intercax

Building Digital Threads

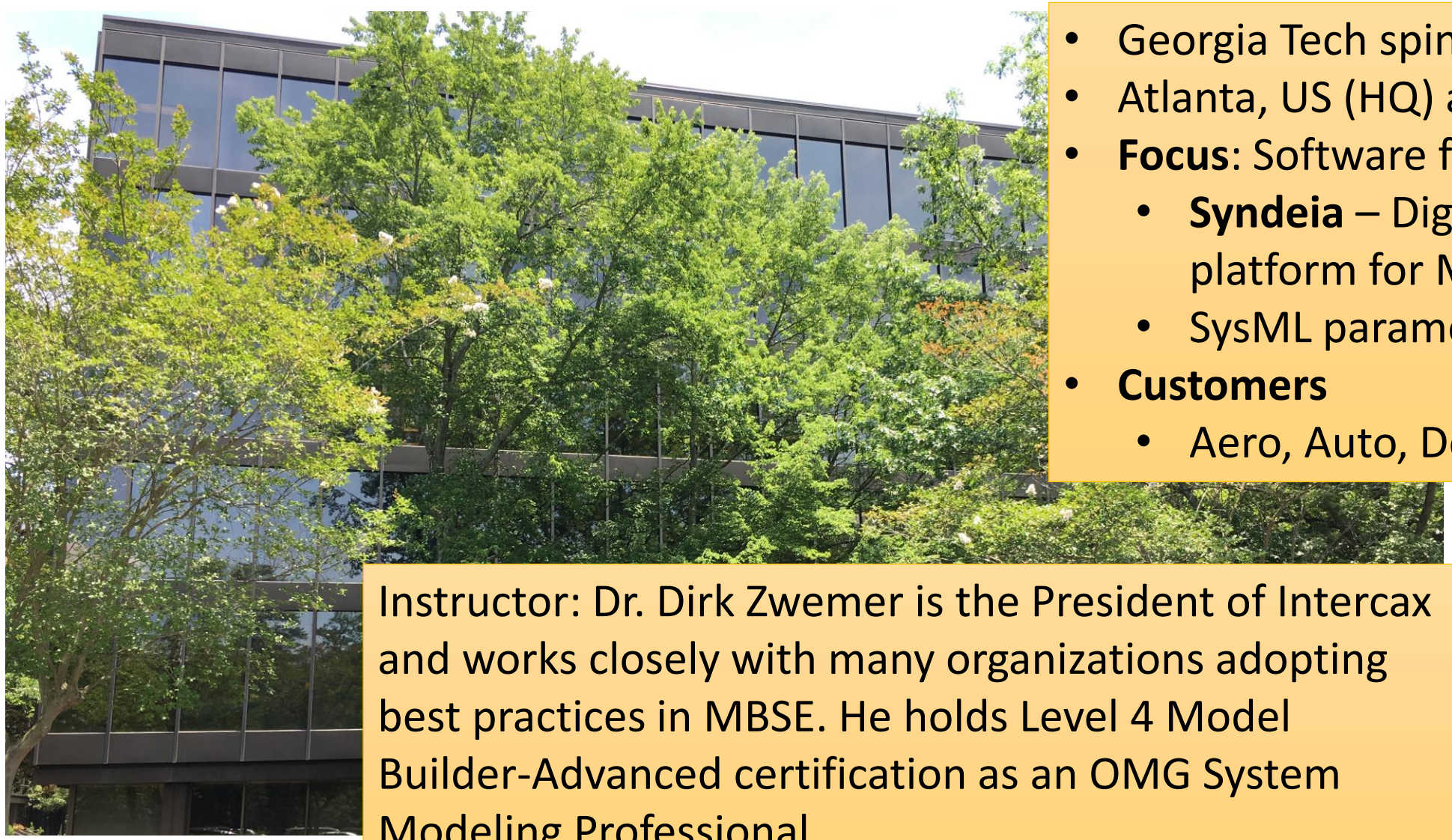
June, 2023

Dirk Zwemer, PhD
President & CEO
dirk.zwemer@intercax.com





About Intercax



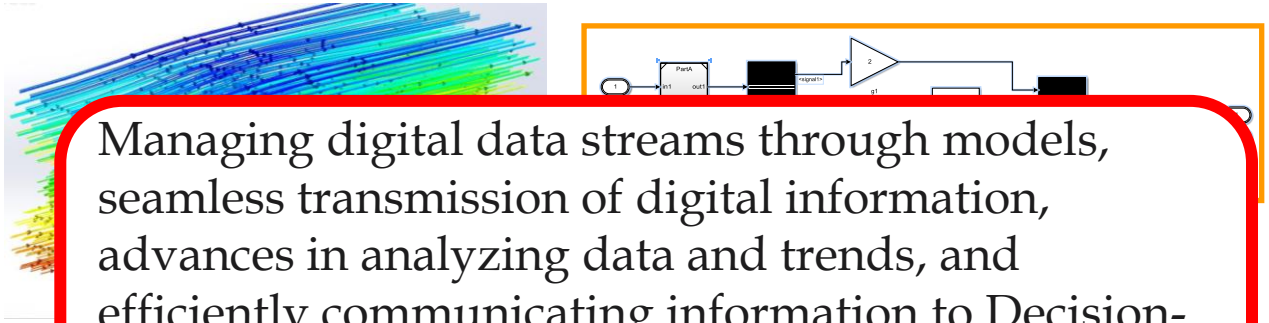
- Georgia Tech spin-off 2008
- Atlanta, US (HQ) and Pune, India
- **Focus**: Software for MBE/MBSE
  - **Syndeia** – Digital Thread platform for MBE/MBSE
  - SysML parametric solvers
- **Customers**
  - Aero, Auto, Defe[illegible]

Instructor: Dr. Dirk Zwemer is the President of Intercax and works closely with many organizations adopting best practices in MBSE. He holds Level 4 Model Builder-Advanced certification as an OMG System Modeling Professional.

What's the Problem?

Knowledge Engineers waste an average of **4 hours each day** on menial data entry.
(https://simplyflows.com/time-wasted-on-repetitive-tasks-is-40-percent)

Paper-based processes are **75% Waste** compared to Digital Engineering (*Hedberg et al., 2016*)



Managing digital data streams through models, seamless transmission of digital information, advances in analyzing data and trends, and efficiently communicating information to Decision-makers would **SAVE** manufacturers **$37 Billion** annually (*Anderson, 2016*).

- Diversity of models
  - Requirements
  - Architecture (SysML, UPDM, AADL,…)
  - 3D/2D Mechanical and Electrical Design
  - Design / Manufacturing BOM (PLM)
  - Software code, tests, releases
  - Simulation/Test/Failure Analysis
- Team members cannot find and share information efficiently.
- Data collection for review, analysis and documentation is slow.
- Capability Gaps and Design Errors are detected too late.
- Projects are behind schedule and over budget.

What is the Digital Thread?

A linked set of digital artifacts whose consistency is actively managed over the life cycle of a product, process, or system.

AIAA Digital Engineering Integration Committee, "DIGITAL THREAD: DEFINITION, VALUE, AND REFERENCE MODEL", June 2023

A powerful communication framework that allows a connected data flow and integrated view of an asset's data throughout its lifecycle across traditionally siloed functional perspectives.

