSE (SysML) + PLM/CAD/CAE/Data/Simulations
  - SysML parametric solvers (**ParaMagic, Melody, Solvea, & ParaSolver**)
- Training, consulting, custom apps
  - 4500+ participants since 2008
- Customers
  - Gov.: NASA, DoD, DoE, DoC
  - Commercial: aero, auto, transportation, consumer goods, energy, mfg., healthcare



# INCOSE SE Vision 2025



Systems

Interconnected

Interdependent

Complex

INCOSE SE Vision 2025  
<http://goo.gl/uE5OS9>



# Systems – Cyber-physical, Multi-Disciplinary, System-of-Systems



**Smart Home**



**Hybrid/Electric/Self-Driving Cars**



**Robotic / Smart Manufacturing**



**Rovers**



**Smart Energy Grids**



**Healthcare**

# What is common across all these systems?

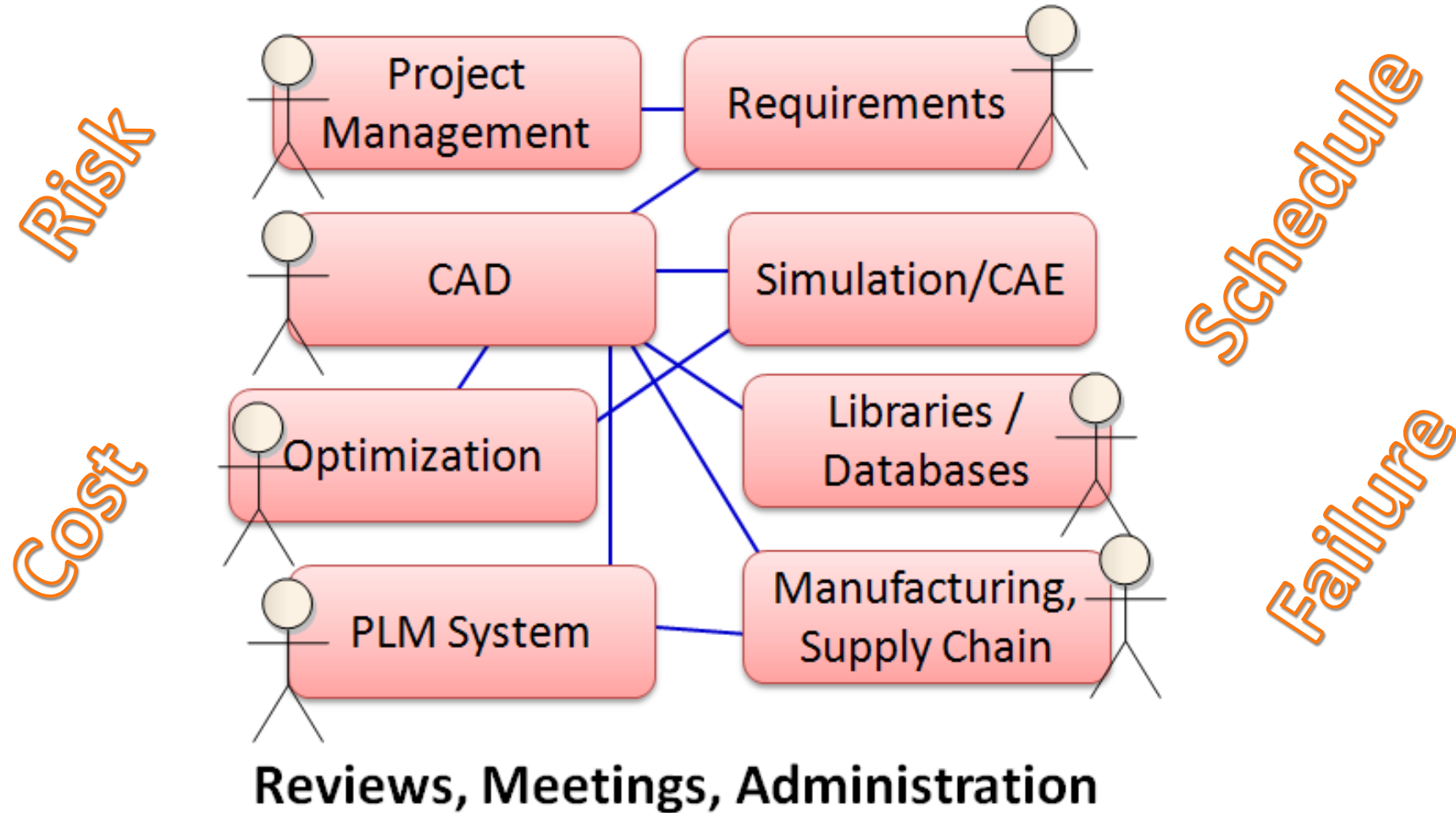


- **What is common to all these systems?**
  - Multi-disciplinary, many teams of engineers, project managers, suppliers, and more
  - Hardware, software, human, robotic sub-systems
  - Many software tools & databases (Systems, PLM, CAD, ALM, Simulation, and more)
  - Manage across lifecycle (conceptual -> design -> manufacturing -> service -> disposal)
- **Where are the biggest challenges in these developing systems?**
  - Managing interfaces between sub-systems
  - Assessing impact of changes, “what-if” analyses and trade-offs
  - Managing variants and options
  - Resilience to failure
  - Reducing margins for error (0 margin for mission- and life-critical systems)
  - Cost, time-to-market and competition

# Where is the system architecture / blueprint?

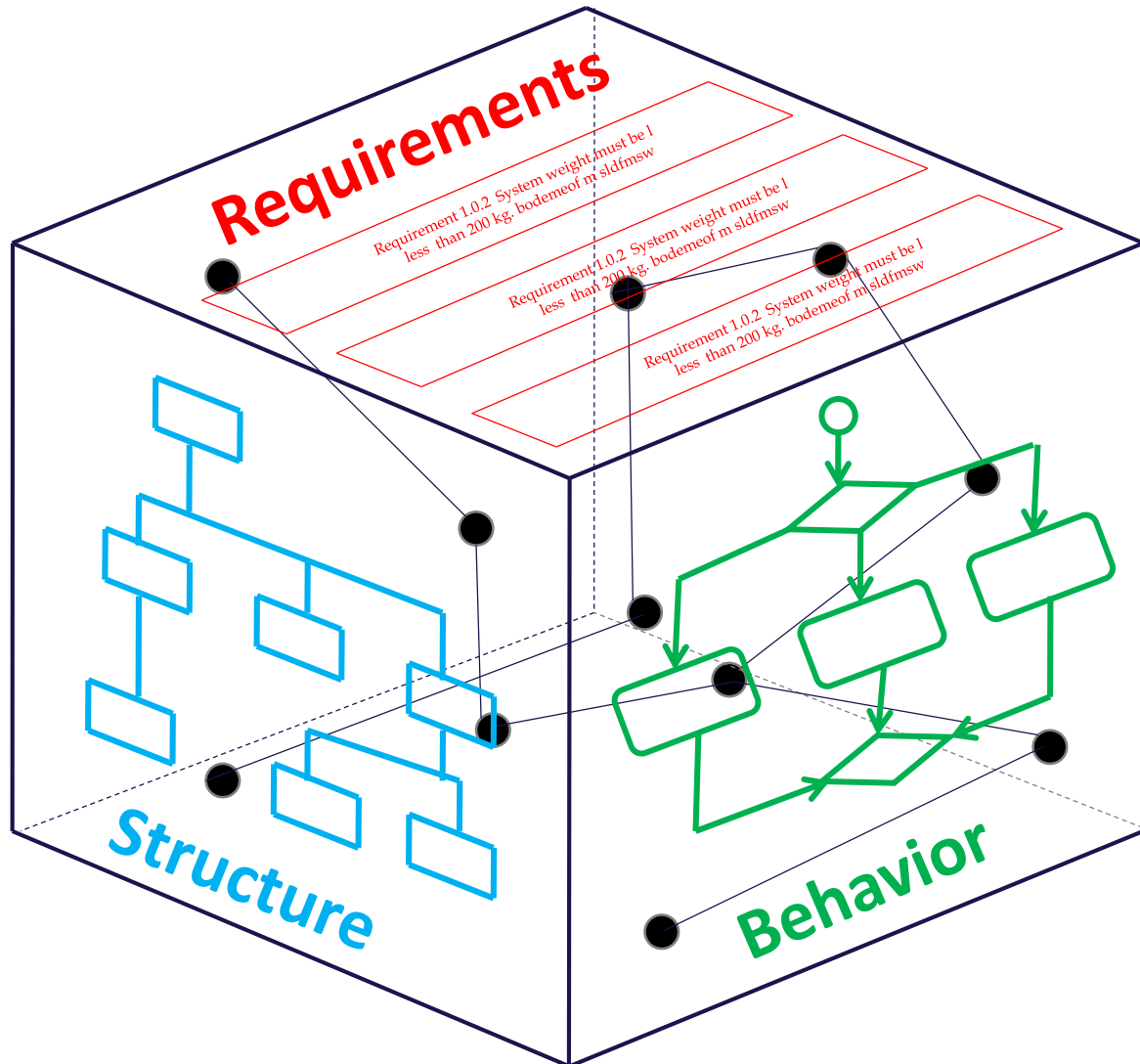


Point-to-point ad-hoc information flows  
without a common architecture model



*Use of models in each engineering discipline is not  
model-based systems engineering*

# What is Model-Based Systems Engineering?



- MBSE = Unified model of the system versus series of disconnected documents or document-based flows between models (DBSE)
- System docs and views can be generated from this unified model
- DBSE > MBSE  $\Leftrightarrow$  2D > 3D CAD
- Models in SE  $\neq$  MBSE

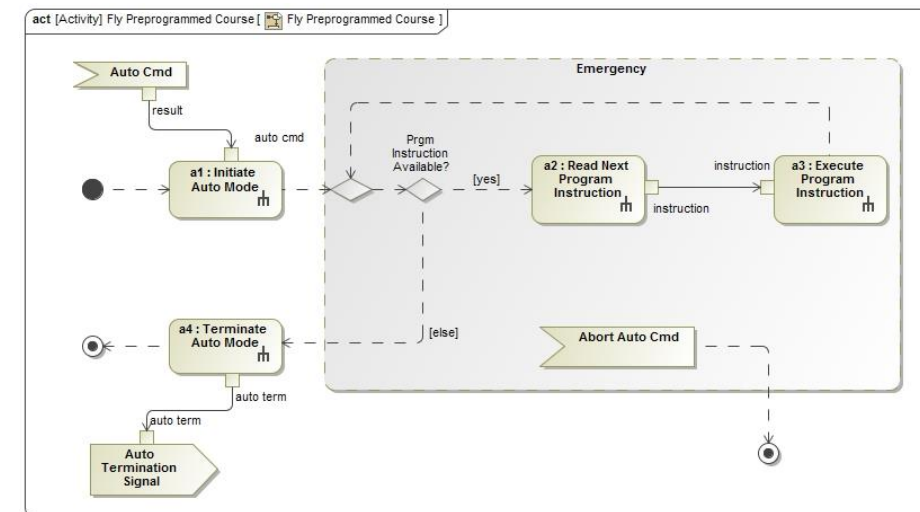
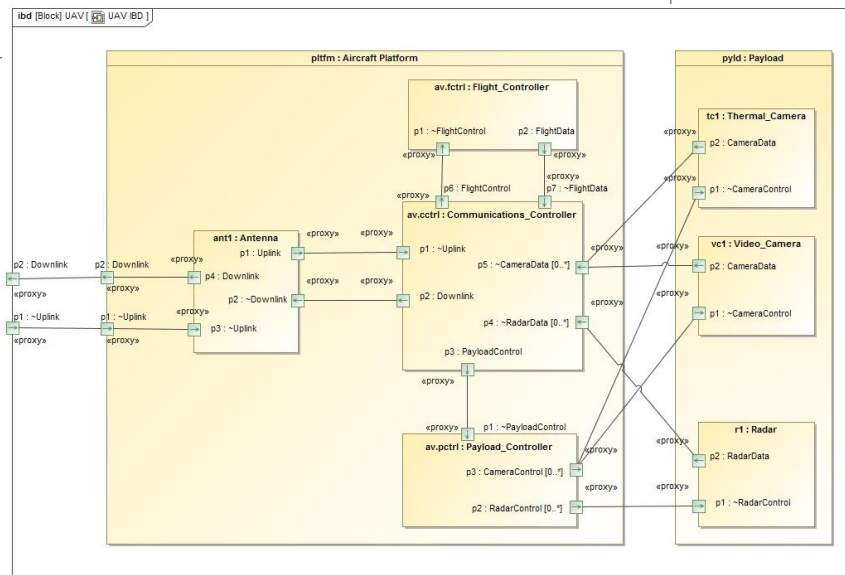
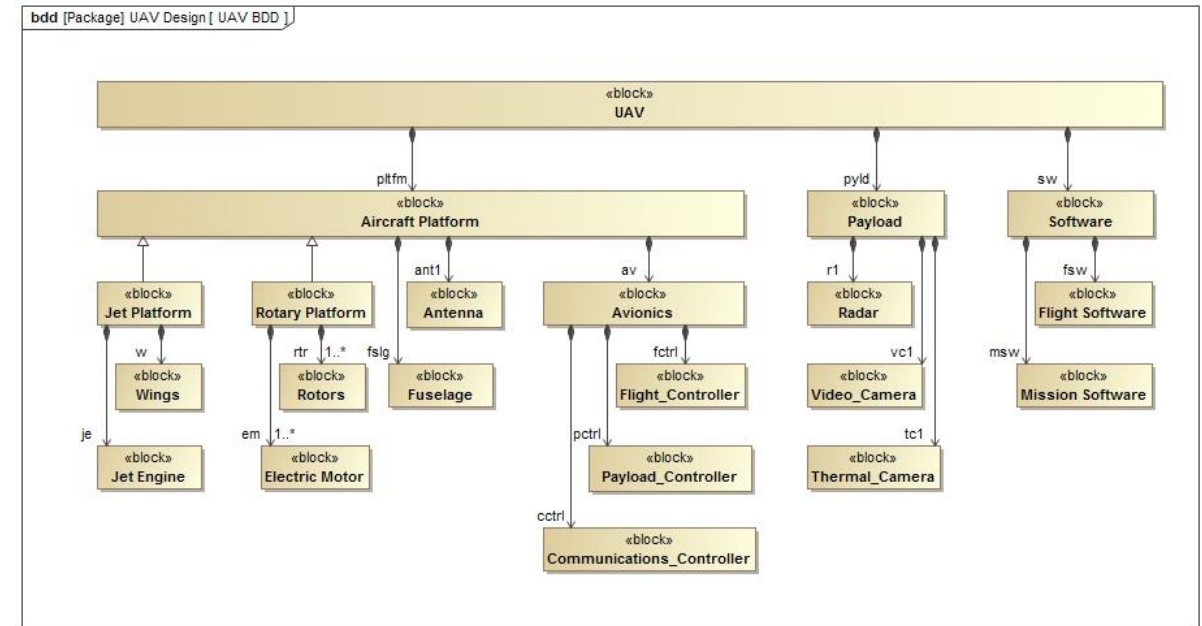
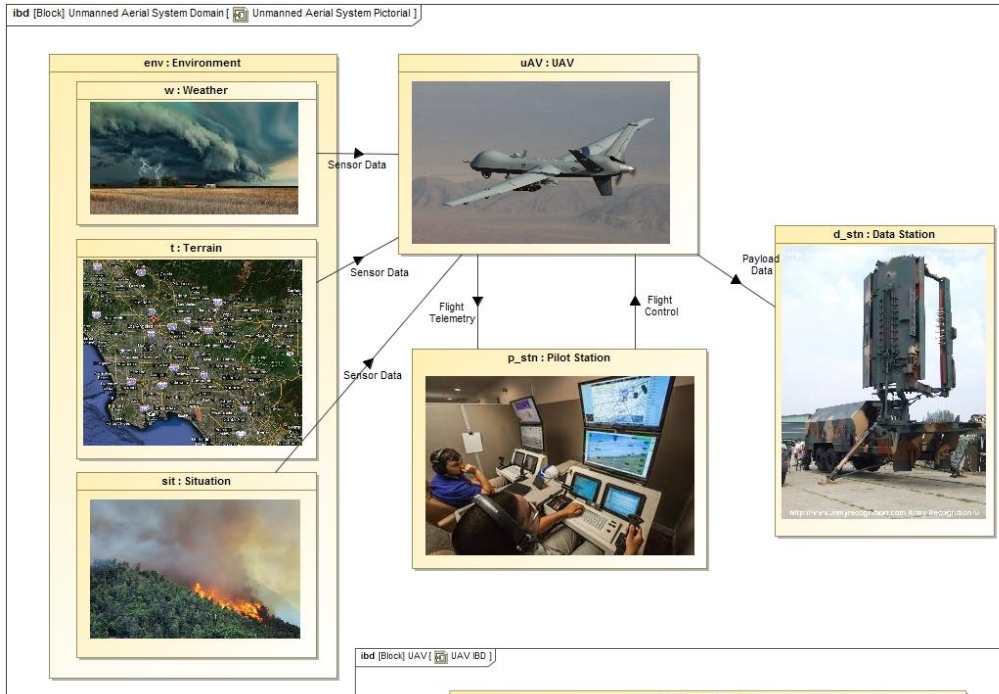




