Jet Propulsion Laboratory
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CAESAR

A Platform to Modernize Systems Engineering

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Roadmap of Systems Engineering

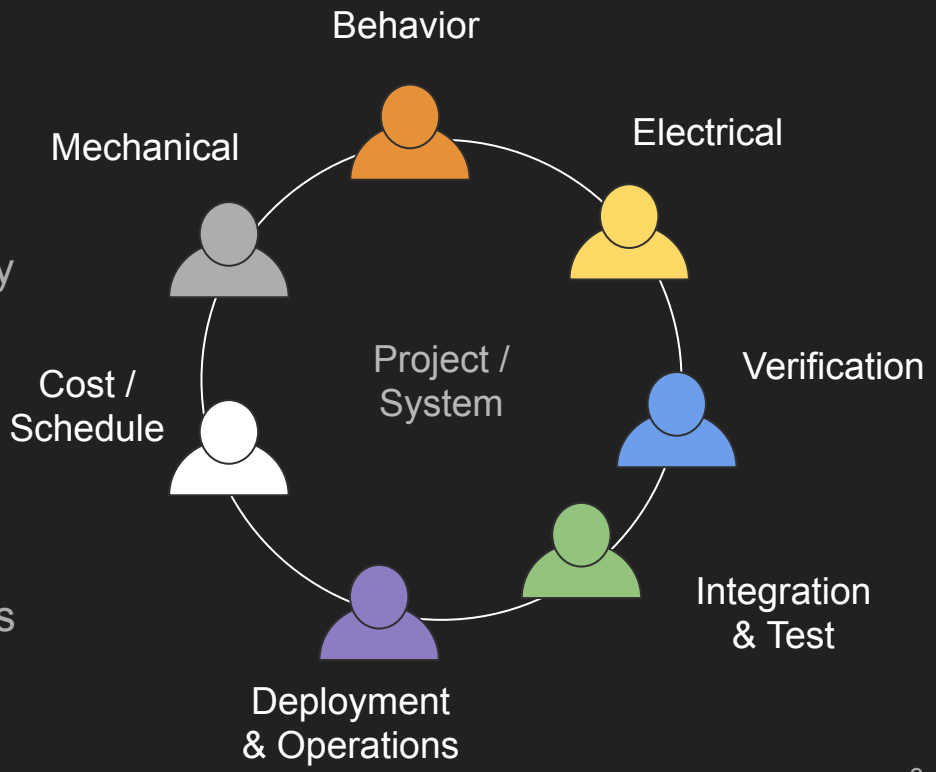
Document Based
Systems Engineering

Model Based
Systems Engineering

Integrated Model
Centric Engineering

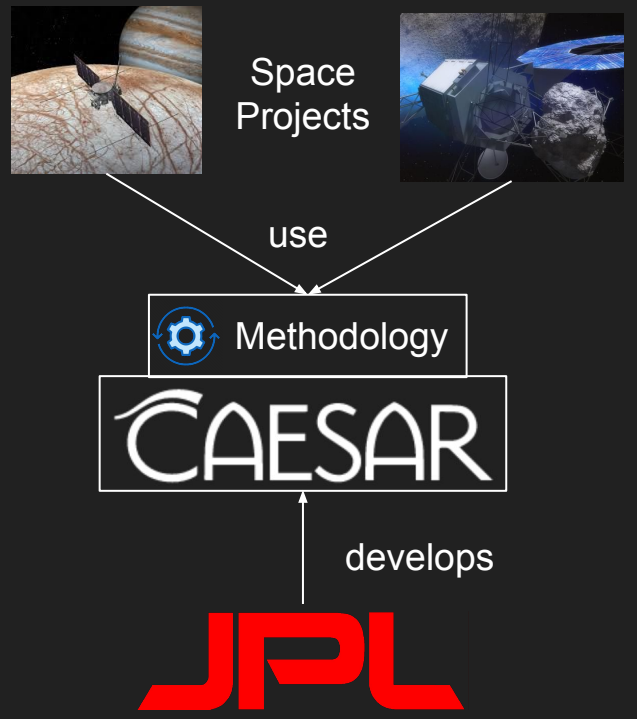
Information in Systems Engineering Today

- Is mostly captured informally
- Spans multiple domains / disciplines
- Does not follow well-defined methodology
- Is configuration managed in silo tools
- Is adhocly and Infrequently integrated
- Is not analyzed automatically enough
- Is not easily traceable to its provenance
- Is not properly change controlled
- Is not effectively shared with stakeholders