iBaseT.com, 2023

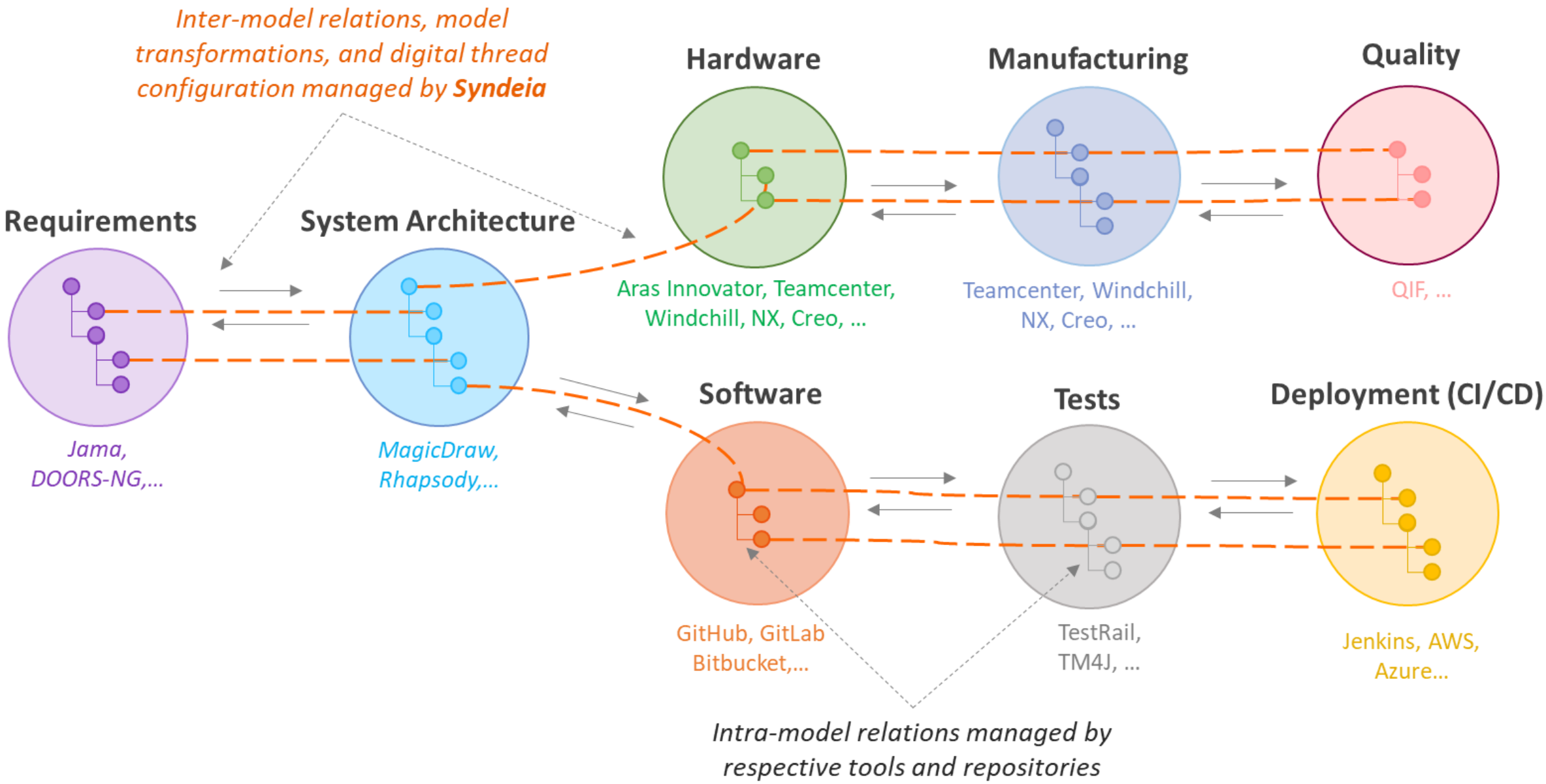
The use of digital tools and representations for design, evaluation, and life cycle management

USAF Global Science and Technology Vision, Task Force. "Global Horizons Final Report". 2013

A data-driven architecture that links together information generated from across the product lifecycle and is envisioned to be the primary or authoritative data and communication platform for a company's products at any instance of time

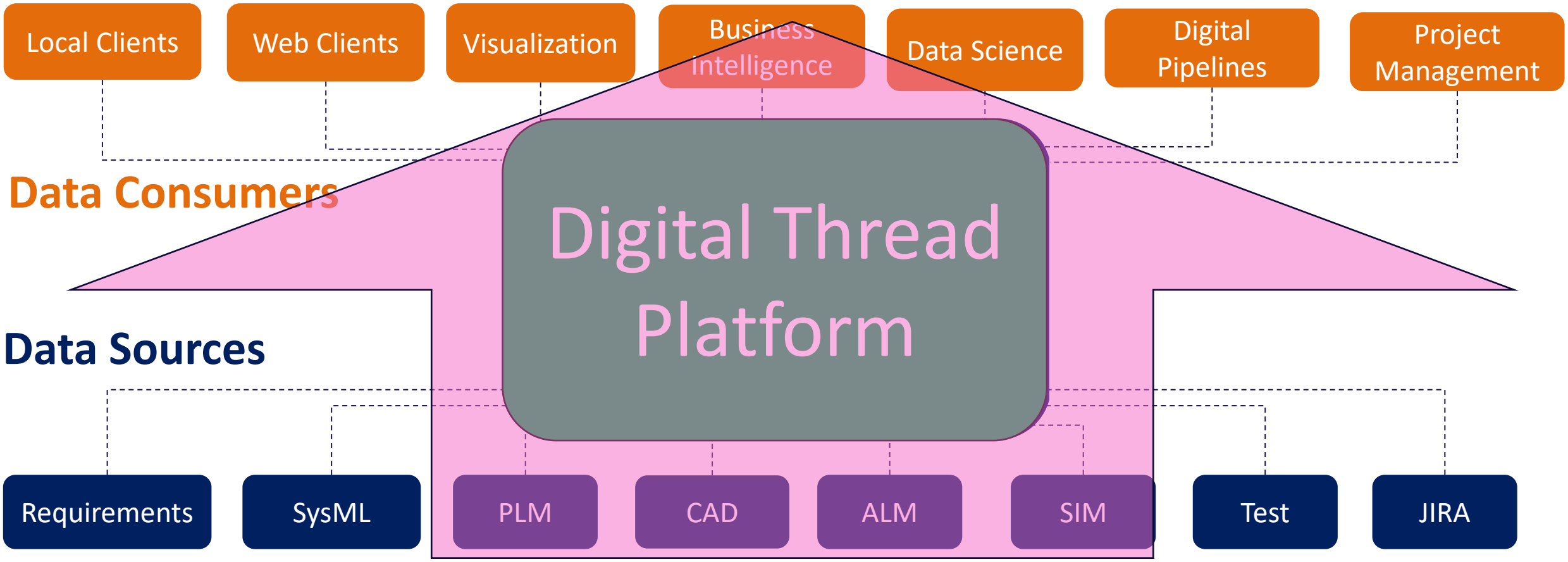
Singh, Victor. "Engineering with a Digital Thread". Aerospace Resource Central, 2018

An Open Digital Thread – Federating models across repositories



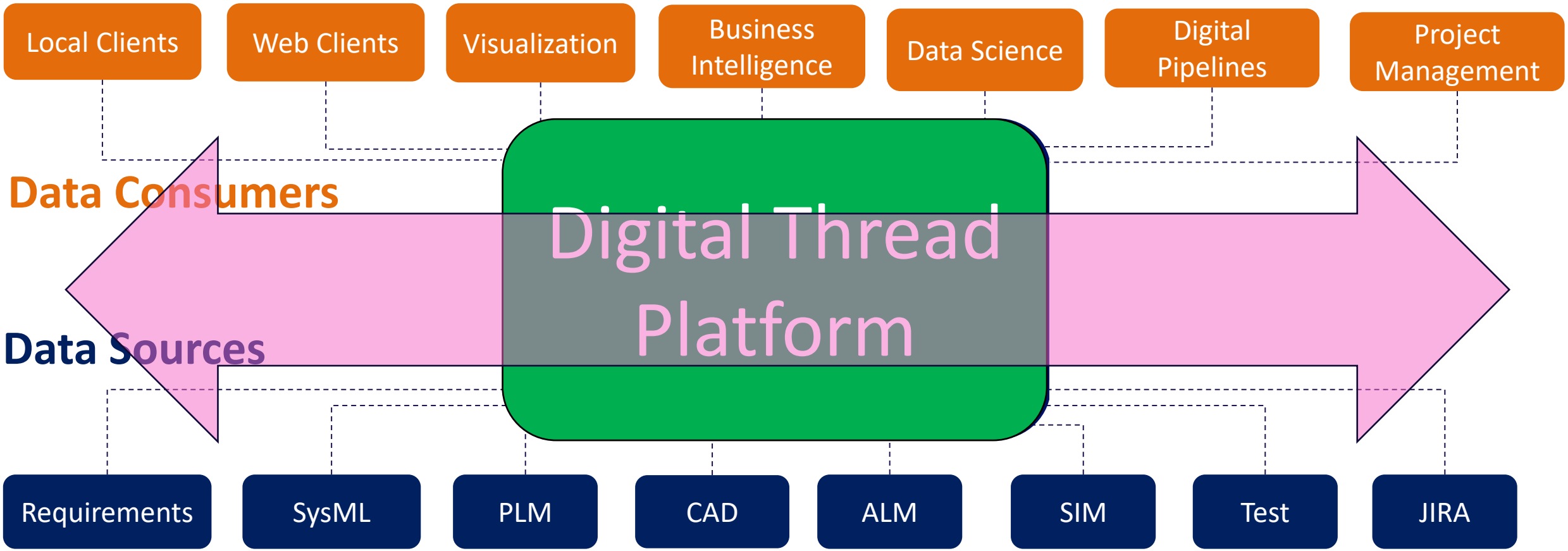
An *effective* digital thread platform offers

- the capability to explore disorganized data to discover what should be, for business or mission purposes, part of a digital thread,