- **SysML is a visual modeling language** that provides:
  - **Semantics** = meaning
  - **Notation** = representation of meaning
- SysML is *not* a methodology or a software tool
  - SysML is methodology-independent & tool-independent
  - Multiple vendor tools support the SysML language
- Supports the specification, analysis, design, verification, and validation of systems that include hardware, software, data, personnel, procedures, and facilities
- History
  - 2003 - UML for Systems Engineering RFP by OMG, INCOSE and ISO 10303 AP233
  - 2007 - SysML 1.0 released
  - 2017 - SysML 1.5 released in May 2017
  - 2019 - SysML 2.0 planned release
- <http://www.omg.sysml.org/> for more information on OMG / ISO IEC SysML standard
- <http://www.omg.sysml.org/news-articles.htm> - publications demonstrating real production use



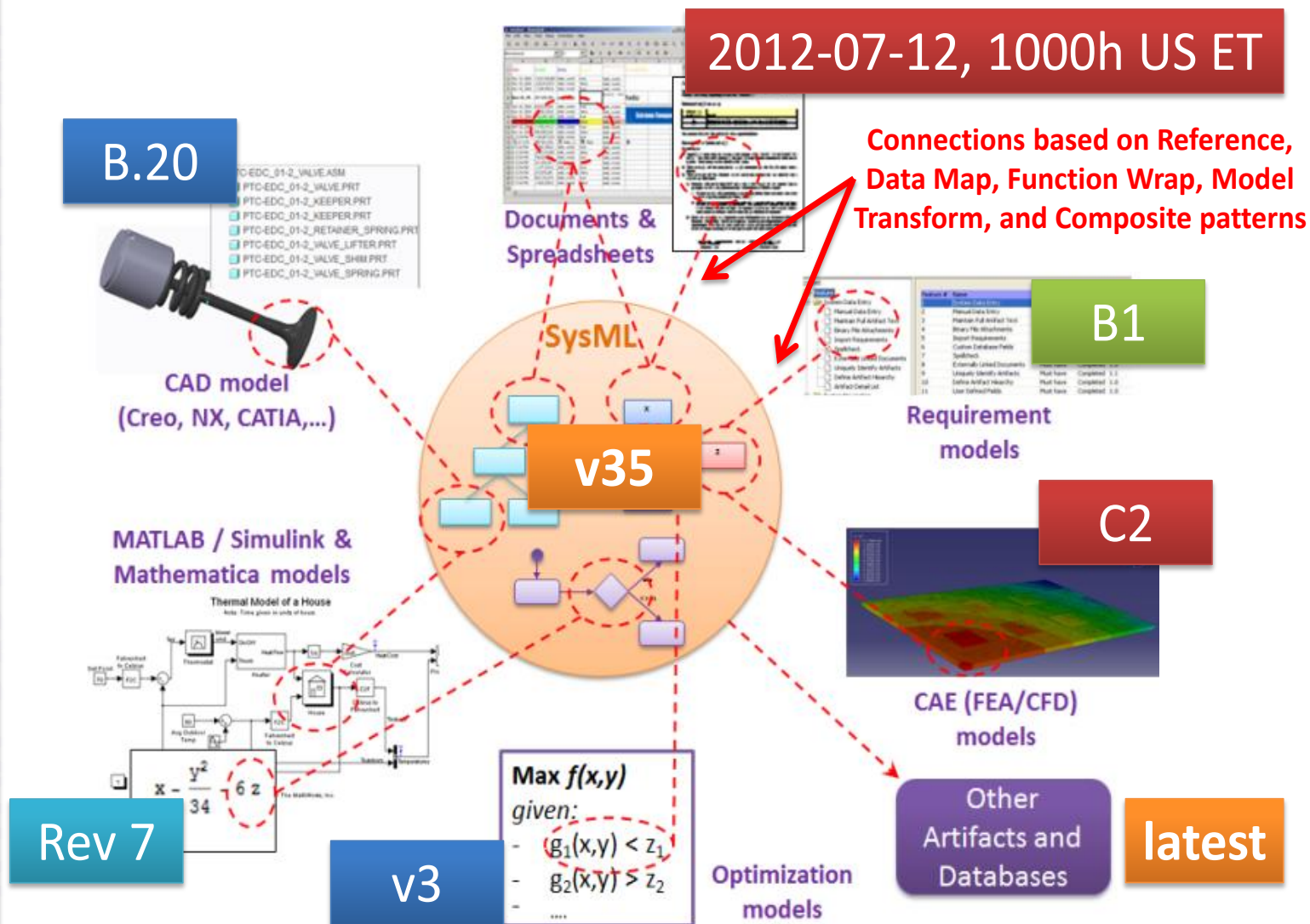
# Example views (diagrams) in a SysML model



# Total System Model – A Federated *Graph*



## TOTAL SYSTEM MODEL (TSM)



Connect architecture model (SysML) with domain-specific models

Total System Model (TSM) as a digital blueprint of the system connecting models across disciplines, tools, and version-management systems

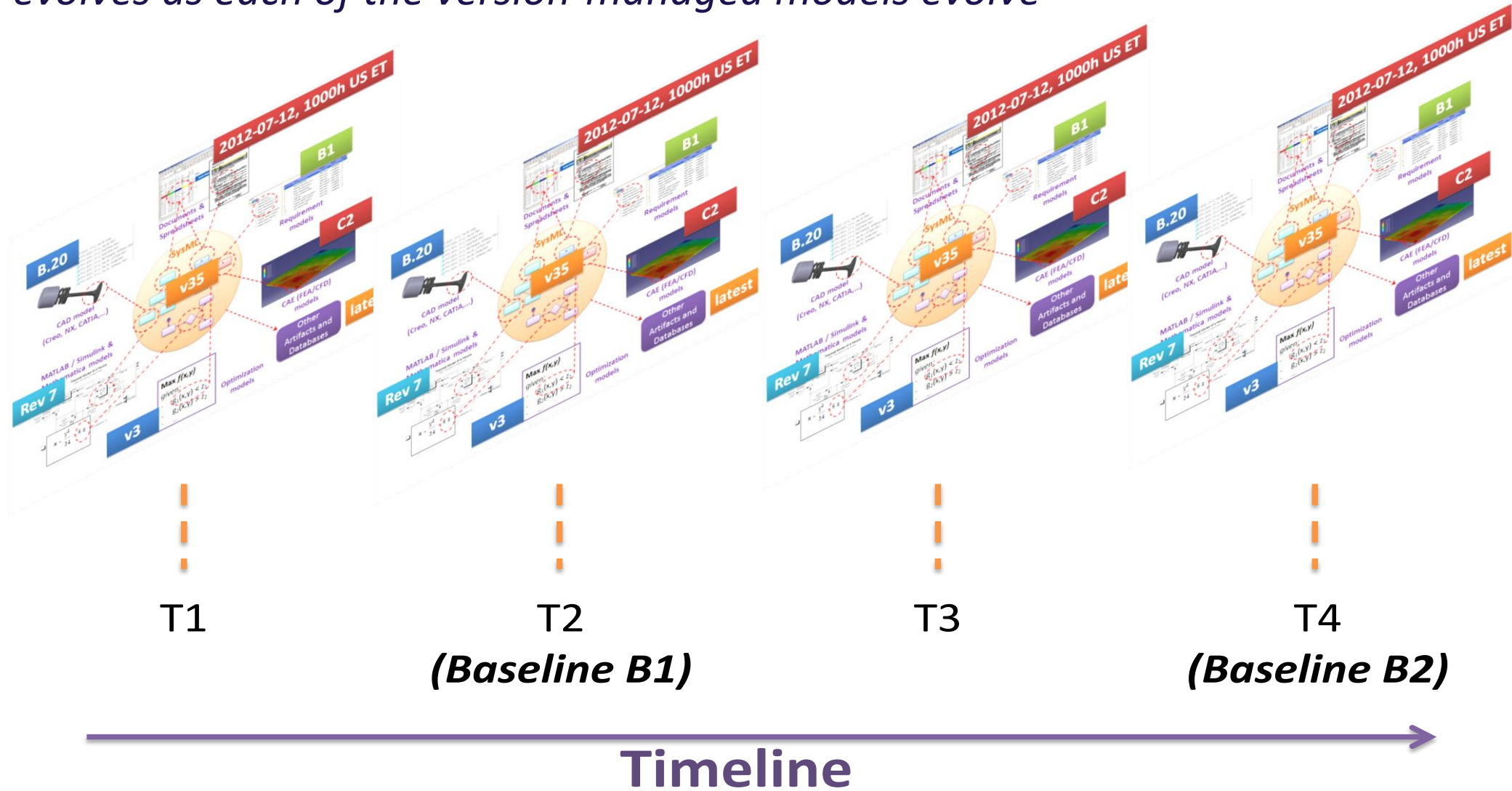
Goal: Seamless traceability between disciplines across the system lifecycle



# Total System Model (TSM)



*TSM evolves as each of the version-managed models evolve*

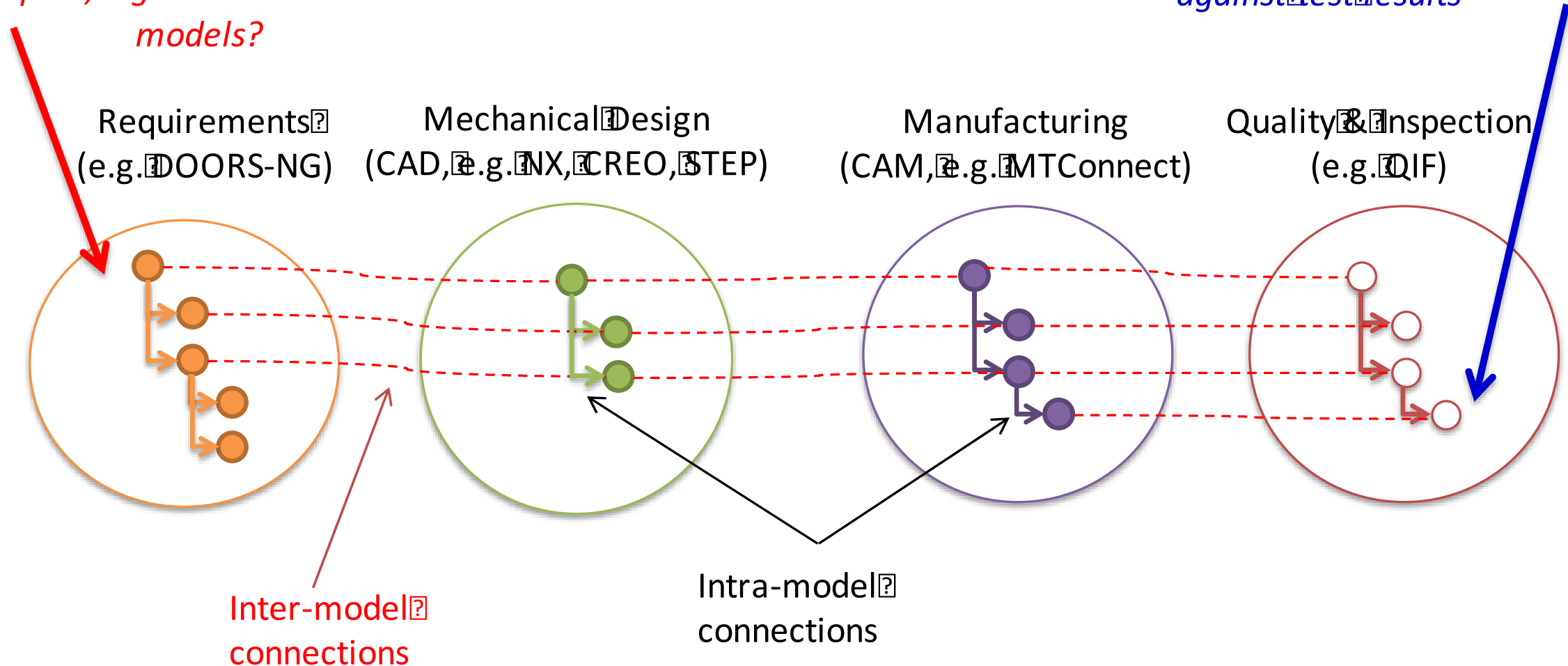


# Intra-Model and Inter-Model Connections



*If I change this requirement, what is the downstream impact, e.g. to CAD and CAM models?*

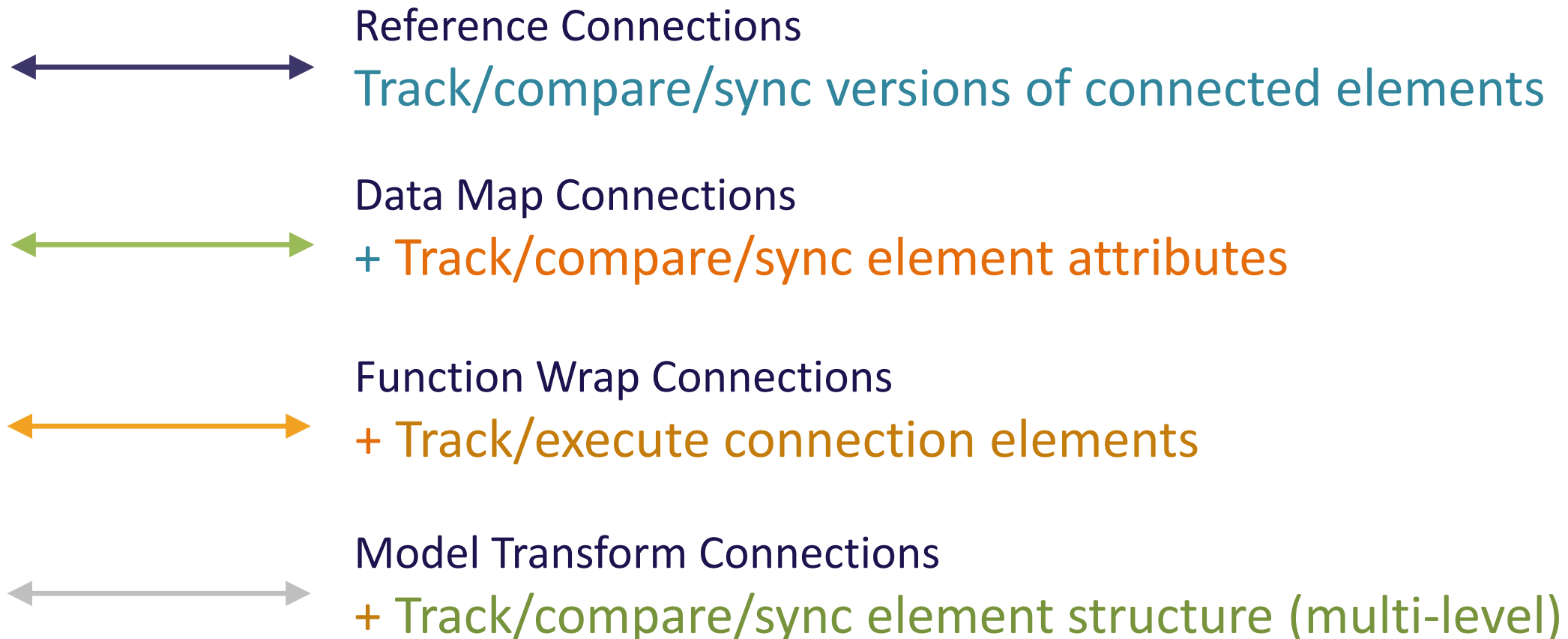
*Trace the CAD and CAM models for this part and compare attributes against test results*







- What is the purpose of model-based connections?