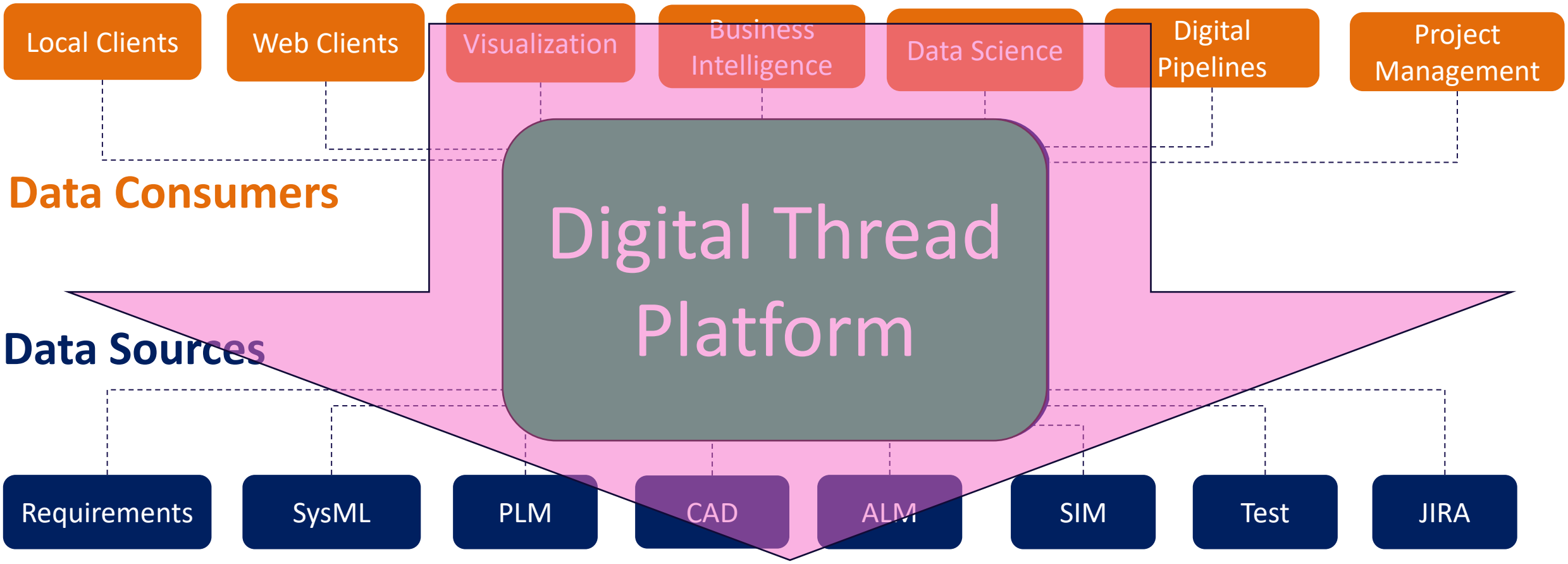
An *effective* digital thread platform offers

- curation for the creation, reporting, update, and deletion of these digital threads,

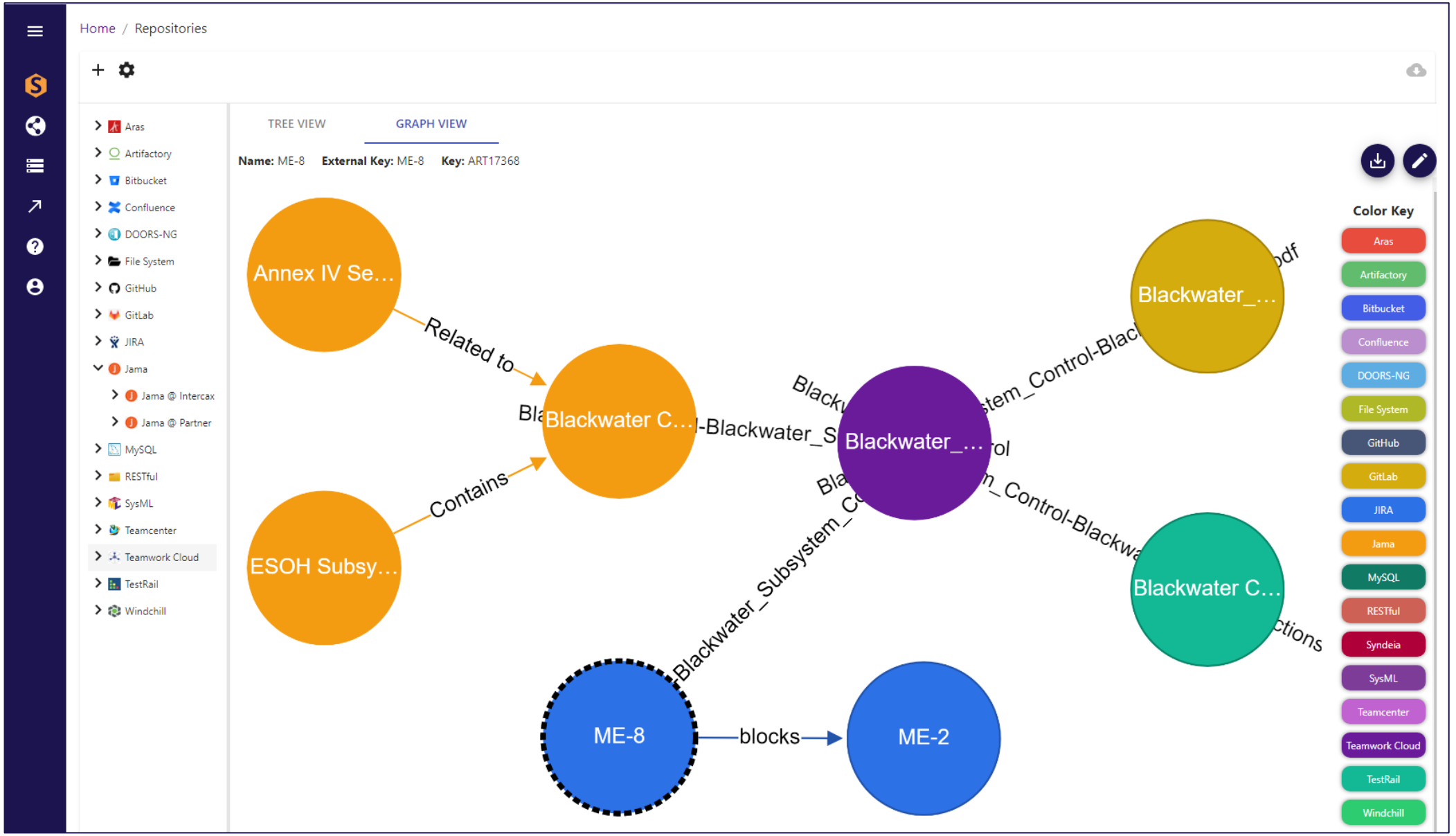


An *effective* digital thread platform offers

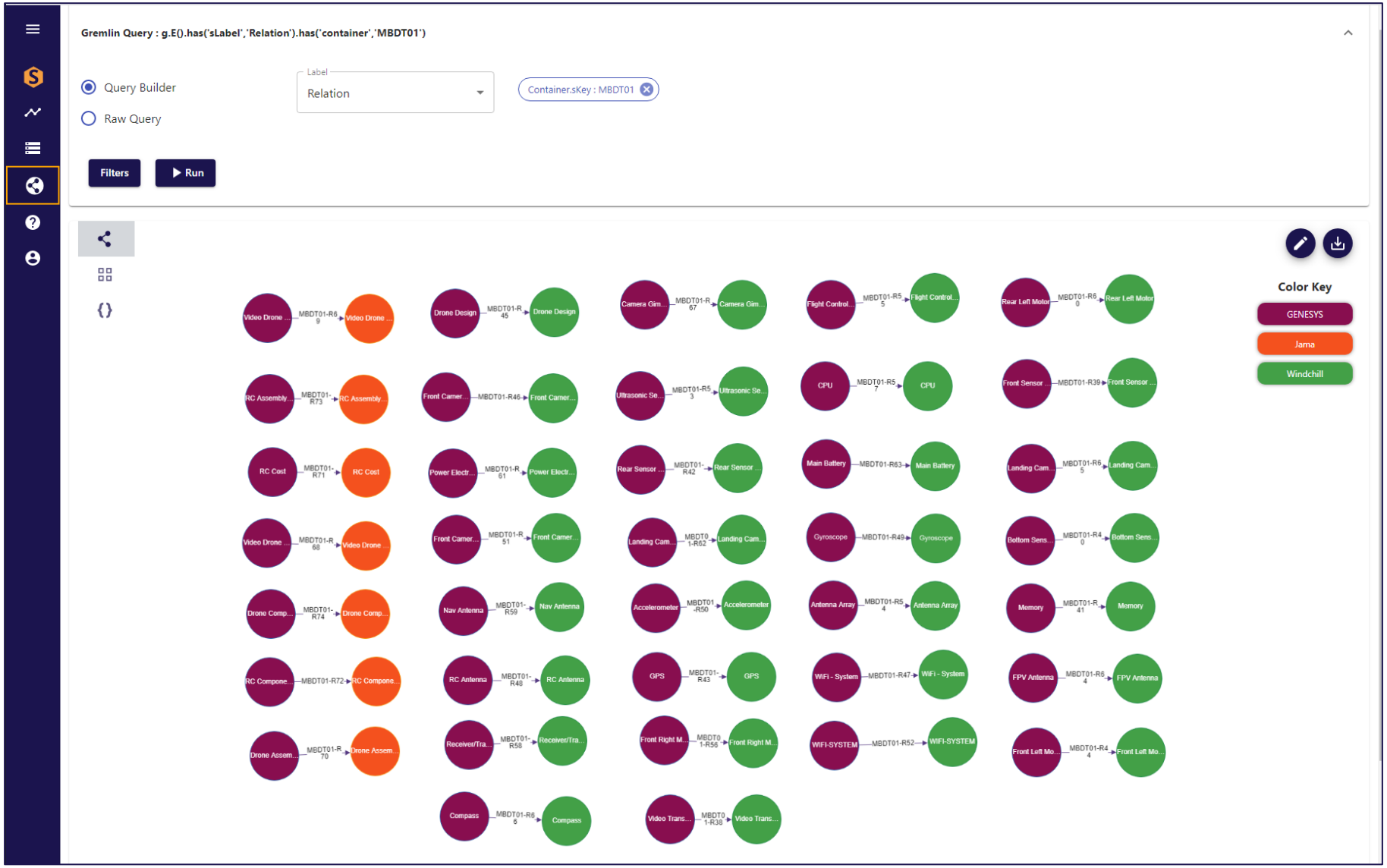
- visualization and analytics over the digital threads and to the connected digital artifacts.