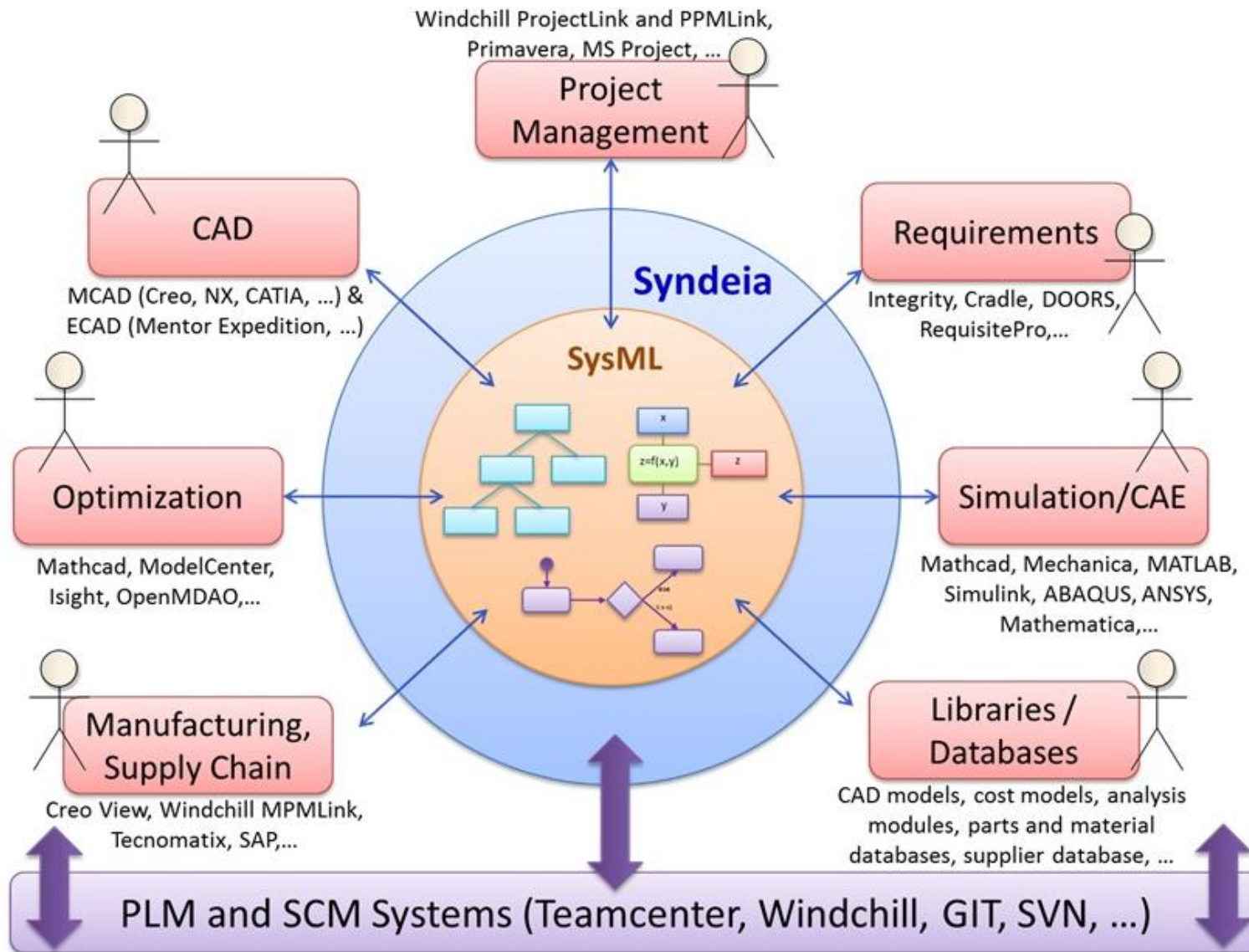


Bajaj, M., Zwemer, D., Yntema, R., Phung, A., Kumar, A., Dwivedi, A., Waikar, M. "MBSE++ — Foundations for Extended Model-Based Systems Engineering Across System Lifecycle". 26th Annual INCOSE International Symposium (IS 2016) Edinburgh, Scotland, UK, July 18-21, 2016

1. Heterogeneous and Decentralized Data
2. Capturing and Maintaining High-Level System Architecture
3. Spectrum of Model-Based Connections
4. Unified Framework for Model-Based Connections
5. From Traceability to Impact
6. Many Users, Many Views



# Syndeia = Software Platform for MBSE / MBE



Search, Connect, Access,  
Transform, Compare, Sync,  
Visualize models in the Total  
System Model

Syndeia 3.1 released May 2017

– [www.syndeia.com](http://www.syndeia.com)

# Connect to enterprise repositories (PLM, ALM, DB,...)



The screenshot shows the 'Repository Manager' application with a tree view of an 'Unmanned Aerial Vehicle' model. The tree structure is as follows:

- Unmanned Aerial Vehicle
  - Part Structure (latest)
    - UnmannedAerialVehicle (A.16)
      - auto1 : Autopilot (A.1)
      - comm\_con1 : CommunicationsController (A.1)
      - databus : Data\_Bus (A.1)
      - flight\_con1 : FlightController (A.1)
      - gprs1 : GPRS\_UMTS (A.1)
      - gps : GPS (A.1)
      - pltfrm1 : Aircraft\_Platform (A.1)
      - pyld\_con1 : PayloadController (A.1)
      - ssr1 : SpreadSpectrum (A.1)
      - sw : UAS\_Software (A.1)
      - therm1 : ThermalCamera (A.1)
      - therm2 : WideAngleIR (A.1)
      - vis1 : VisualCamera (A.1)
      - wifi1 : WiFi\_WiMax (A.1)
  - Folders
    - Hardware Component
      - Aircraft Platform (A.1)
      - Aircraft\_Platform (A.1)
      - Autopilot (000000)
      - CommunicationsController (A.1)
      - Data\_Bus (000000)
      - FlightController (A.1)
      - GPRS\_UMTS\_Module (A.1)
      - GPS (0000000002)
      - PayloadController (A.1)

On the left, a list of repositories is shown, including DOORS, GitHub, Jama, JIRA, Local File System, MySQL, Teamcenter, and Windchill. The 'Windchill' repository is highlighted with a purple box.

Example – Connecting to multiple enterprise model repositories from a single interface (Syndeia – [www.syndeia.com](http://www.syndeia.com))

Teamcenter

MySQL

# Drag-n-Drop connect existing or generate new models



**Syndeia Dashboard (2.0.0) - Unmanned Aerial Vehicle**

Repository Manager | Connection Manager | Connection Browser | Connection Summary | Comparison Result | Settings

**SysML Model**

- Unmanned Aerial Vehicle
  - Aircraft Platform
    - blackbox : BlackBox
    - body : Body
    - elec assembly : Electrical Assembly
    - engine : Engine
    - fuel system : Fuel System
    - powertrain : Powertrain
    - rotor : Rotor
    - tail assembly : Tail Assembly
  - Analysis Manager
  - APU
  - Autopilot
  - Battery
  - BlackBox
  - Body
  - Communications Controller
  - Communications Interface
  - Cowling

**Connection Type**

- ☐ Reference
- ☐ Function Wrap
- ☐ Data Map
- ☒ Model Transform

**TC91**

- Requirements
- Satellite (Precise BOM)
- TraceLinks
- UAV (Imprecise BOM)
  - 000464-Unmanned Aerial Vehicle
    - 000464/A; 1-Unmanned Aerial Vehicle
    - 000464/B; 1-Unmanned Aerial Vehicle
    - 000464/C; 2-Unmanned Aerial Vehicle
    - Unmanned Aerial Vehicle->Fire
    - 000464/C-View (Imprecise)
  - aircraft platform : 000465
  - gps : 000466/A; 1-GPS
  - autopilot : 000467/A; 1-Autopilot
  - databus : 000468/A; 1-Databus
  - flight controller : 000469/A; 1-Flight Controller
  - payload controller : 000470/A; 1-Payload Controller
  - communications controller : 000471/A; 1-Communications Controller
  - wimax module : 000472/A; 1-WiMax Module
  - gprs module : 000473/A; 1-GPRS Module

**Drag-n-Drop**

**Switch repos**

**Repository Manager**

- Local File System Repositories
  - Creo
  - NX
  - Simulink
- MySQL Repositories
  - MySQL1
- Teamcenter Repositories
  - TC101
  - TC91
- Windchill Repositories
  - WC101
  - WC102

**Log**

BLOCK\_TC\_PART\_MODEL\_TRANSFORM\_CONNECTION

[10:52:48] INFO SysML dependencies will not be generated from Teamcenter trace links for item DDS Middleware. Option to generate SysML dependencies and trace links is not selected in Syndeia settings.

[10:52:48] INFO Finished generating block structure and creating connections for part DDS Middleware

[10:52:48] INFO SysML dependencies will not be generated from Teamcenter trace links for item Software System. Option to generate SysML dependencies and trace links is not selected in Syndeia settings.

Ready | 10:54:22 AM | 442M of 791M

Example using Syndeia  
[www.syndeia.com](http://www.syndeia.com)



# Compare and synchronize across inter-model connections



Repository Manager Connection Manager Connection Browser Connection Summary Comparison Result Settings

Q Type here to filter connections Clear Export to Excel

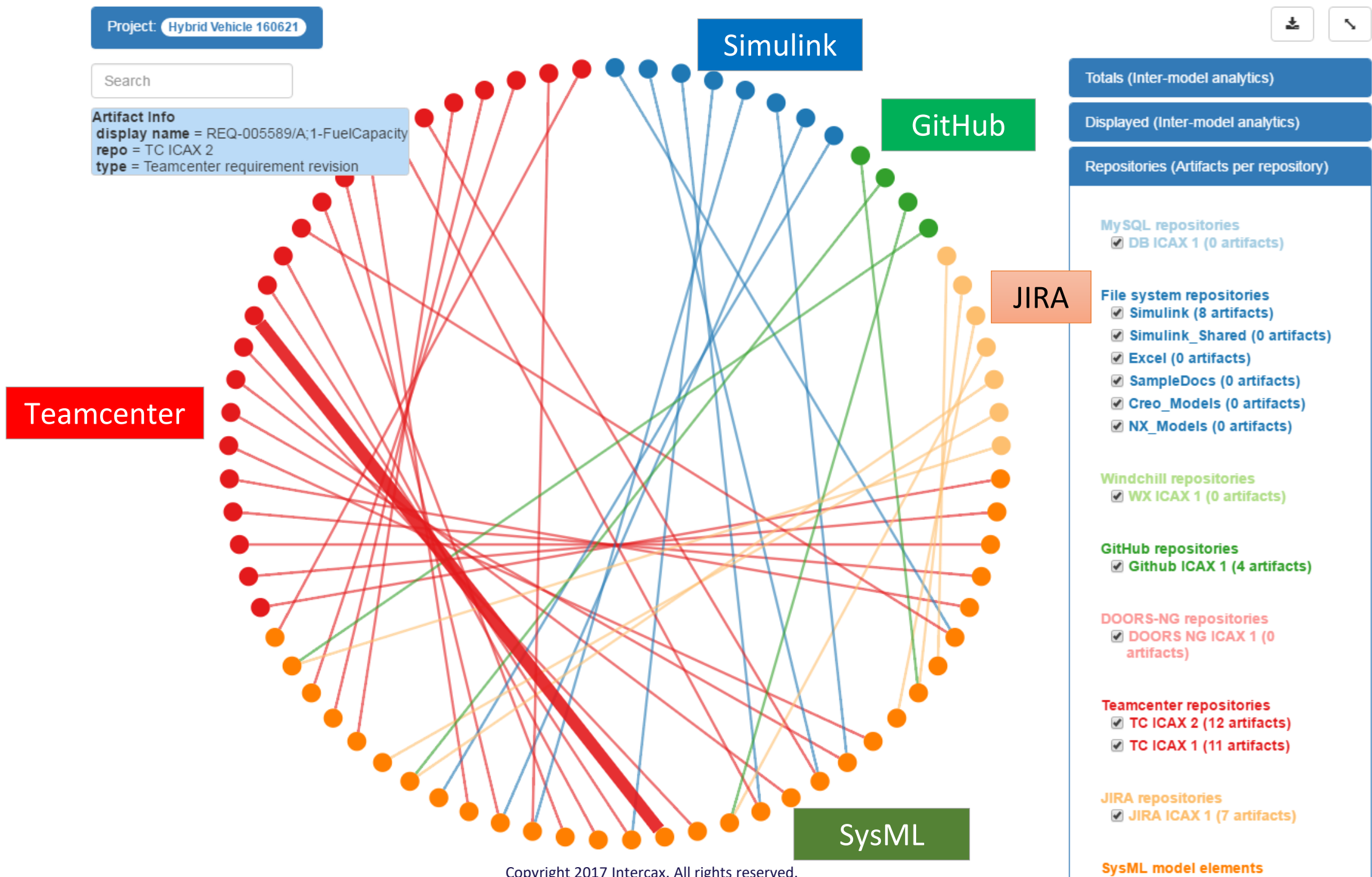
Conn ID	Source	Target	Latest Target	Comment
e3f03...	Unmanned Aerial Vehicle	000464/C;2-Unmanned Aerial Vehicle	000464/C;2-Unmanned Aerial Vehicle	The block Unmanned Aerial Vehic...
	wimax module : WiMax Module	wimax module : 000472/A;1-WiMa...	wimax module : 000472/A;1-WiMax M...	Part property wimax module and...
	visual camera : Visual Camera	visual camera : 000475/A;1-Visual ...	visual camera : 000475/A;1-Visual Ca...	Part property visual camera and ...
	trackers : Sensor			Part property trackers has no co...
	thermal camera : Thermal Camera	thermal camera : 000476/A;1-Ther...	thermal camera : 000476/A;1-Therma...	Part property thermal camera an...
	software : Software System	software : 000487/B;1-Software S...	software : 000487/B;1-Software Syst...	Part property software and part...
	payload controller : Payload Controller	payload controller : 000470/A;1-P...	payload controller : 000470/A;1-Payl...	Part property payload controller ...
	modem : Spread Spectrum Radio M...	modem : 000474/A;1-Spread Spec...	modem : 000474/A;1-Spread Spectru...	Part property modem and part o...
	ir detector : Wide Angle IR Detector	ir detector : 000477/A;1-Wide Ang...	ir detector : 000477/A;1-Wide Angle I...	Part property ir detector and pa...
	gps : GPS	gps : 000466/A;1-GPS	gps : 000466/A;1-GPS	Part property gps and part occu...
	gprs module : GPRS UMTS Module	gprs module : 000473/A;1-GPRS U...	gprs module : 000473/A;1-GPRS UMT...	Part property gprs module and p...
	flight controller : Flight Controller	flight controller : 000469/A;1-Fligh...	flight controller : 000469/A;1-Flight C...	Part property flight controller an...

[11:56:22] INFO Comparing SysML part property and Teamcenter part occurrence (BOM line with ref des) thermal camera.