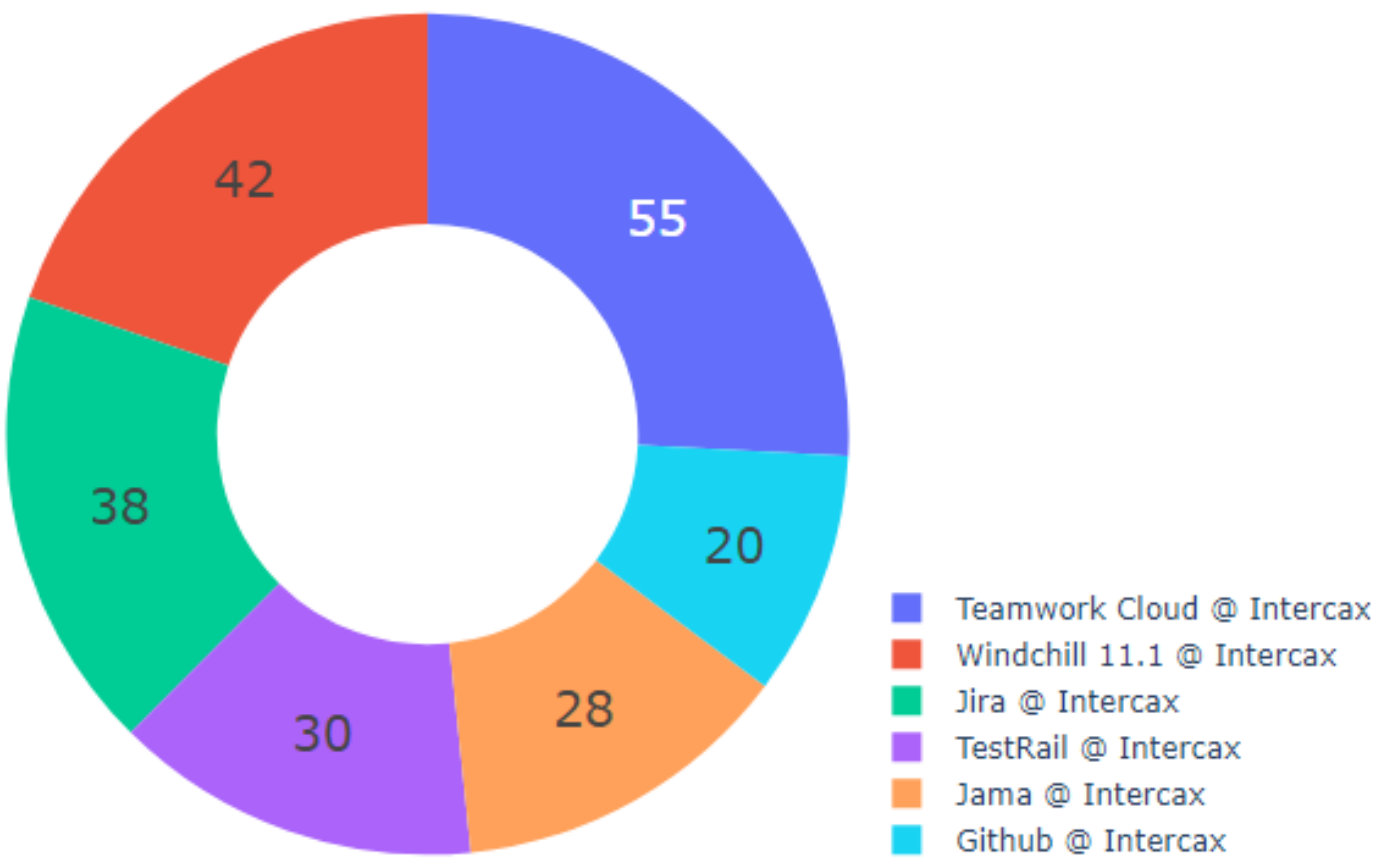
Interactive Traceability



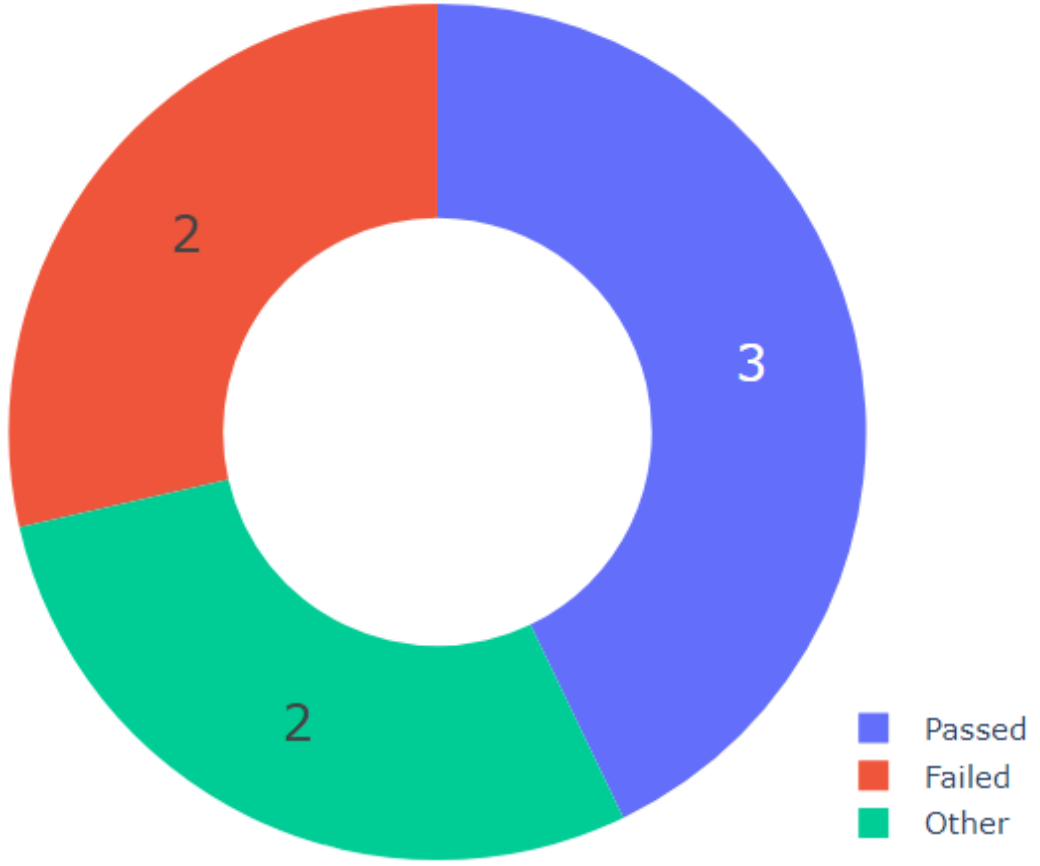
Graph Analysis Pattern Matching



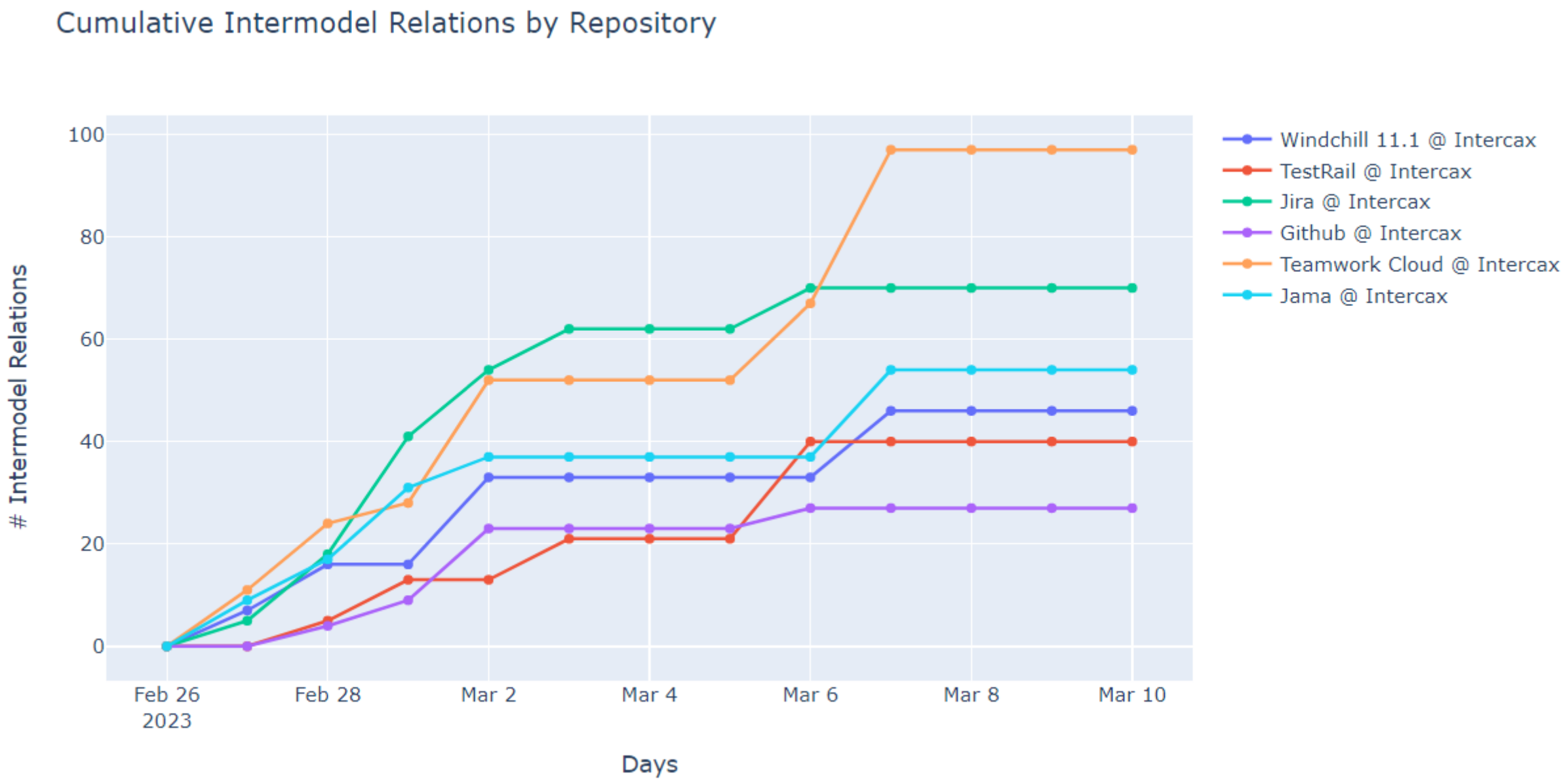
- Connected Artifacts by Repository



Tested Requirements by Test Status



Project Metrics - Cumulative Intermodel Relations by Repository



Syndeia comes with

- **Syndeia Cloud, a network-based set of microservices embedded in your development environment to**
  - Read/write the contents of the underlying repositories
  - Create and update a network of inter-model connections for users to navigate and share system data
  - Provide visualization and analytics over the digital threads and to the connected digital artifacts
  - Authenticate users' access to specific data sources
- **An open, fully documented REST API**
- **Specialized clients to support particular use cases:** e. g. Syndeia plug-in clients for Cameo and Rhapsody, Syndeia Web Dashboard, Python and Java language clients

Building Digital Thread Connections

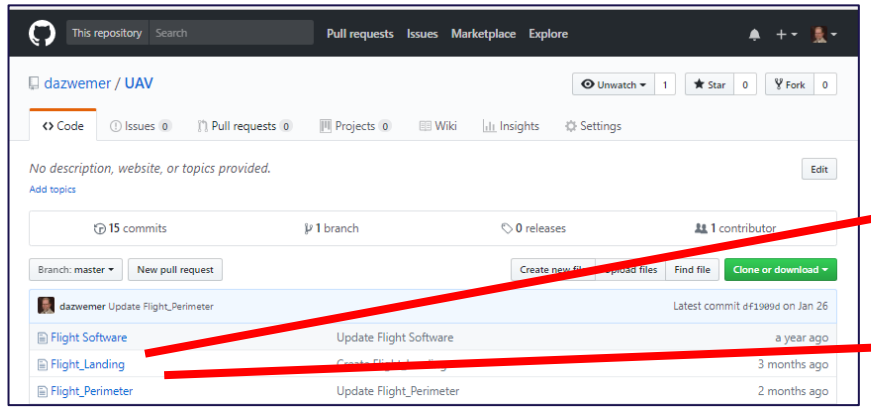
- Manually linking pre-existing data elements across model boundaries
- Creating linkages by transforming data between model repositories
- Using key parameter matches to link data elements
- Rule-based reasoning and automation
- Machine learning and automation

Syndeia Connection Types

Reference connections link model elements in different tools

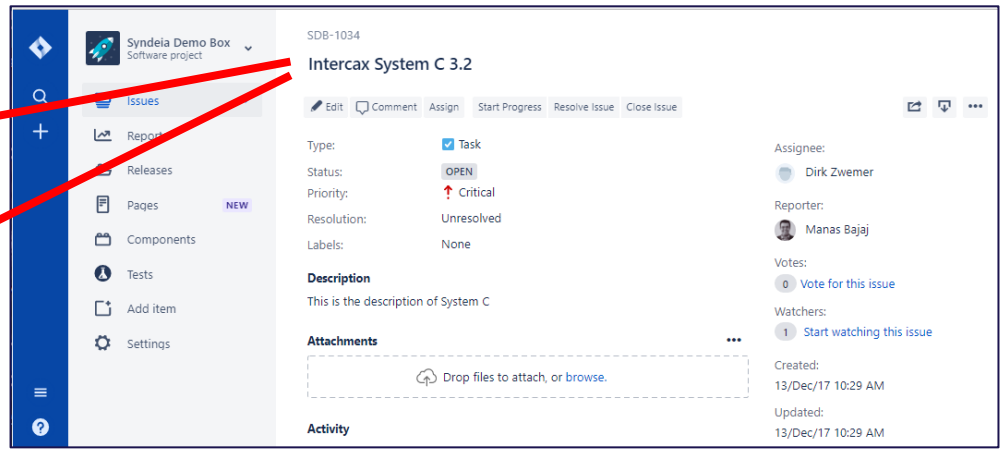
- They provide traceability between elements of different types
- They provide quick access to those elements
- They can detect version or timestamp changes in connected elements
- They can be updated to a newer version on demand

GitHub File



Syndeia Reference Connections

JIRA Issue



Syndeia Connection Types

Model Transform connections take elements in one tool and create new elements in another, including model structure and attributes. The elements remain connected and can be compared and updated as the models evolve.

«block»
«Creo_Assembly»
1_FORMULA_SAE_RACECAR

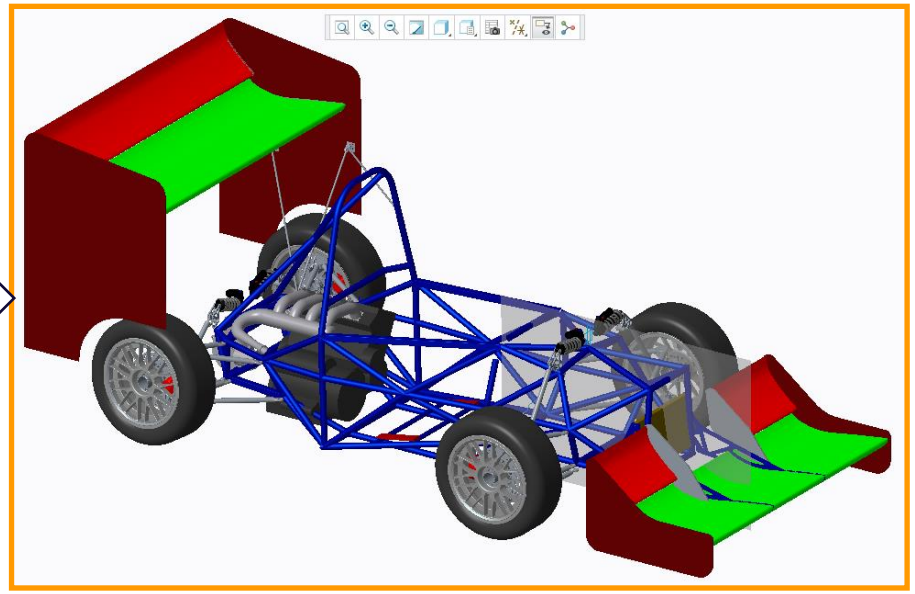
parts

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

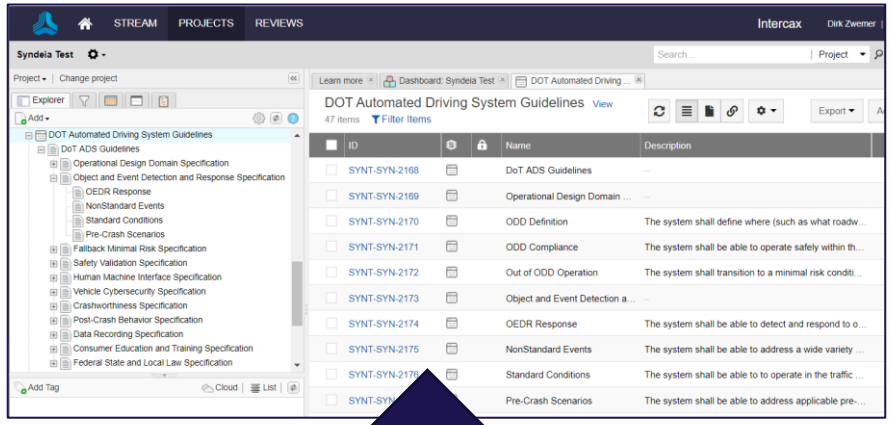
«Creo_Mass_Property» **mass** : Real = 4368835.841697232{base_Property, unit = "N/A"}
«Creo_Mass_Property» **volume** : Real = 7931.782068842051{base_Property, unit = "in^3"}
«Creo_Mass_Property» **density** : Real = 550.8012958221673{base_Property, unit = "N/A"}
«Creo_Mass_Property» **surface_area** : 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"}
...