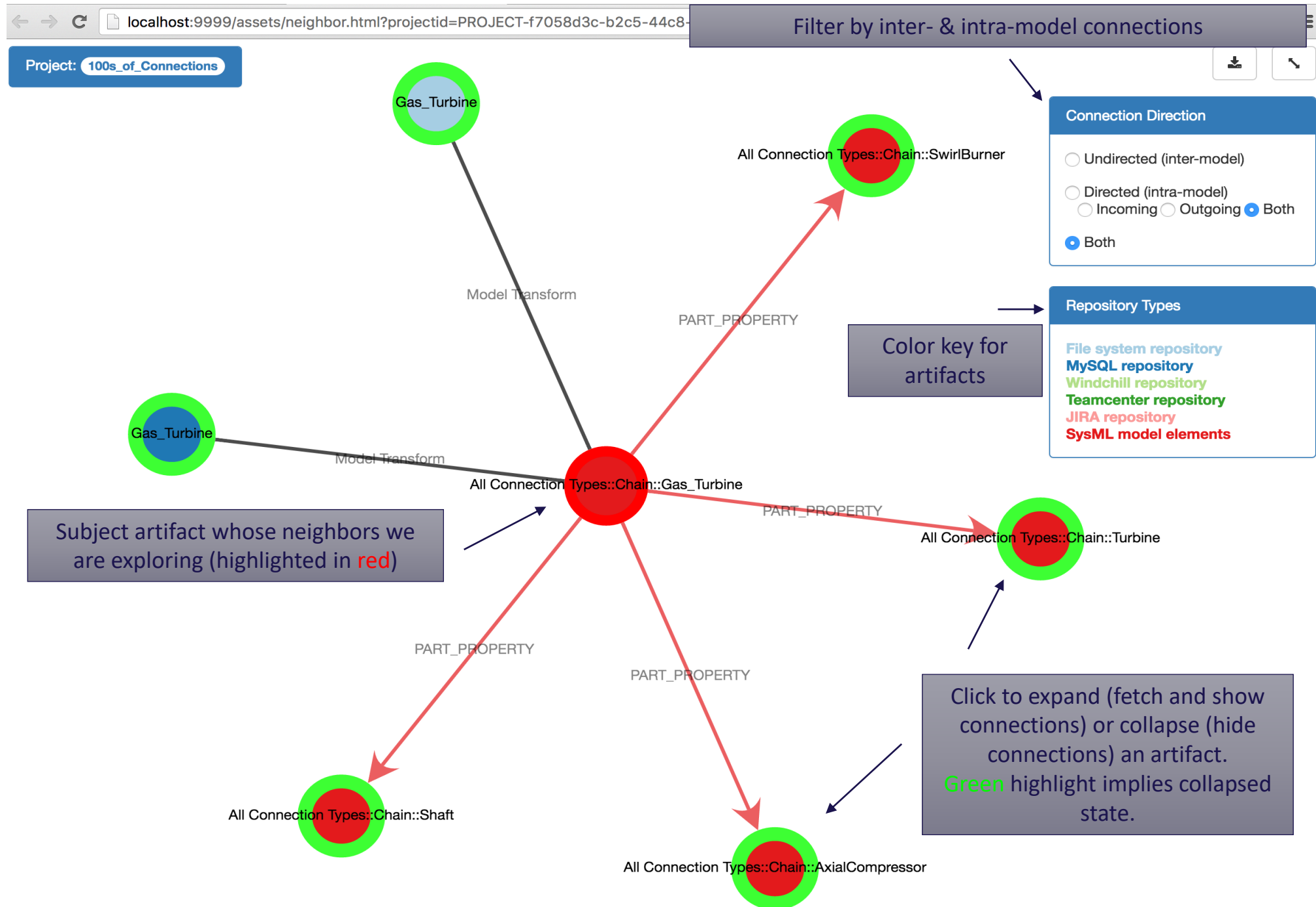
Ready 11:56:55 AM 549M of 735M

Example using Syndeia  
[www.syndeia.com](http://www.syndeia.com)

# Interactive Graph of Total System Model

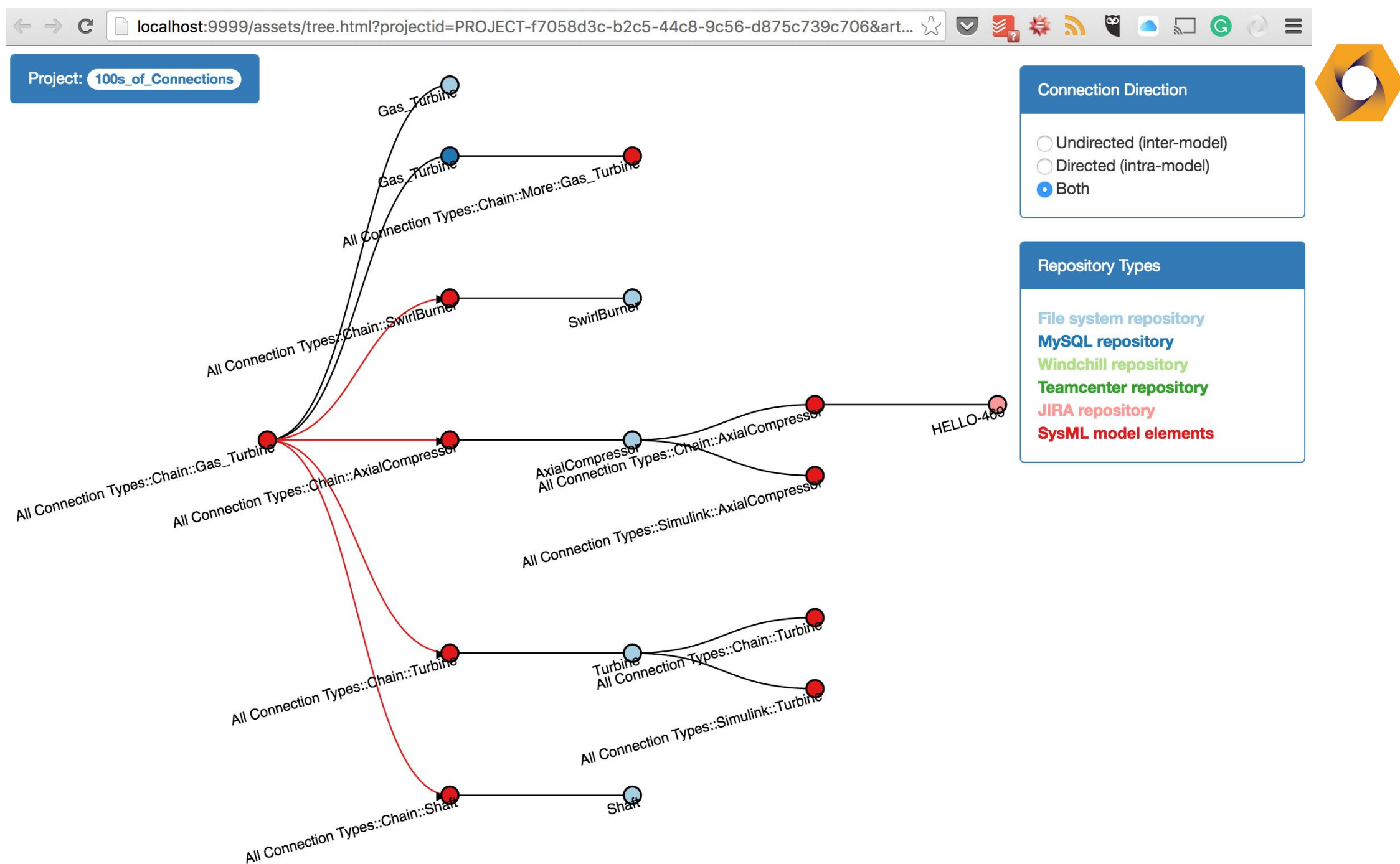


# Explore your neighbors

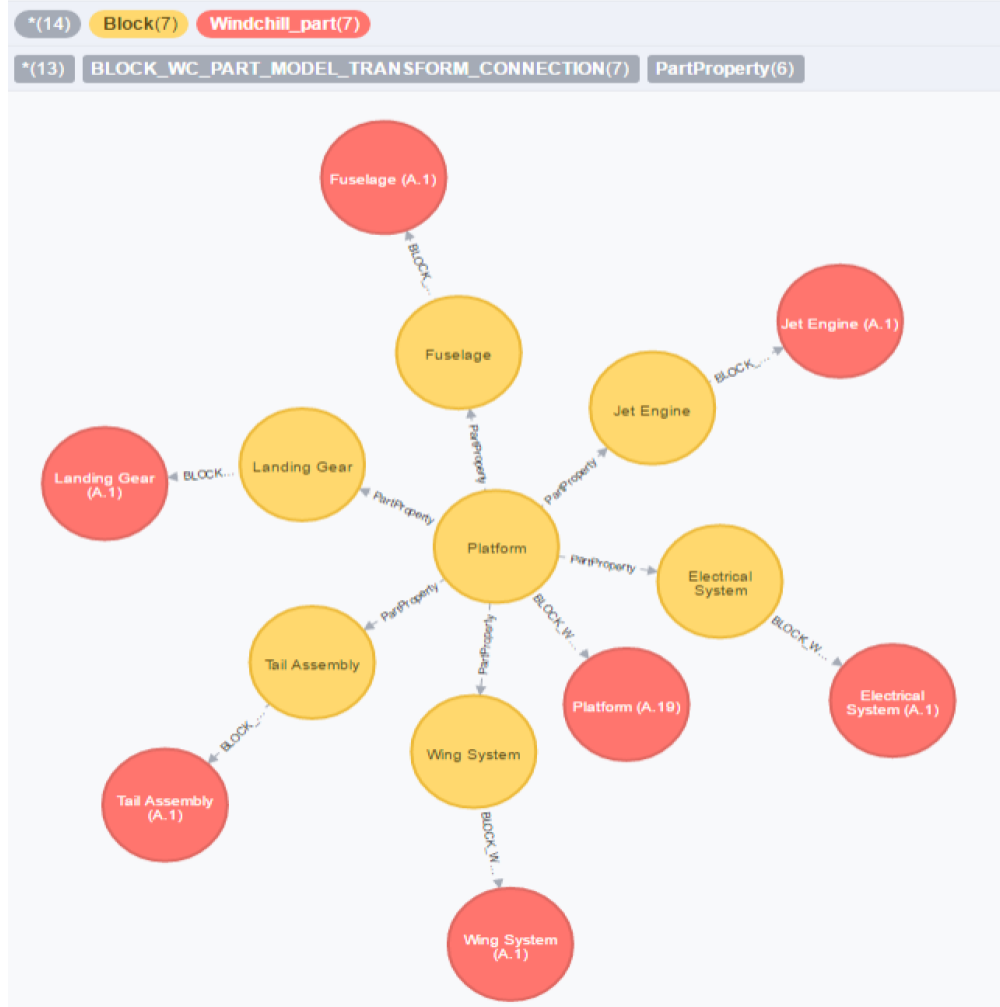




# Explore your neighbors (continued)

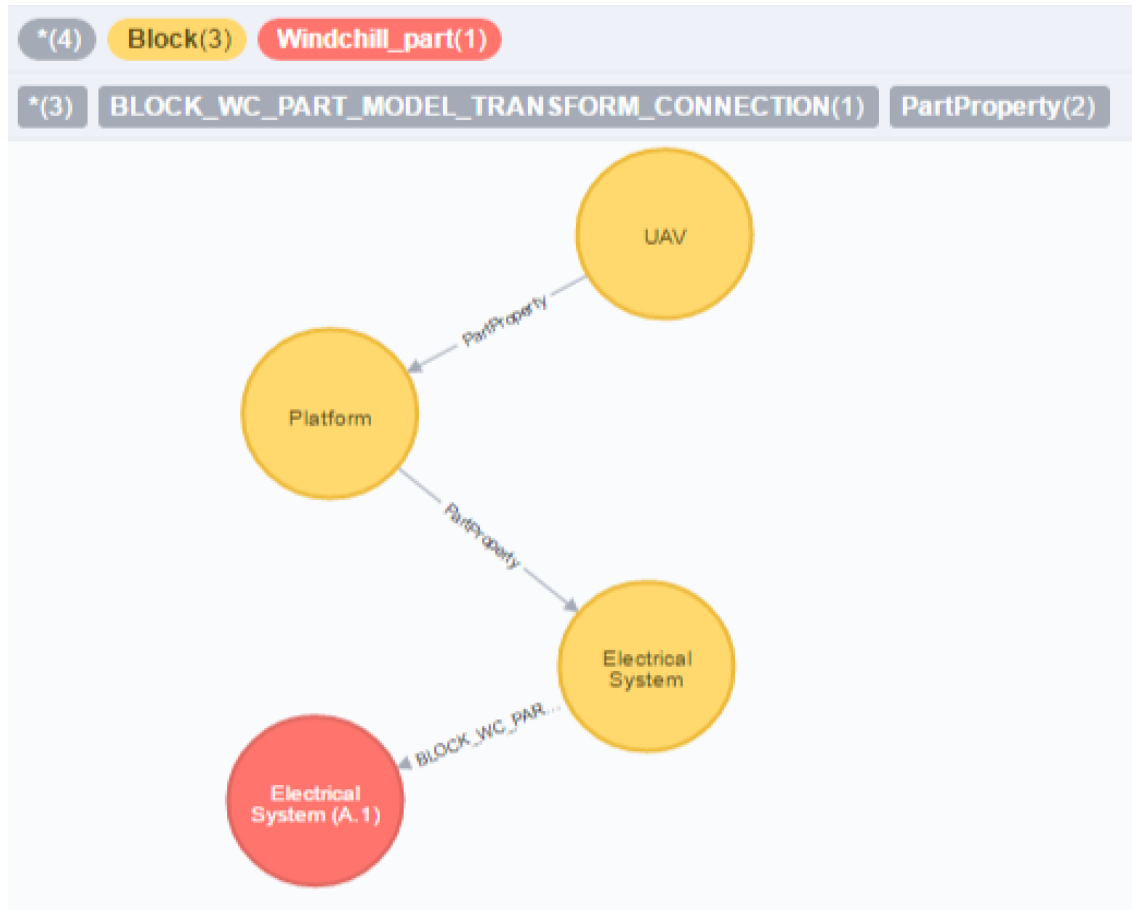


## 2. Get all connections between system architecture (SysML) and hardware parts (PLM)

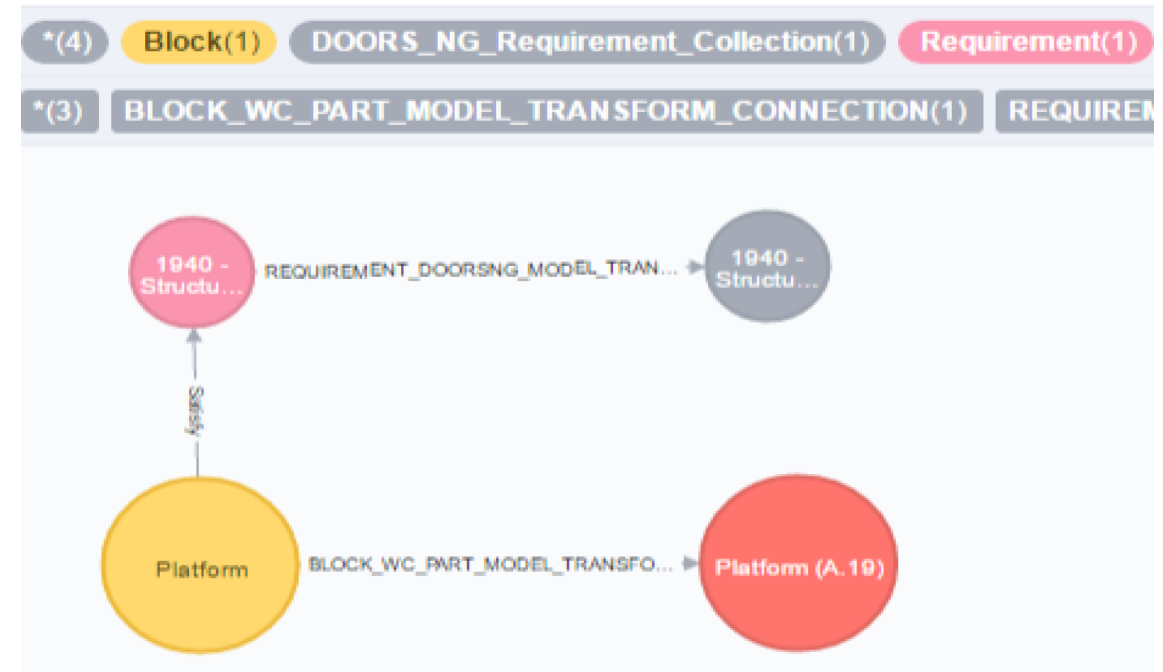




3. How does a failure in the Electrical System assembly (PLM) affect the overall UAV architecture (SysML)?



4. What hardware parts (PLM) may get affected if a requirement is changed (DOORS-NG)?



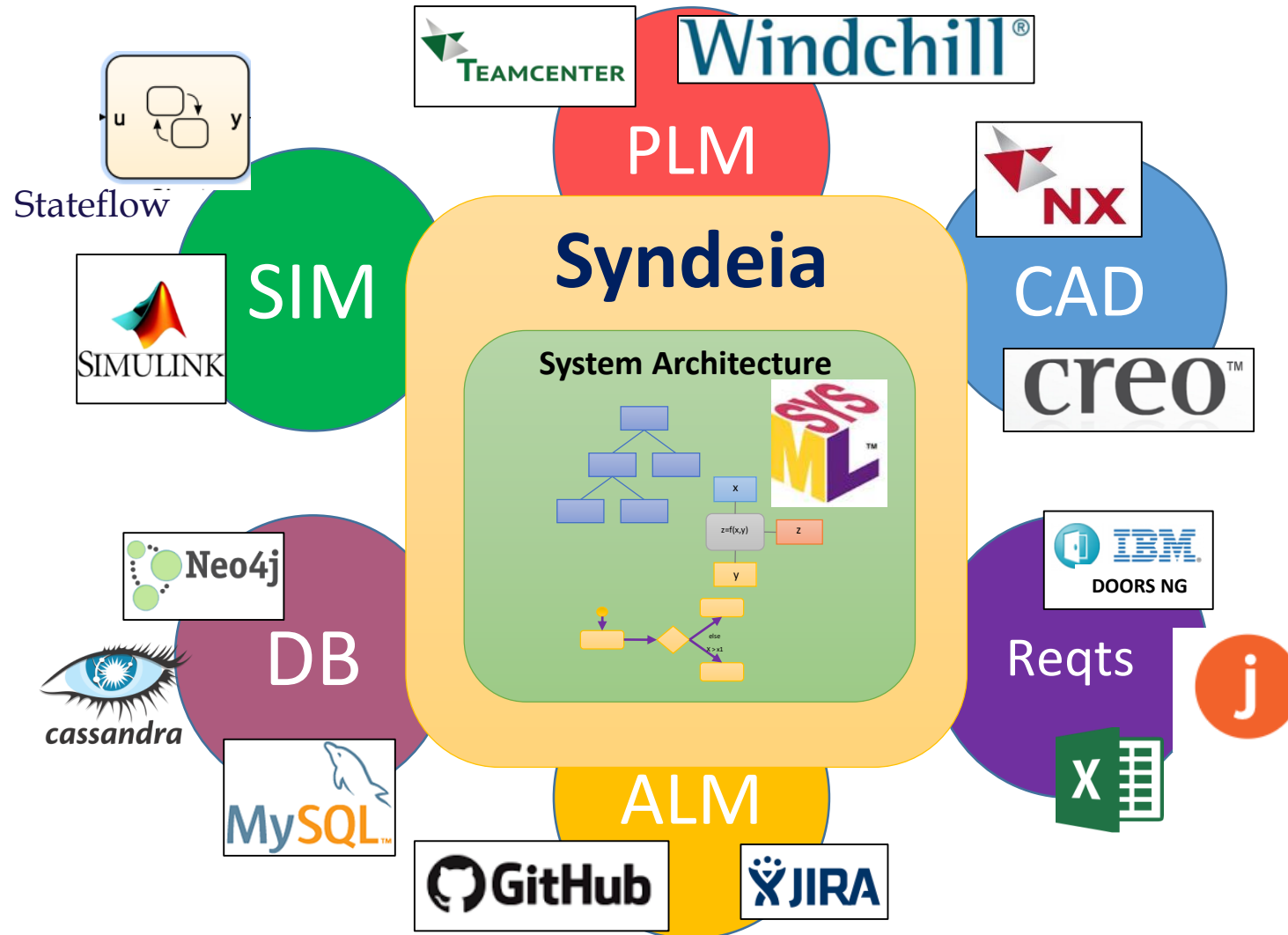


**Syndea 1.0 (SLIM)**  
**Jul 2014**

**Syndea 2.0**  
**Jul 2015**

**Syndea 3.0**  
**Jul 2016**

**Syndea 3.1**  
**May 2017**



## Syndea

- [www.syndea.com](http://www.syndea.com)
- YouTube demo video [www.intercax.com/products/syndea/demos/](http://www.intercax.com/products/syndea/demos/)
- Download a free evaluation [www.intercax.com/products/syndea/download/](http://www.intercax.com/products/syndea/download/)

# Syndeia 3.1 Interfaces



## Syndeia 3.1 Interfaces

SysML	MagicDraw (No Magic), Rhapsody (IBM)
PLM	Teamcenter (Siemens), Windchill (PTC)
CAD	Creo (PTC), NX (Siemens)
Simulation	Simulink (The Mathworks), Stateflow (The Mathworks)
Database	MySQL (Oracle), Excel (Microsoft), Apache Cassandra, Neo4j (Neo Tech)
Requirements	DOORS NG (IBM), Teamcenter (Siemens), Jama (Jama Software)
Project Management	JIRA (Atlassian)
ALM	GitHub (GitHub), JIRA (Atlassian)



- Systems Modeling Language
  - MagicDraw, Rhapsody, Enterprise Architect, Integrity Modeler
- REST Web Services
- JSON
- JDBC
- ISO STEP 10303
- Apache projects (multiple)
- OSLC
- FMI
- ... and others





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Web – [www.intercax.com](http://www.intercax.com)

LinkedIn - [www.linkedin.com/in/manasbajaj](http://www.linkedin.com/in/manasbajaj)

Twitter - @intercax @syndeia @manasbajaj



## Appendix



## OMG Systems Modeling Language™ (SysML®)

The current version is found at <http://www.omg.org/spec/SysML/Current>

### OMG Formal Versions Of SysML

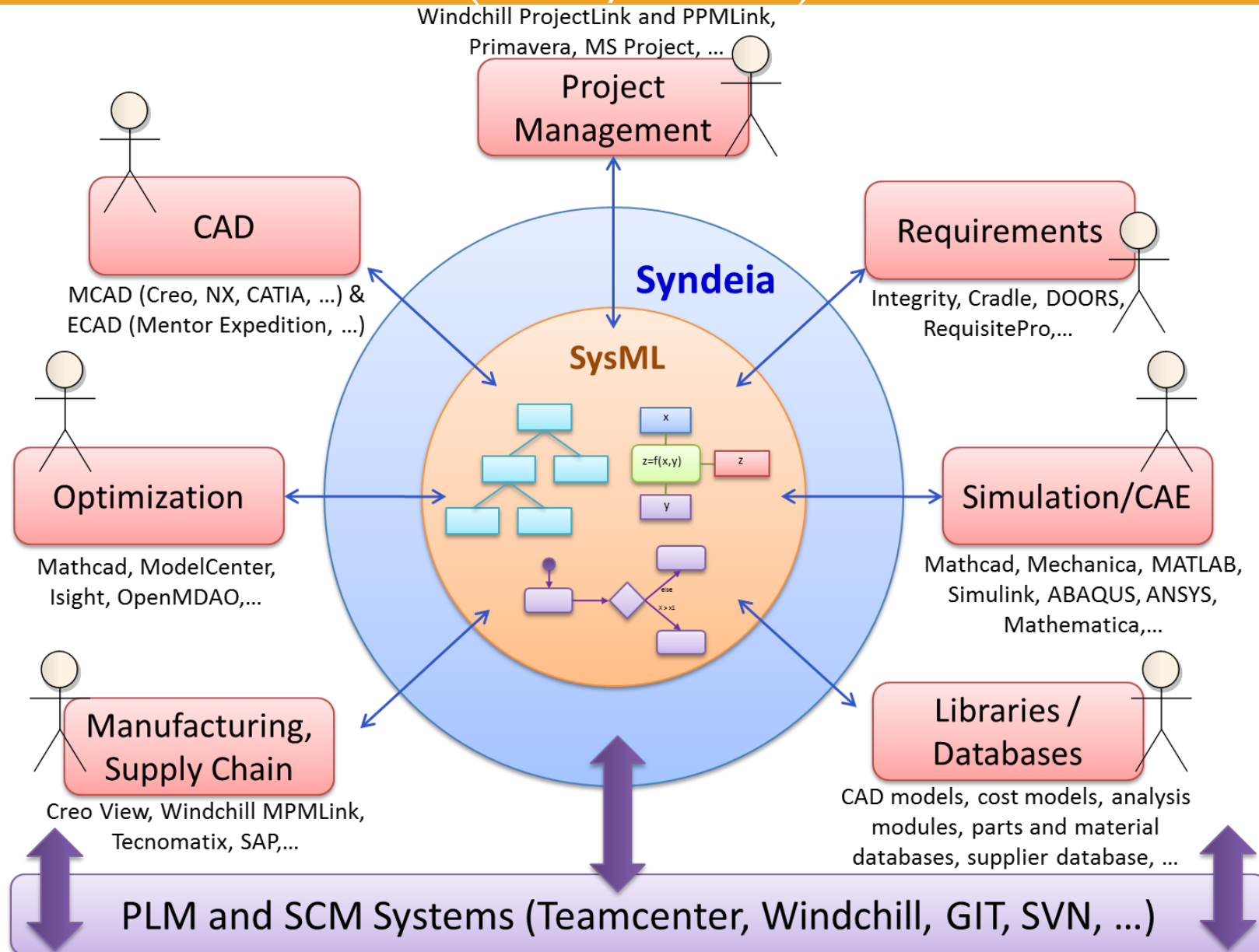
FORMAL Version	Release date	URL
1.5	May 2017	<a href="http://www.omg.org/spec/SysML/1.5/">http://www.omg.org/spec/SysML/1.5/</a>
1.4	September 2015	<a href="http://www.omg.org/spec/SysML/1.4/">http://www.omg.org/spec/SysML/1.4/</a>
1.3	June 2012	<a href="http://www.omg.org/spec/SysML/1.3/">http://www.omg.org/spec/SysML/1.3/</a>
1.2	June 2010	<a href="http://www.omg.org/spec/SysML/1.2/">http://www.omg.org/spec/SysML/1.2/</a>
1.1	November 2008	<a href="http://www.omg.org/spec/SysML/1.1/">http://www.omg.org/spec/SysML/1.1/</a>
1.0	September 2007	<a href="http://www.omg.org/spec/SysML/1.0/">http://www.omg.org/spec/SysML/1.0/</a>

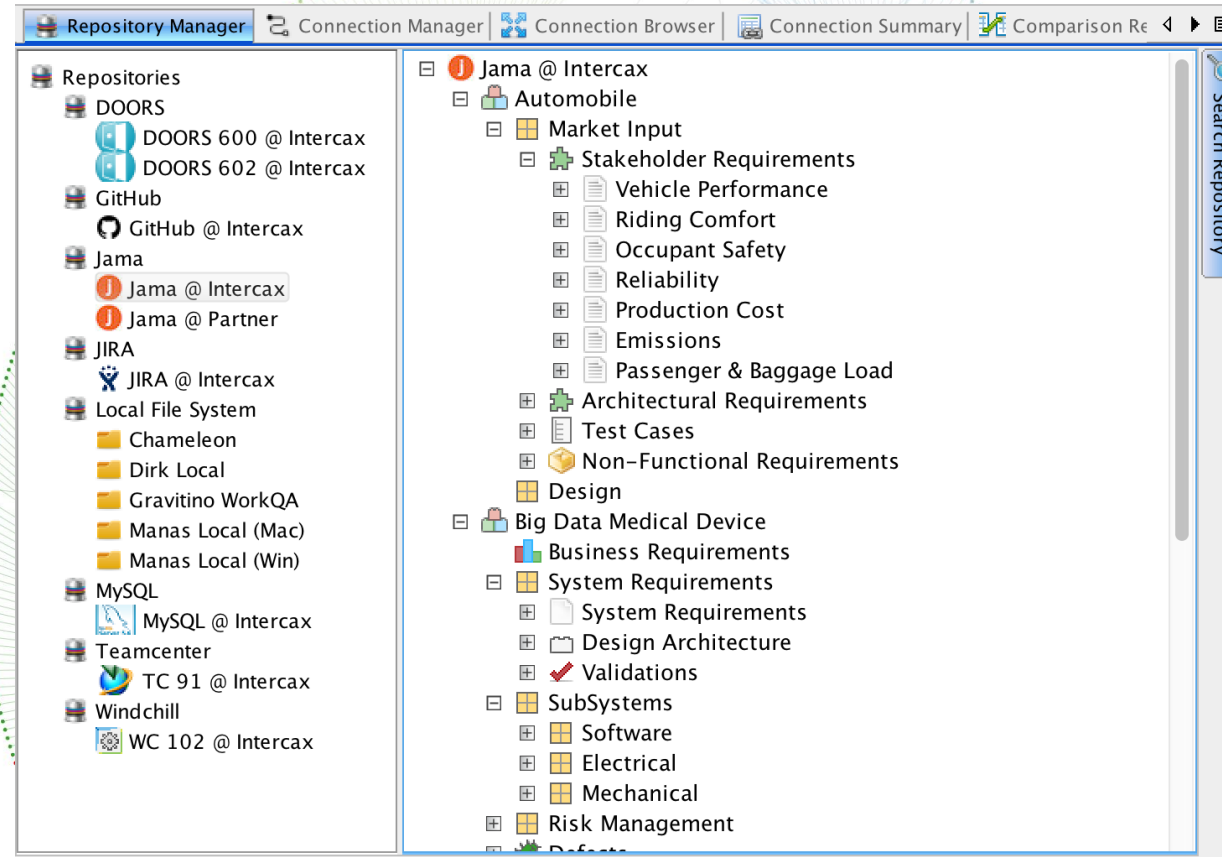
### ISO Release Information

ISO Release Information	Format	URL
This is the formally published 2017 edition standard - ISO/IEC 19514.	PDF	<a href="http://www.omg.org/spec/SysML/ISO/19514/PDF">http://www.omg.org/spec/SysML/ISO/19514/PDF</a>