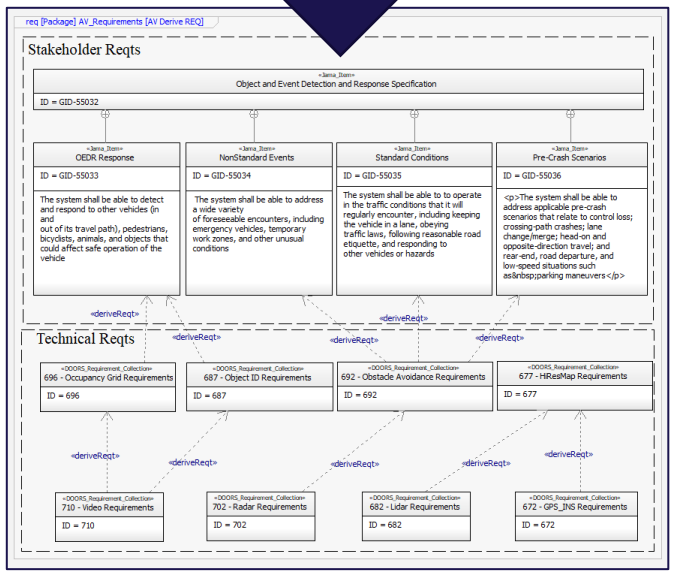
Syndeia
Model Transform



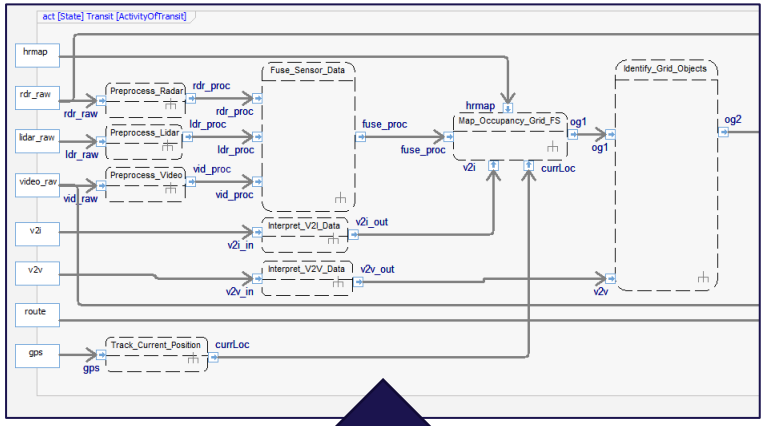
Syndeia Services – Model Transform

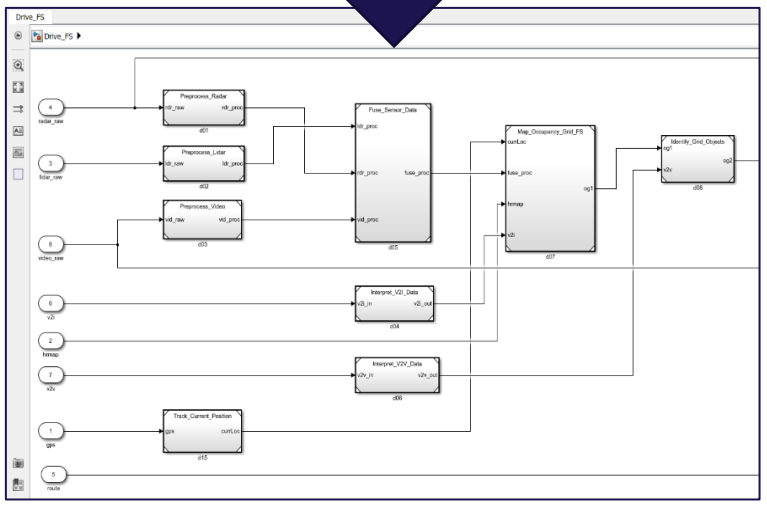
Requirements ↔ Architecture



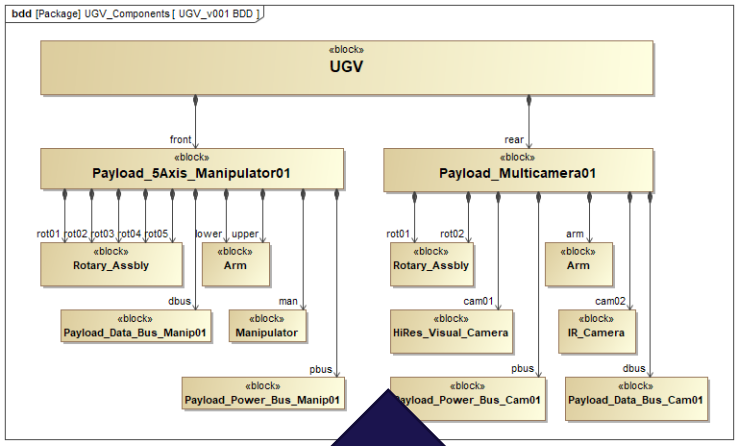


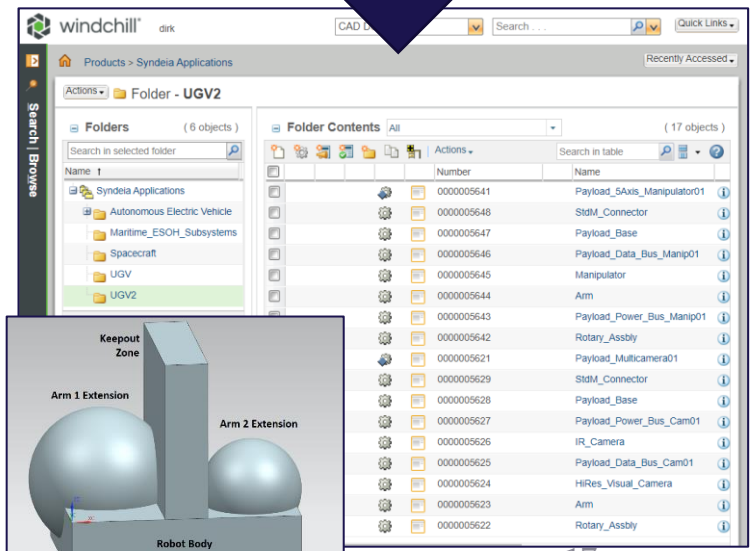
Architecture ↔ Simulation





Architecture ↔ PLM/CAD

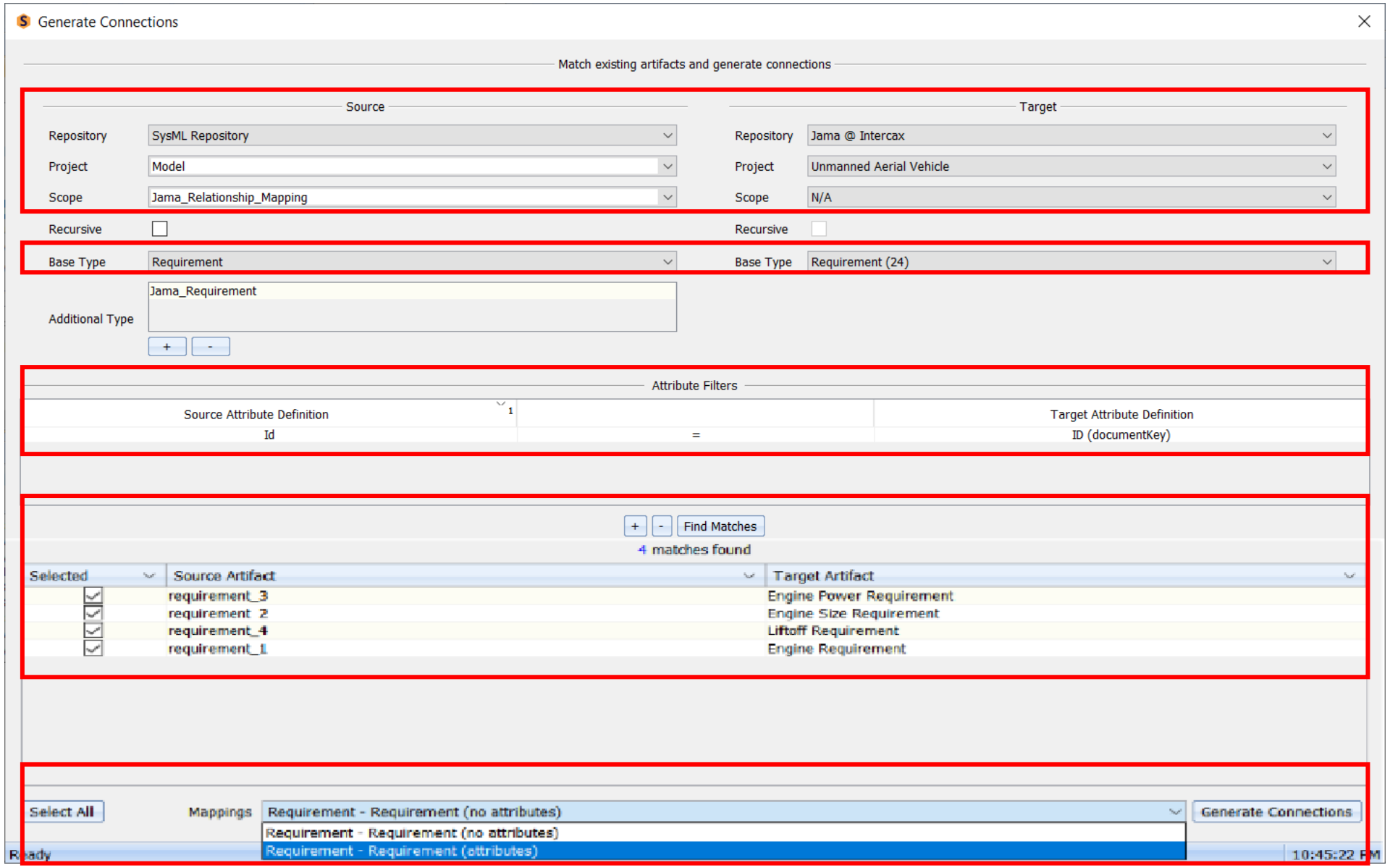




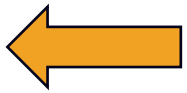
Building Digital Thread Connections

- Manually linking pre-existing data elements across model boundaries
- Creating linkages by transforming data between model repositories
- Using key parameter matches to link data elements 
- Rule-based reasoning and automation
- Machine learning and automation

Connection Generator



Building Digital Thread Connections

- Manually linking pre-existing data elements across model boundaries
- Creating linkages by transforming data between model repositories
- Using key parameter matches to link data elements
- Rule-based reasoning and automation 
- Machine learning and automation

Syndeia Cloud – An API-first, Microservices Platform

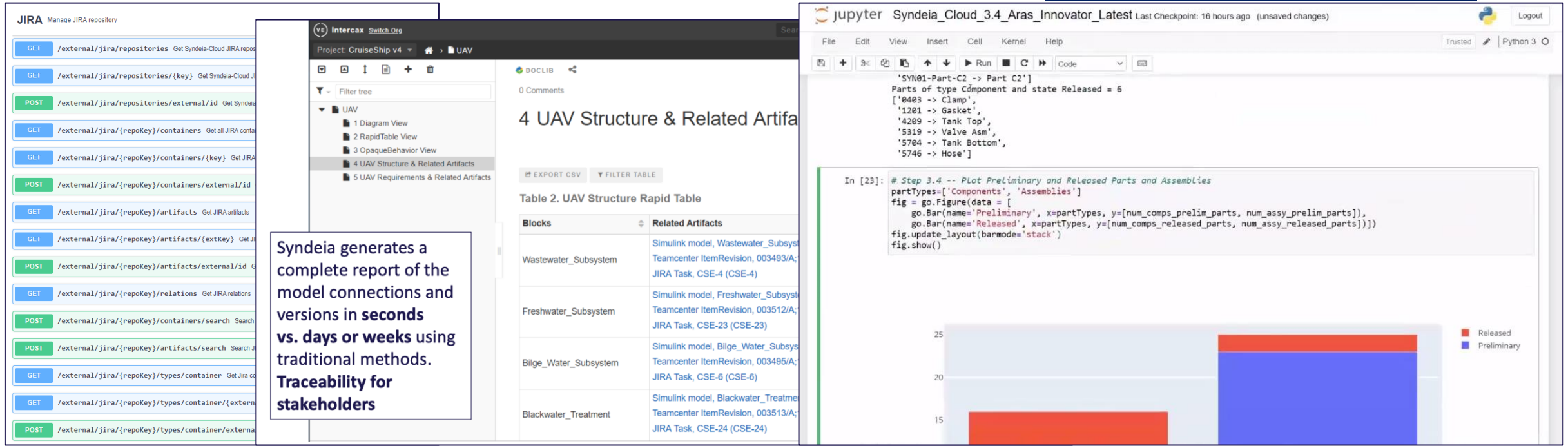
Syndeia Cloud REST API – Key enabler for an Open Digital Thread

- Digital Engineering platform provides “ready-to-integrate” services
- Build custom interfaces for report generation, design reviews, project management, and more
- API is open and fully documented, secure access to all Digital Thread content through SSO/LDAP/…

Endpoints for core domain concepts and accessing external repositories (e.g. JIRA)

Digital documents (traceability report using OpenMBEE)

Data science (Jupyter notebook analysis of Aras Innovator PLM repository)