# Syndeia for Model-based Engineering (MBE/MBSE)

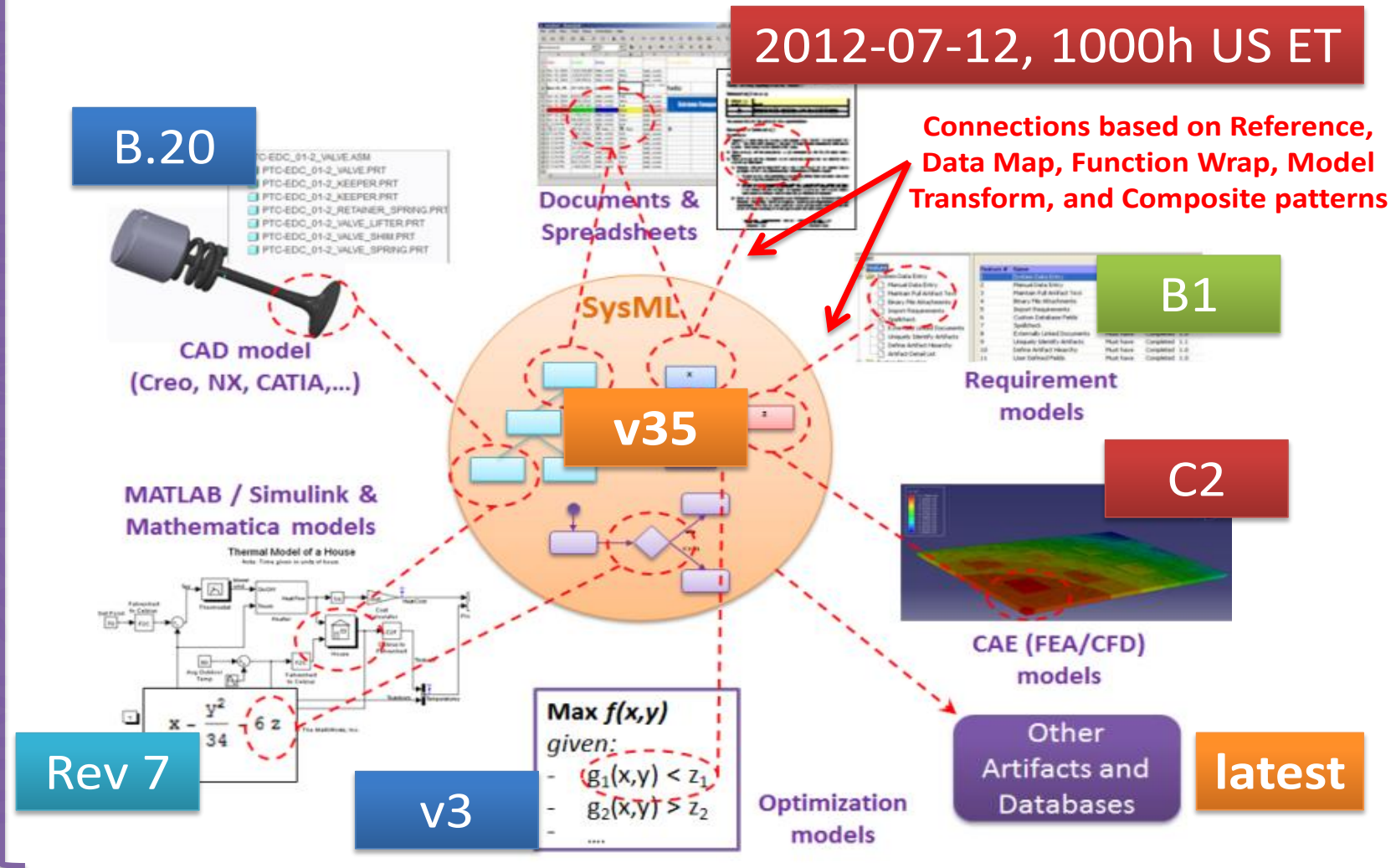




# Syndeaia creates & manages the Total System Model graph



## TOTAL SYSTEM MODEL (TSM)





Repository Manager

Connection Manager

Connection Summary

Comparison Result

Settings

Repositories

DOORS

DOORS @ Intercax

DOORS @ Supplier A

GitHub

GitHub @ Intercax

JIRA

JIRA @ Intercax

Local File System

Creo Models

Excel Models

NX Models

Simulink Models

MySQL

MySQL @ Intercax

Parts Lib @ Supplier A

RESTful

Teamcenter

TC9 @ Intercax

TC9 @ manas

Windchill

WC @ Supplier B

WC10.2 @ Intercax

DOORS @ Intercax

Automated Meter Reader (Water)

Unmanned Aerial Vehicle

Fire Station

Automobile

1171 - Automobile Project-level Requirement Collection

1172 - Automobile Project Kick-off Requirement

Link From

1171 - Automobile Project-level Requirement Collection

1173 - Automobile Project Schedule Requirement

1871 - Automobile Project-level Module

2090 - D1

Automobile Project-level Module artifacts

Customer Specification

1144 - Automobile Customer Specification Module

1147 - Vehicle Performance

1146 - Passenger and Baggage Load

1159 - Fuel Economy

1152 - Riding Comfort

1153 - Space

1154 - Vibration

1155 - Noise

1156 - Occupant Safety

1157 - Reliability

1158 - Emissions

1160 - Production Cost

1162 - Passenger Comfort-related Requirements

1161 - Automobile Customer Req Collection

1152 - Riding Comfort

1147 - Vehicle Performance

1151 - Turning Radius

1153 - Space

1155 - Noise

1149 - Top Speed

1156 - Occupant Safety

1150 - Braking Distance

DOORS-NG repository

Project

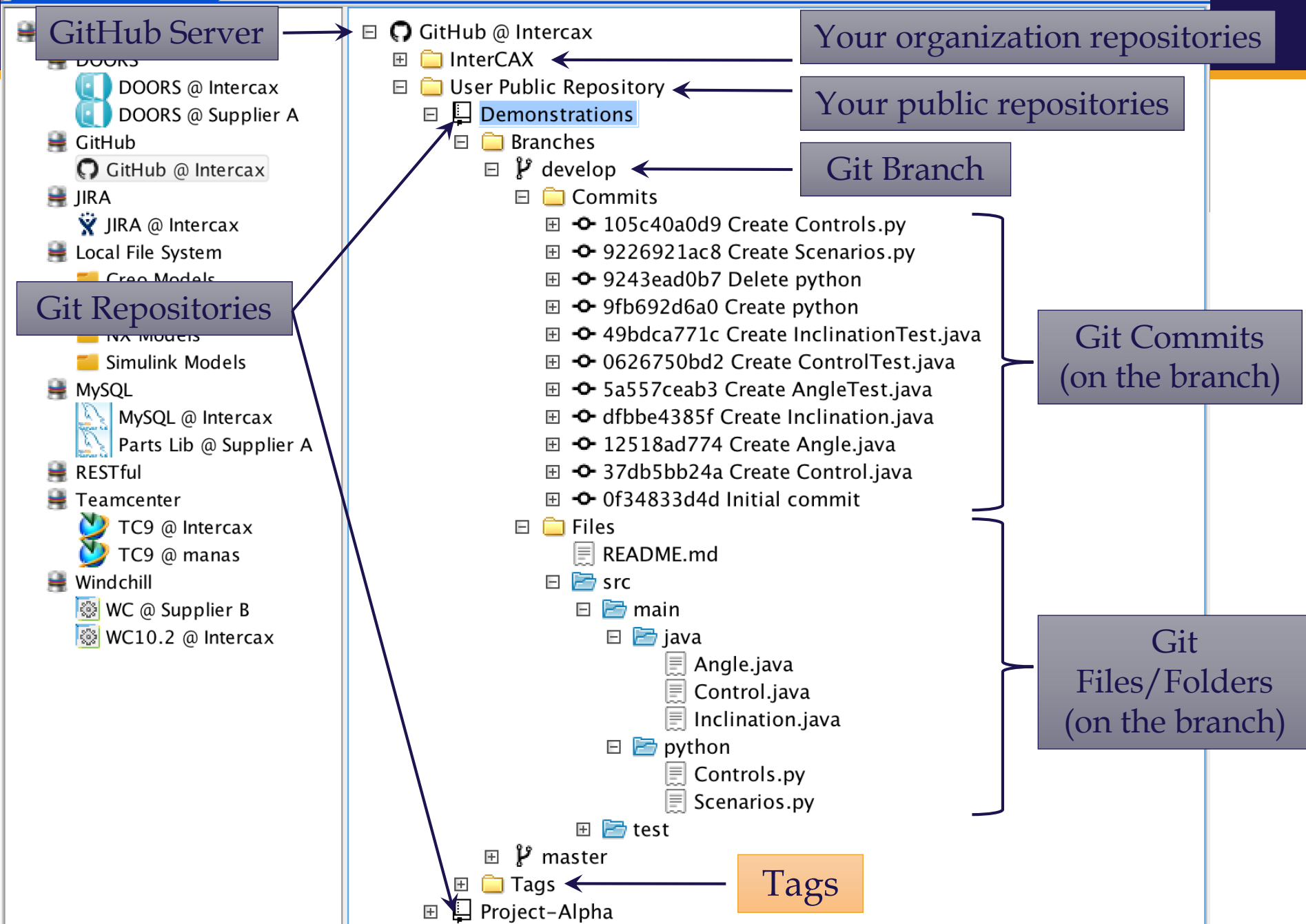
Link

Folder

Module

Requirements

Requirement Collection



Repositories

DOORS

DOORS @ Intercax

DOORS @ Supplier A

GitHub

GitHub @ Intercax

JIRA

JIRA @ Intercax

Local File System

Creo Models

Ex...

NX

Simulink Models

MySQL

MySQL @ Intercax

Parts Lib @ Supplier A

RESTful

Teamcenter

TC9 @ Intercax

TC9 @ manas

Windchill

JIRA @ Intercax

Projects

Big Bang (BIG)

HelloJIRA (HELLO)

Syndeia Demo Box (SDB)

SDB-128

Project: Syndeia Demo Box

Summary: Problem with the document

Type: Bug

Status: Open

Priority: Major

Updated: 2016-06-30T08:31:24

Assignee: manasbajaj

Reporter: manasbajaj

SDB-127

SDB-126

SDB-118

SysML Interface (SYSML)

Test-Basic-Desk (TESTBASIC)

Test-IT-Service-Desk (TESTITDESK)

Issues

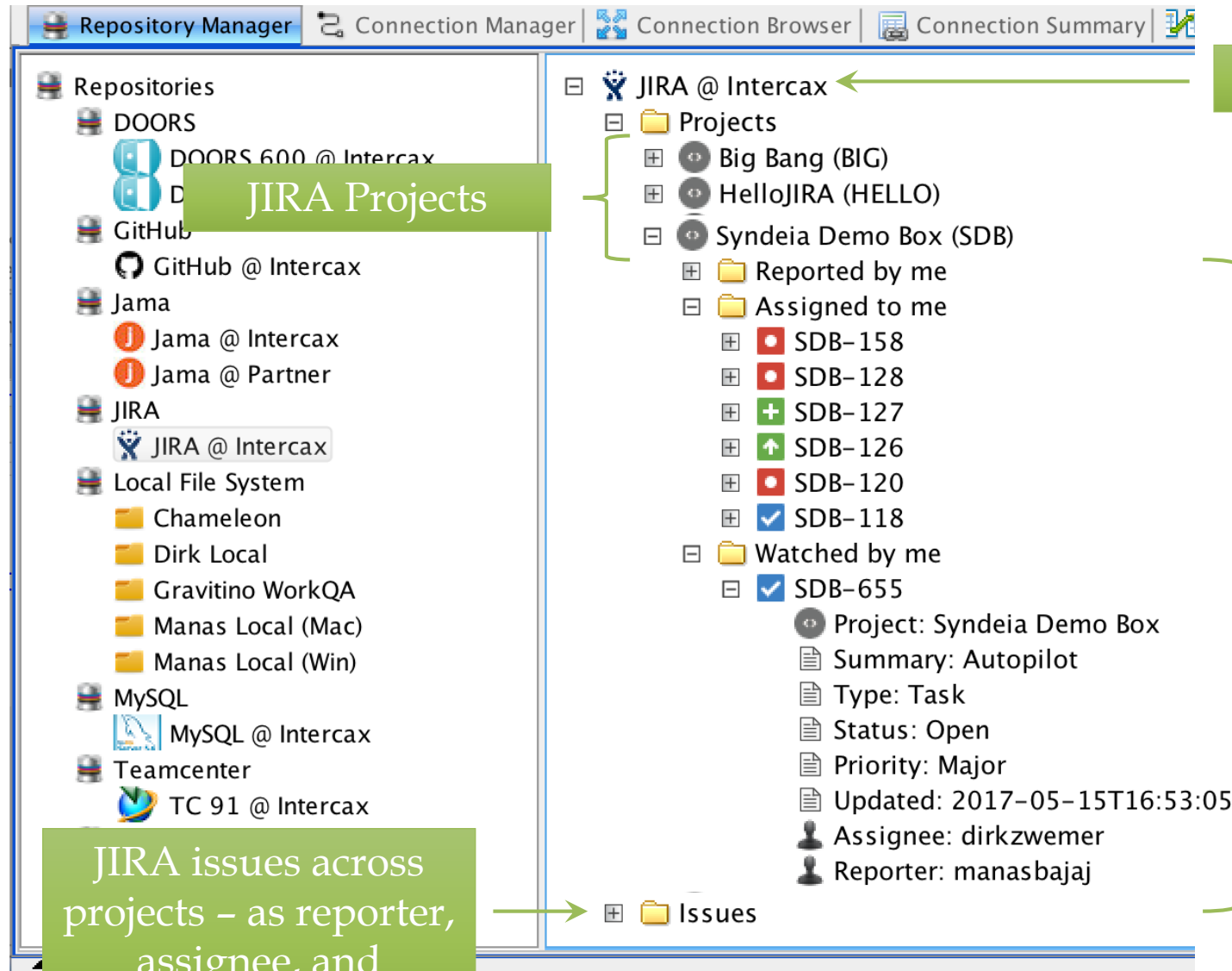
JIRA repository

JIRA Projects

Issue details

JIRA Issues (assigned to you for this project)

JIRA Issues (assigned to you for all projects)