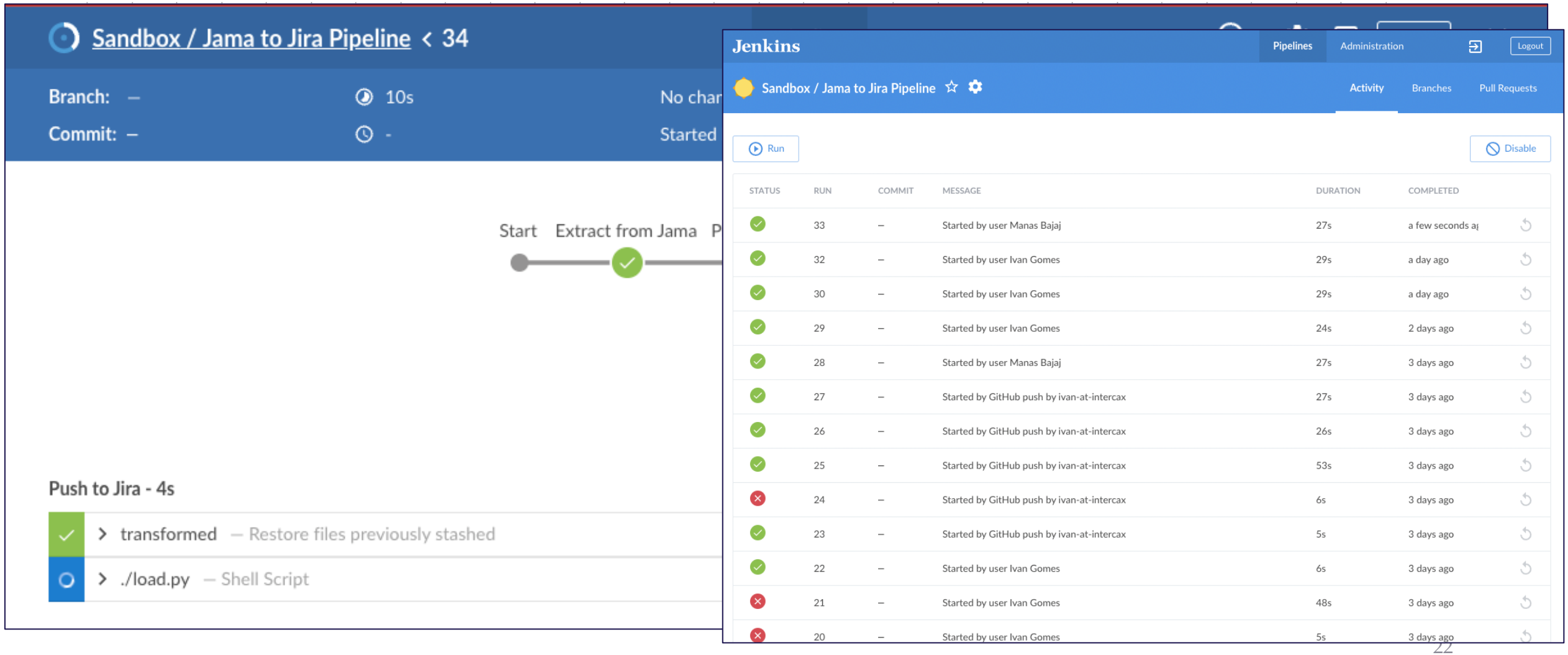


Syndeia Services – Digital Pipelines

Conceptual Model of a Digital Pipeline

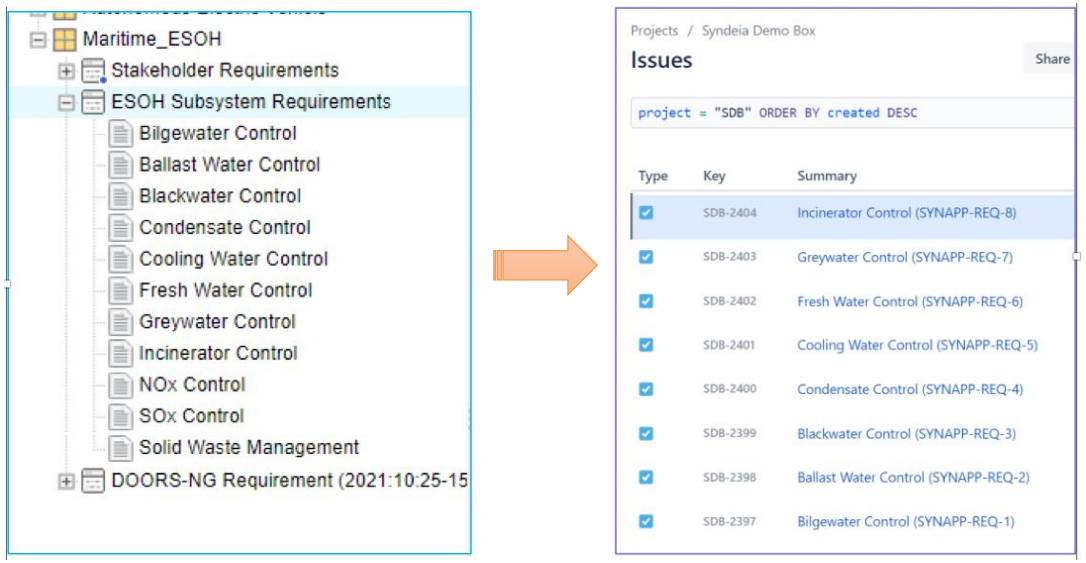
Automated Jama -> Jira model transform + digital thread synthesis pipeline (**Running in Jenkins**)

Schedule = Runs every 12 hours, starting 25-Feb-2021 at 0600 hours
Current = Run #3 started 26-Feb-2021 at 0600 hours



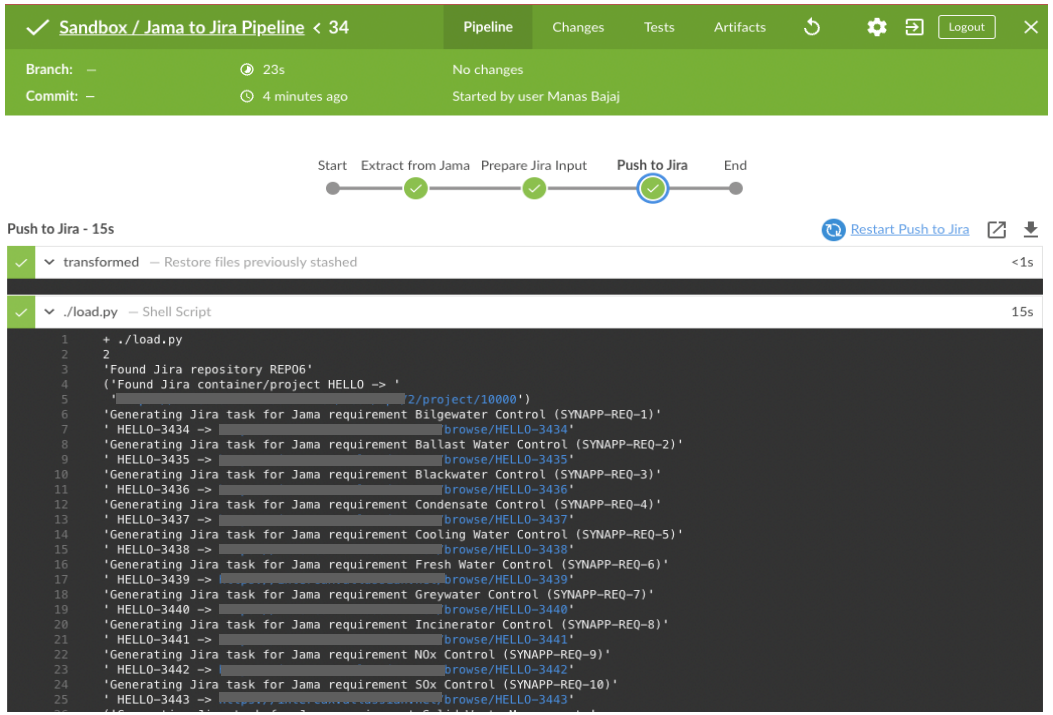
Digital Pipelines = CI/CD Pipelines for Digital Threads / MBE

- Modern software DevOps uses CI/CD pipelines
- Digital Pipelines = DevSecOps + Digital Thread
  - Automatically build, update, test, baseline digital threads and generate reports
  - Schedule based on time and events
  - NASA SBIR Phase 1 and 2 awards (2021-2023)



Jama

Jira



Jenkins Pipeline using Syndeia Cloud API

Take-aways

- Building the Digital Thread is an important issue
- There are multiple effective approaches
- The long-term goal is to make it as transparent as possible to the users

To learn more about Syndeia,

- Check out our website for product info and video demonstrations at www.intercax.com/syndeia
- Read our on-line user guide and tutorials at https://intercax.atlassian.net/wiki/spaces/SYN35
- Schedule a web demo with Intercax – contact us at info@intercax.com
- Request an evaluation license – set up an account and submit your request at www.intercax.com/help
- Syndeia Live Training Program – https://intercax.com/services/syndeia-training-programs/

Questions?

Questions / Comments

Dirk Zwemer, PhD
President & CEO
dirk.zwemer@intercax.com

Manas Bajaj, PhD
Chief Systems Officer
manas.bajaj@intercax.com

Greg Salow
VP, Business Development
greg.salow@intercax.com

Lonnie VanZandt
Principal Solutions Architect
lonnie.vanzandt@intercax.com

Web – www.intercax.com

Questions – www.intercax.com/help

LinkedIn - www.linkedin.com/company/intercax-llc

Twitter - @intercax @syndeia

27