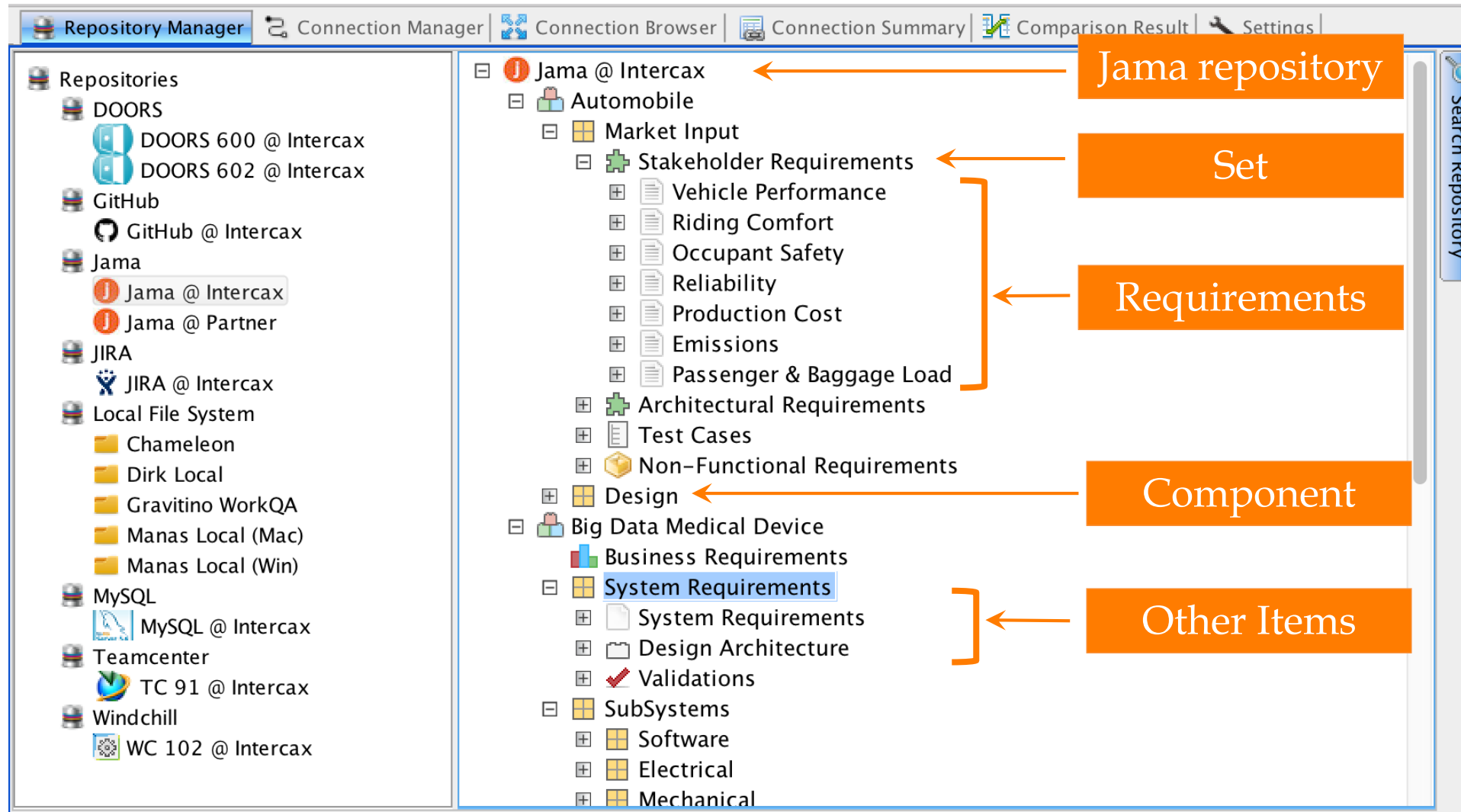


JIRA repository

JIRA Issues for a project – as reporter, assignee, and watcher

JIRA issues across projects – as reporter, assignee, and watcher





View model analytics

Fit-to-screen, Download



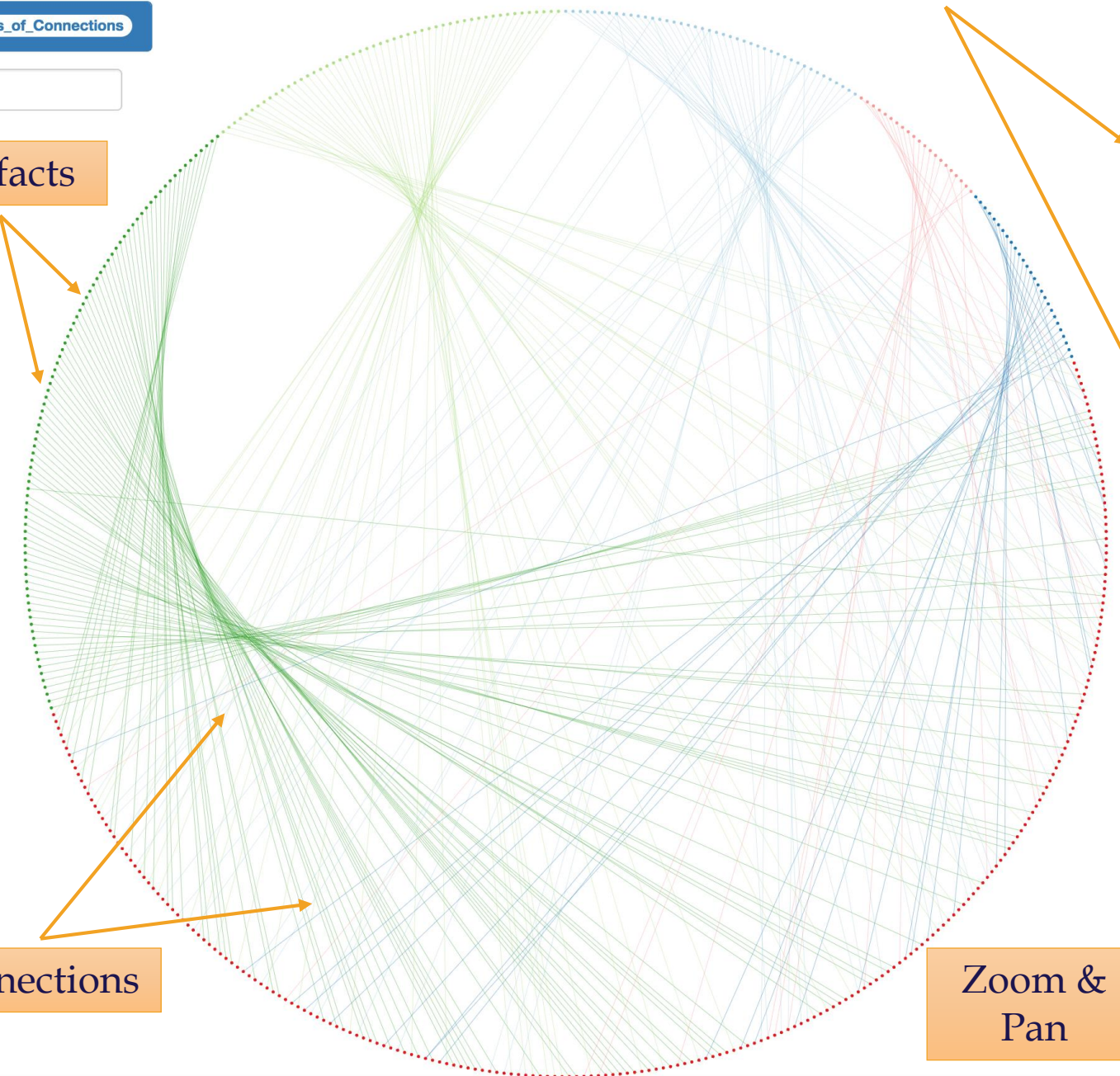
Project: 100s\_of\_Connections

Search

Artifacts

Connections

Zoom & Pan



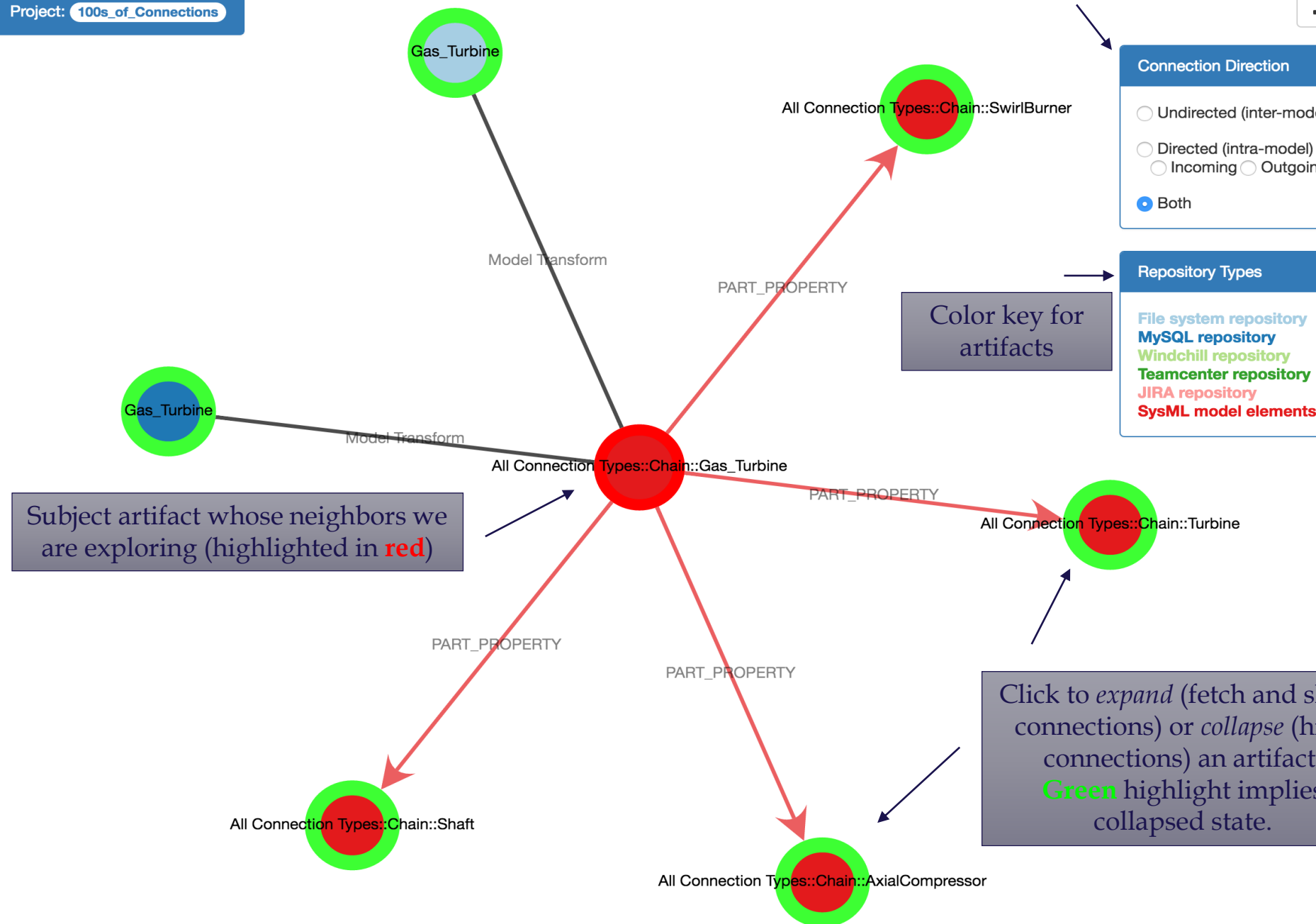
Totals (Inter-model analytics)	
# connections (c) =	245
# connected artifacts (a) =	467
connection density (c / a) =	0.52

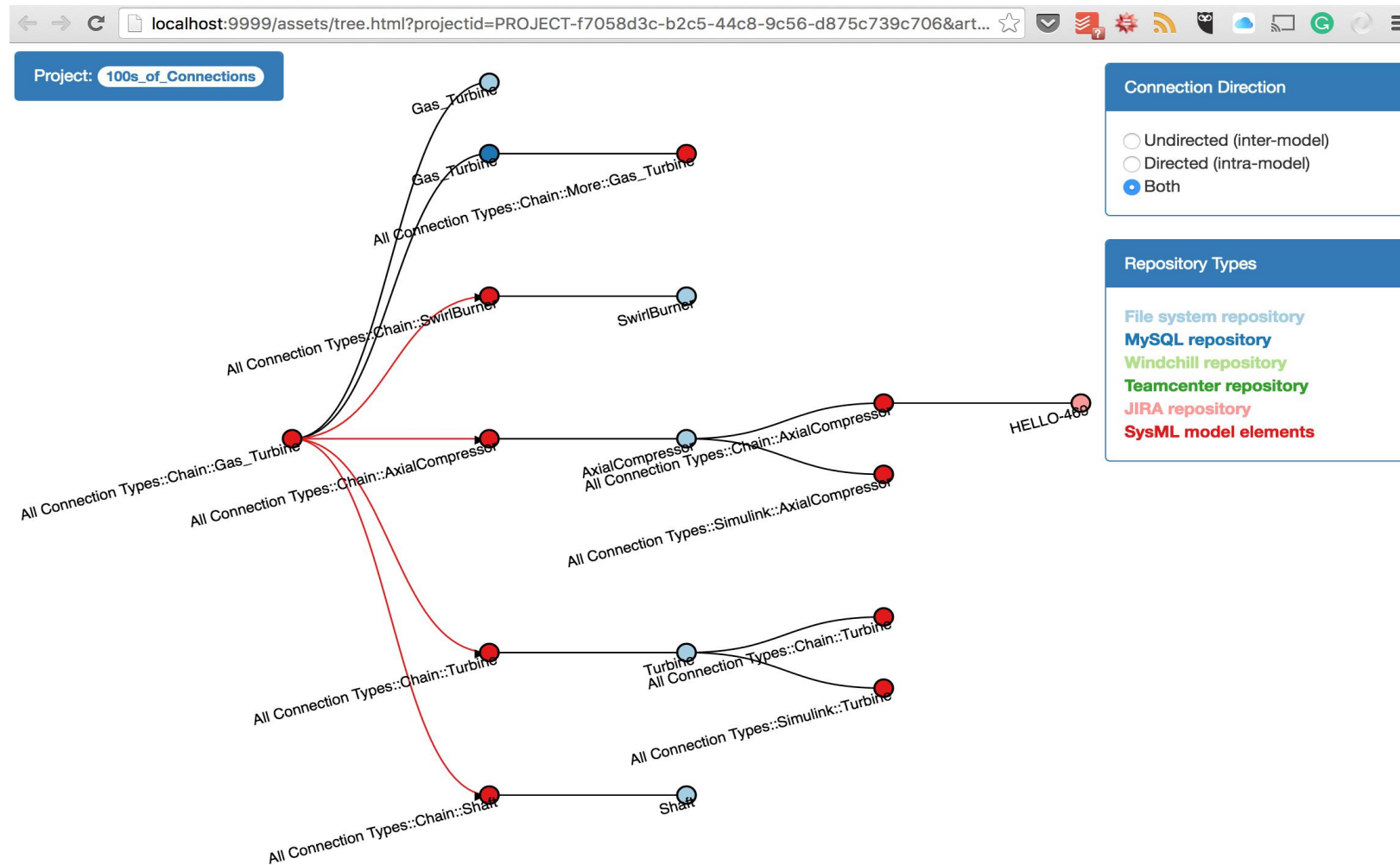
Displayed (Inter-model analytics)	
# connections (c) =	245
# connected artifacts (a) =	467
connection density (c / a) =	0.52

- | Repositories (Artifacts per repository) |                                |
|---|--------------------------------|
| <b>File system repositories</b>         |                                |
| <input checked="" type="checkbox"/>     | Simulink Demo (0 artifacts)    |
| <input checked="" type="checkbox"/>     | SL Examples (0 artifacts)      |
| <input checked="" type="checkbox"/>     | BioMed (0 artifacts)           |
| <input checked="" type="checkbox"/>     | SLIM Repository (43 artifacts) |
| <input checked="" type="checkbox"/>     | MATLAB Directory (0 artifacts) |
| <b>MySQL repositories</b>               |                                |
| <input checked="" type="checkbox"/>     | MySQL (27 artifacts)           |
| <b>Windchill repositories</b>           |                                |
| <input checked="" type="checkbox"/>     | WC (51 artifacts)              |
| <b>Teamcenter repositories</b>          |                                |
| <input checked="" type="checkbox"/>     | TC (89 artifacts)              |



Project: 100s\_of\_Connections









# Connect and deep dive into PLM systems and databases

The screenshot displays the Repository Manager application with the following components:

- Repository Manager** (Main Window):
  - Repositories Panel:** Lists Local File System Repositories (Creo, NX, Simulink), MySQL Repositories (MySQL1), Teamcenter Repositories (TC101, TC91), and Windchill Repositories (WC101, WC102).
  - Tree View:** Shows a hierarchy starting with 'Requirements', followed by 'Satellite (Precise BOM)', 'TraceLinks', and 'UAV (Imprecise BOM)'. Under 'UAV', it lists '000464-Unmanned Aerial Vehicle' and its sub-items like '000464/A;1-Unmanned Aerial Vehicle', '000464/B;1-Unmanned Aerial Vehicle', '000464/C;2-Unmanned Aerial Vehicle', 'Unmanned Aerial Vehicle->Fire', and '000464/C-View (Imprecise)'.
- Teamcenter** (Highlighted):
  - Shows a 'Part Structure (latest)' for 'UnmannedAerialVehicle (A. 16)'.
  - Includes components like 'auto1: Autopilot (A. 1)', 'comm\_con1: Communication', 'databus: Data\_Bus (A. 1)', 'flight\_con1: FlightControl', 'gprs1: GPRS\_UMTS\_Modem', 'gps: GPS (A. 1)', 'pltfm1: Aircraft\_Platform', 'pyld\_con1: PayloadControl', 'ssr1: SpreadSpectrumRadar', 'sw: UAS\_Software\_Abs', 'therm1: ThermalCamera', 'therm2: WideAngleIR\_Detector', 'vis1: VisualCamera (A. 1)', and 'wifi1: WiFi\_WiMax\_Modem'.
- Windchill** (Highlighted):
  - Shows a 'Part Structure (latest)' for 'UnmannedAerialVehicle (A. 16)'.
  - Includes components like 'auto1: Autopilot (A. 1)', 'comm\_con1: Communication', 'databus: Data\_Bus (A. 1)', 'flight\_con1: FlightControl', 'gprs1: GPRS\_UMTS\_Modem', 'gps: GPS (A. 1)', 'pltfm1: Aircraft\_Platform', 'pyld\_con1: PayloadControl', 'ssr1: SpreadSpectrumRadar', 'sw: UAS\_Software\_Abs', 'therm1: ThermalCamera', 'therm2: WideAngleIR\_Detector', 'vis1: VisualCamera (A. 1)', and 'wifi1: WiFi\_WiMax\_Modem'.
- MySQL** (Highlighted):
  - Shows a 'Part Structure (latest)' for 'UnmannedAerialVehicle (A. 16)'.
  - Includes components like 'auto1: Autopilot (A. 1)', 'comm\_con1: Communication', 'databus: Data\_Bus (A. 1)', 'flight\_con1: FlightControl', 'gprs1: GPRS\_UMTS\_Modem', 'gps: GPS (A. 1)', 'pltfm1: Aircraft\_Platform', 'pyld\_con1: PayloadControl', 'ssr1: SpreadSpectrumRadar', 'sw: UAS\_Software\_Abs', 'therm1: ThermalCamera', 'therm2: WideAngleIR\_Detector', 'vis1: VisualCamera (A. 1)', and 'wifi1: WiFi\_WiMax\_Modem'.

# Drag-n-Drop generates models & creates connections



**Syndeia Dashboard (2.0.0) - Unmanned Aerial Vehicle**

**Repository Manager** | **Connection Manager** | **Connection Browser** | **Connection Summary** | **Comparison Result** | **Settings**

**SysML Model**

- Unmanned Aerial Vehicle
  - Aircraft Platform
    - blackbox : BlackBox
    - body : Body
    - elec assembly : Electrical Assembly
    - engine : Engine
    - fule system : Fuel System
    - powetrain : Powertrain
    - rotor : Rotor
    - tail assembly : Tail Assembly
  - Analysis Manager
  - APU
  - Autopilot
  - Battery
  - BlackBox
  - Body
  - Communications Controller
  - Communications Interface
  - Cowling

**Connection Type**

- ☐ Reference
- ☐ Function Wrap
- ☐ Data Map
- ☒ Model Transform

**TC91**

- Requirements
- Satellite (Precise BOM)
- TraceLinks
- UAV (Imprecise BOM)
  - 000464-Unmanned Aerial Vehicle
    - 000464/A;1-Unmanned Aerial Veh
    - 000464/B;1-Unmanned Aerial Veh
    - 000464/C;2-Unmanned Aerial Veh
    - Unmanned Aerial Vehicle->Fir
    - 000464/C-View ( Imprecise )
  - aircraft platform : 000465
  - gps : 000466/A;1-GPS
  - autopilot : 000467/A;1-Autopilo
  - databus : 000468/A;1-Databus
  - flight controller : 000469/A;1-Fli
  - payload controller : 000470/A;1
  - communications controller : 000
  - wimax module : 000472/A;1-Wif
  - gprs module : 000473/A;1-GPRS

**Drag-n-Drop**

**Switch repos**

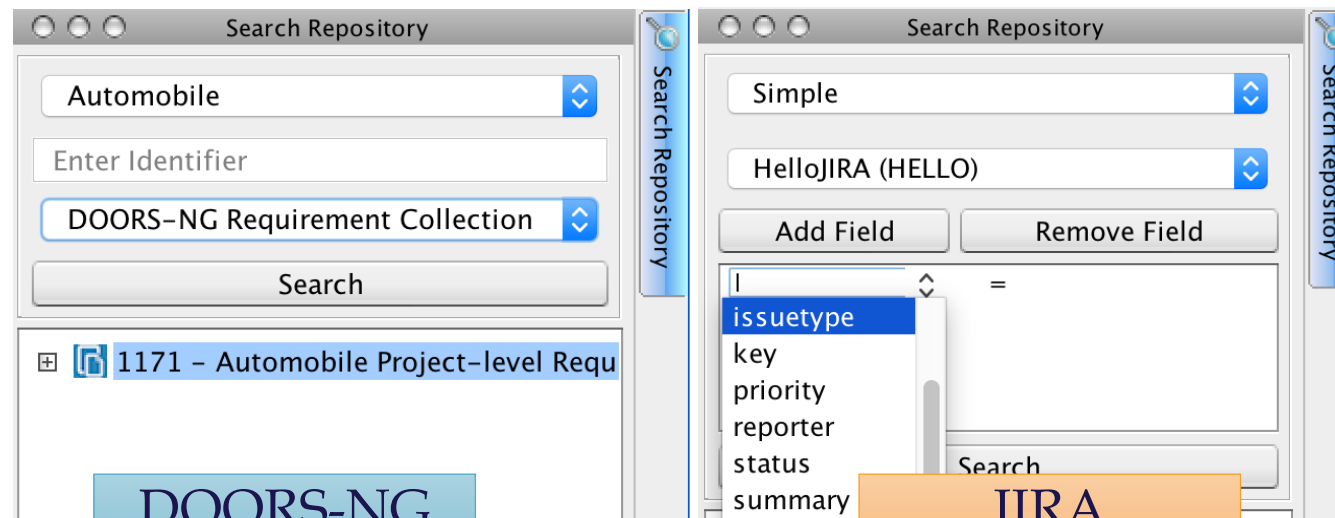
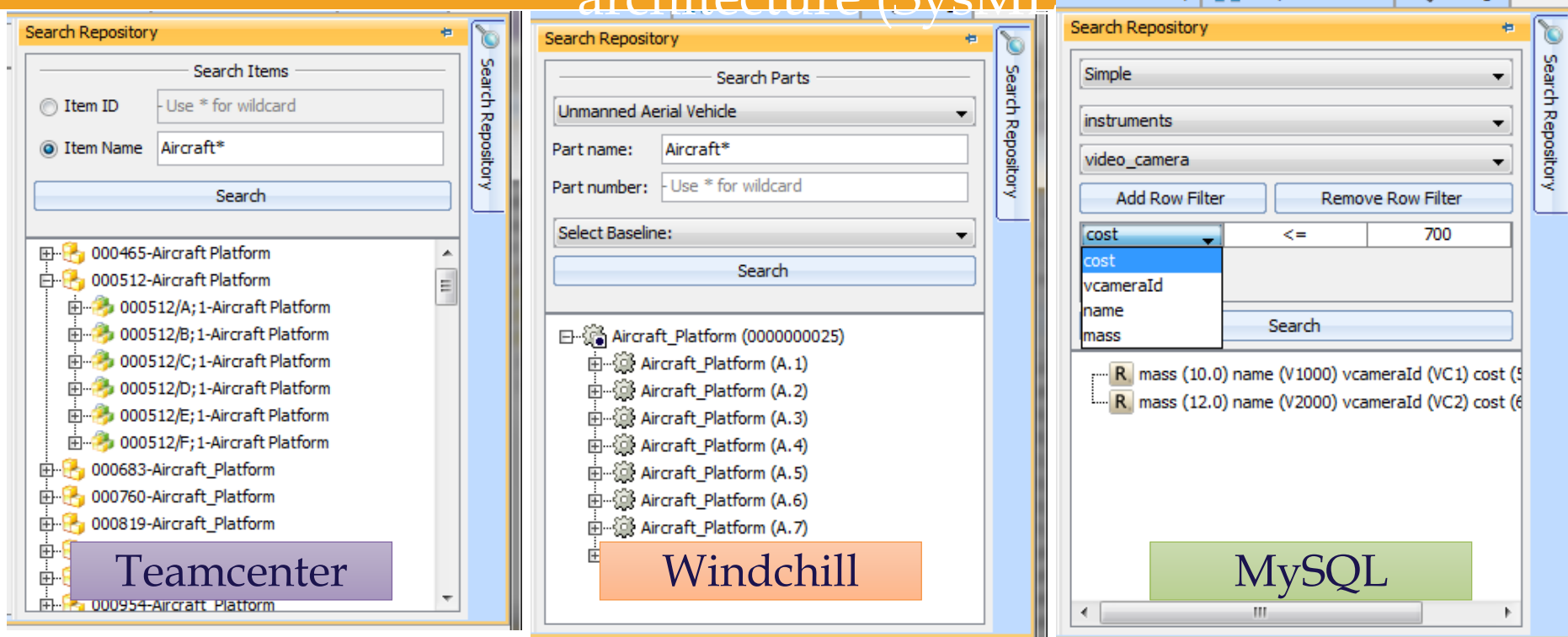
- Local File System Repositories
  - Creo
  - NX
  - Simulink
- MySQL Repositories
  - MySQL 1
- Teamcenter Repositories
  - TC101
  - TC91
- Windchill Repositories
  - WC101
  - WC102

**Log:**

```
BLOCK_TC_PART_MODEL_TRANSFORM_CONNECTION
[10:52:48] INFO SysML dependencies will not be generated from Teamcenter trace links for item DDS Middleware. Option to generate SysML dependencies and trace links is not selected in Syndeia settings.
[10:52:48] INFO Finished generating block structure and creating connections for part DDS Middleware
[10:52:48] INFO SysML dependencies will not be generated from Teamcenter trace links for item Software System. Option to generate SysML dependencies and trace links is not selected in Syndeia settings.
```

**Ready** | 10:54:22 AM | 442M of 791M

Search enterprise repositories from the SysML Dashboard. Open results in native clients or drag-n-drop to connect to system architecture (SysML)



Browse, filter, search connections. Open connected models.



The screenshot displays the Syndeia Dashboard (2.0.0) interface. The main window is titled "Syndeia Dashboard (2.0.0) - Unmanned Aerial Vehicle". It features a "Repository Manager" tab and a "Connection Manager" tab. The "Connection Manager" tab is active, showing a table of connections between SysML elements and targets. The table has columns: Source (SysML Element), Name, Type, and Target. The "Unmanned Aerial Vehicle" repository is expanded, showing various components like Aircraft Platform, Analysis Manager, APU, Autopilot, Battery, BlackBox, Body, and Communications Controller. A context menu is open over the "Aircraft Platform" connection, with the "Open Target" option highlighted. The menu also includes options like "Expand All", "Collapse All", "Refresh", "Go to...", "Compare SysML & Target", "Sync SysML -> Target", "Sync Target -> SysML", and "Delete Connection(s)".

Source (SysML Element)	Name	Type	Target
Unmanned Aerial Vehicle			
Aircraft Platform			
Analysis Manager	[Unmanned Aerial Vehicle::...	BLOCK_TC_PART_MODE...	000465/E;1-Aircra
APU	[Unmanned Aerial Vehicle::...	BLOCK_TC_PART_MODE...	000492/A;1-Analy
Autopilot	[Unmanned Aerial Vehicle::...	BLOCK_TC_PART_MODE...	000566/A;1-APU
Battery	[Unmanned Aerial Vehicle::...		
BlackBox	[Unmanned Aerial Vehicle::...		
Body	[Unmanned Aerial Vehicle::...		
Communications Controller	[Unmanned Aerial Vehicle::...		

loaded) between artifacts {[Unmanned Aerial Vehicle::Commu  
successfully added to connection manager.

Ready

My Teamcenter

Overview Related Datasets Impact Analysis

Available Revisions Viewer Details

000465/E;1-Aircraft Platform Owner : Manas Bajaj (manas)

Last Modified Date : 23-Apr-2014 15:21 Release Status :

Type : ItemRevision

Open Cut Copy Paste Delete Properties

Add to Favorites

Item Properties

Description

Item: 000465-Aircraft Platform

Owner: Manas Bajaj (manas)

Group ID: dba

Last Modifying: Manas Bajaj

*Synidea opens models in native repositories (e.g. Teamcenter)*





## Compare and Sync (bi-directionally) using model-based connections

Syndeia Dashboard (2.0.0) - Unmanned Aerial Vehicle

Repository Manager | Connection Manager | Connection Browser | Connection Summary | Comparison Result | Settings

Q- Type here to filter connections

Clear Export to Excel

Conn ID	Source	Target	Latest Target	Comment
e3f03...	Unmanned Aerial Vehicle	000464/C;2-Unmanned Aerial Vehicle	000464/C;2-Unmanned Aerial Vehicle	The block Unmanned Aerial Vehic...
	wimax module : WiMax Module	wimax module : 000472/A;1-WiMa...	wimax module : 000472/A;1-WiMax M...	Part property wimax module and...
	visual camera : Visual Camera	visual camera : 000475/A;1-Visual ...	visual camera : 000475/A;1-Visual Ca...	Part property visual camera and ...
	trackers : Sensor			Part property trackers has no co...
	thermal camera : Thermal Camera	thermal camera : 000476/A;1-Ther...	thermal camera : 000476/A;1-Therma...	Part property thermal camera an...
	software : Software System	software : 000487/B;1-Software S...	software : 000487/B;1-Software Syst...	Part property software and part...
	payload controller : Payload Controller	payload controller : 000470/A;1-P...	payload controller : 000470/A;1-Payl...	Part property payload controller ...
	modem : Spread Spectrum Radio M...	modem : 000474/A;1-Spread Spec...	modem : 000474/A;1-Spread Spectru...	Part property modem and part o...
	ir detector : Wide Angle IR Detector	ir detector : 000477/A;1-Wide Ang...	ir detector : 000477/A;1-Wide Angle I...	Part property ir detector and pa...
	gps : GPS	gps : 000466/A;1-GPS	gps : 000466/A;1-GPS	Part property gps and part occu...
	gprs module : GPRS UMTS Module	gprs module : 000473/A;1-GPRS U...	gprs module : 000473/A;1-GPRS UMT...	Part property gprs module and p...
	flight controller : Flight Controller	flight controller : 000469/A;1-Fligh...	flight controller : 000469/A;1-Flight C...	Part property flight controller an...

[11:56:22] INFO Comparing SysML part property and Teamcenter part occurrence (BOM line with ref des) thermal camera.

Ready 11:56:55 AM 549M of 735M

# CAD (NX and Creo) – Connect to CAD models, generate system architecture elements (SysML) from CAD, and vice versa. Compare & sync *Mass Properties*



Syndeia Dashboard (2.0.0) - Unmanned Aerial Vehicle

Repository Manager | Connection Manager | Connection Browser | Connection Summary | Comparison Result | Settings

**SysML Model**

- Automobile System
  - 1\_FORMULA\_SAE\_RACECAR
    - 20\_6950\_10
    - 20\_6950\_10\_MIR
    - 618132RS1\_ASM\_2
    - 618132RS1\_ASM\_2\_MIR
    - 618132RS1\_PART1\_1
    - 618132RS1\_PART1\_1\_MIR
    - 618132RS1\_PART2\_2
    - 618132RS1\_PART2\_2\_MIR
    - 618132RS1\_PART3\_2

**Connection Type**

- ☐ Reference
- ☐ Function Wrap
- ☐ Data Map
- ☒ Model Transform

**Creo**

- 1\_formula\_sae\_racecar.asm.115
- 1\_formula\_sae\_racecar.asm.116
- 1\_formula\_sae\_racecar.asm.117
- 1\_FORMULA\_SAE\_RACECAR
  - : MANIFOLD
  - : SUSPENSION
  - : DIFFERENTIAL
  - : RR\_CORNER
  - : CENTER\_SUPPORT
  - : FRONT\_FAIRING\_COMPLETE
  - : LF\_CORNER
  - : FRONT\_PAN

*Drag-n-drop to generate & connect*

**1\_FORMULA\_SAE\_RACECAR**

parts

- MANIFOLD : MANIFOLD
- SUSPENSION : SUSPENSION
- DIFFERENTIAL : DIFFERENTIAL
- RR\_CORNER : RR\_CORNER
- CENTER\_SUPPORT : CENTER\_SUPPORT
- FRONT\_FAIRING\_COMPLETE : FRONT\_FAIRING\_COMPLETE
- LF\_CORNER : LF\_CORNER
- FRONT\_PAN : FRONT\_PAN
- FRONT\_FAIRING : FRONT\_FAIRING
- FLOORBOARD : FLOORBOARD
- SEAT : SEAT
- LR\_CORNER : LR\_CORNER
- RF\_CORNER : RF\_CORNER
- REAR\_MOUNT : REAR\_MOUNT
- MOTOR : MOTOR
- CHASSIS : CHASSIS
- FRONT\_WING : FRONT\_WING

values

- «Creo\_Mass\_Property» mass : Real = 4368835.841697232{base\_Property, unit = "N/A"}
- «Creo\_Mass\_Property» volume : Real = 7931.782068842051{base\_Property, unit = "in^3"}
- «Creo\_Mass\_Property» density : Real = 550.8012958221673{base\_Property, unit = "N/A"}
- «Creo\_Mass\_Property» surface\_area : Real = 35929.021892241966{base\_Property, unit = "in^2"}
- «Creo\_Mass\_Property» lower\_left\_x : Real = -33.07675515554973{base\_Property, unit = "in"}
- «Creo\_Mass\_Property» lower\_left\_y : Real = -3.710721295311635{base\_Property, unit = "in"}
- «Creo\_Mass\_Property» lower\_left\_z : Real = -24.500000000000004{base\_Property, unit = "in"}
- «Creo\_Mass\_Property» upper\_right\_x : Real = 27.722209118508943{base\_Property, unit = "in"}
- «Creo\_Mass\_Property» upper\_right\_y : Real = 47.43358481145667{base\_Property, unit = "in"}
- «Creo\_Mass\_Property» upper\_right\_z : Real = 101.03467048617387{base\_Property, unit = "in"}

**Creo Race Car**

Example model from PTC Creo