CAESAR: Computer Aided Engineering for Systems ARchitecture

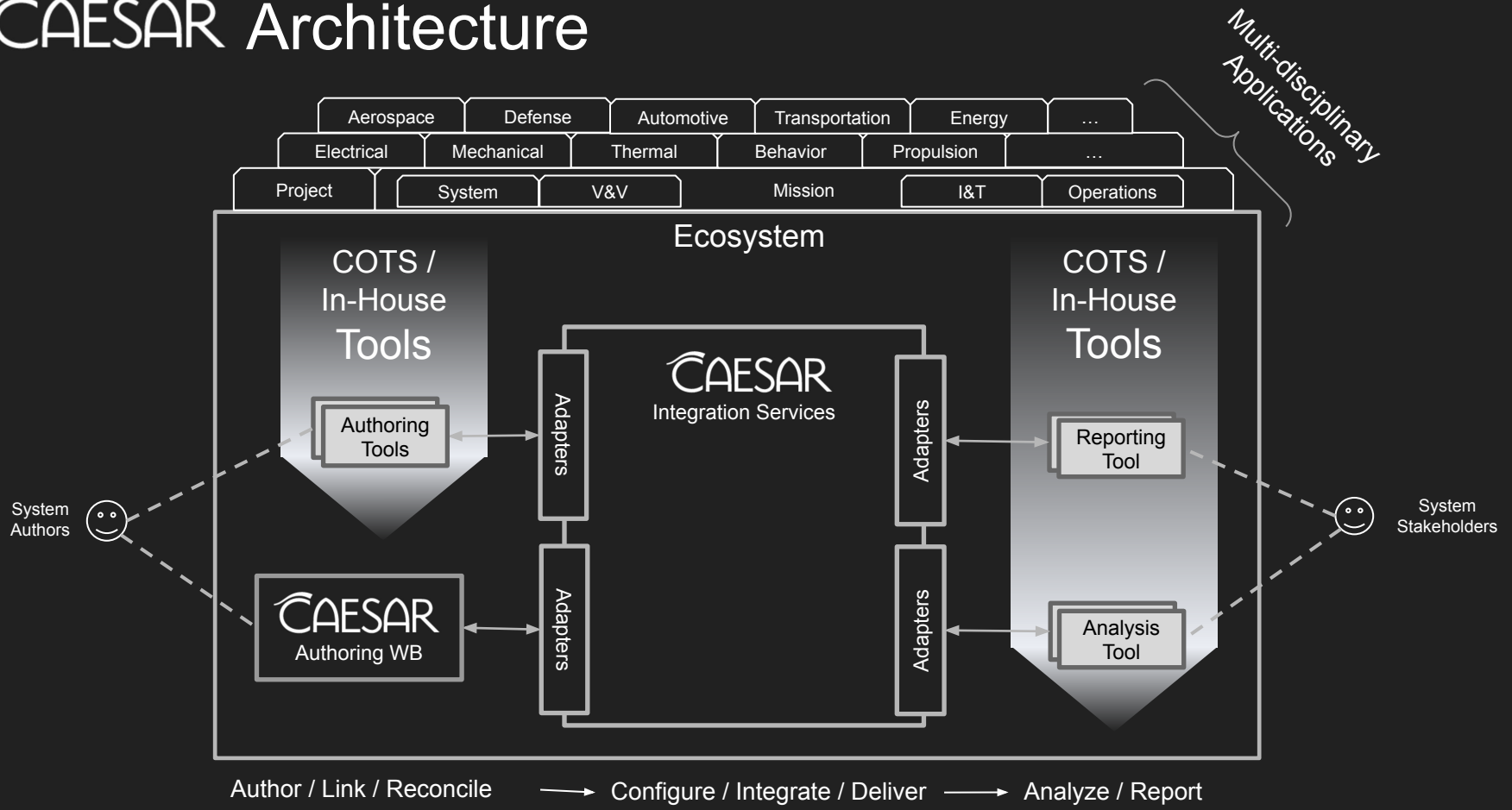
- Allows defining a SE methodology with a set of interrelated **domain specific languages** (DSLs)
- Allows representing information precisely using **semantic web** (OWL2-DL) **ontologies**
- Allows integration of information in **engineering tools** based on the methodological DSLs
- Allows federated **configuration management**, **linking** and **reconciliation** of datasets
- Allows employing the **DevOps practices** (CI/CD) in the systems engineering process



CAESAR Main Functions

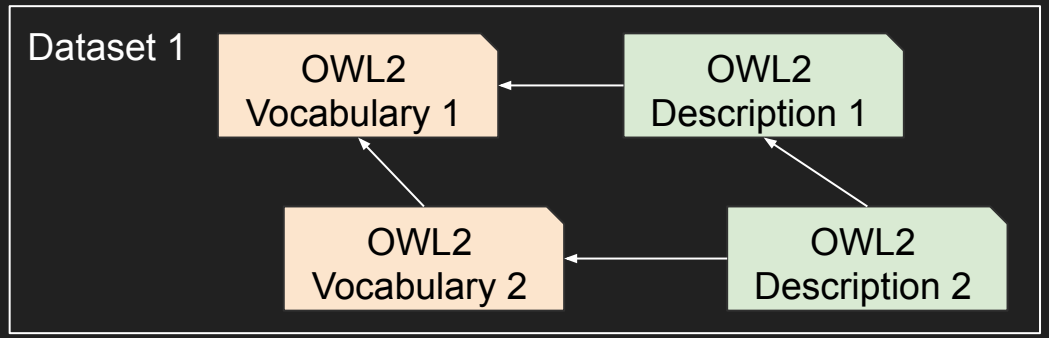
1. **Information Representation**
   Semantic web ontologies with precise syntax and logical semantics
2. **Information Authoring**
   Methodology-specific authoring using COTS and In-house tools
3. **Information Federation**
   Organized based on provenance and managed by authorities
4. **Information Configuration**
   Support for different configurations / management of dependencies
5. **Information Integration**
   Continuous and incremental integration of federated datasets
6. **Information Analysis**
   Scalable analysis of consistency, correctness, and completeness
7. **Information Reporting**
   Dashboards of canned / dynamic reports for different stakeholders

CAESAR Architecture

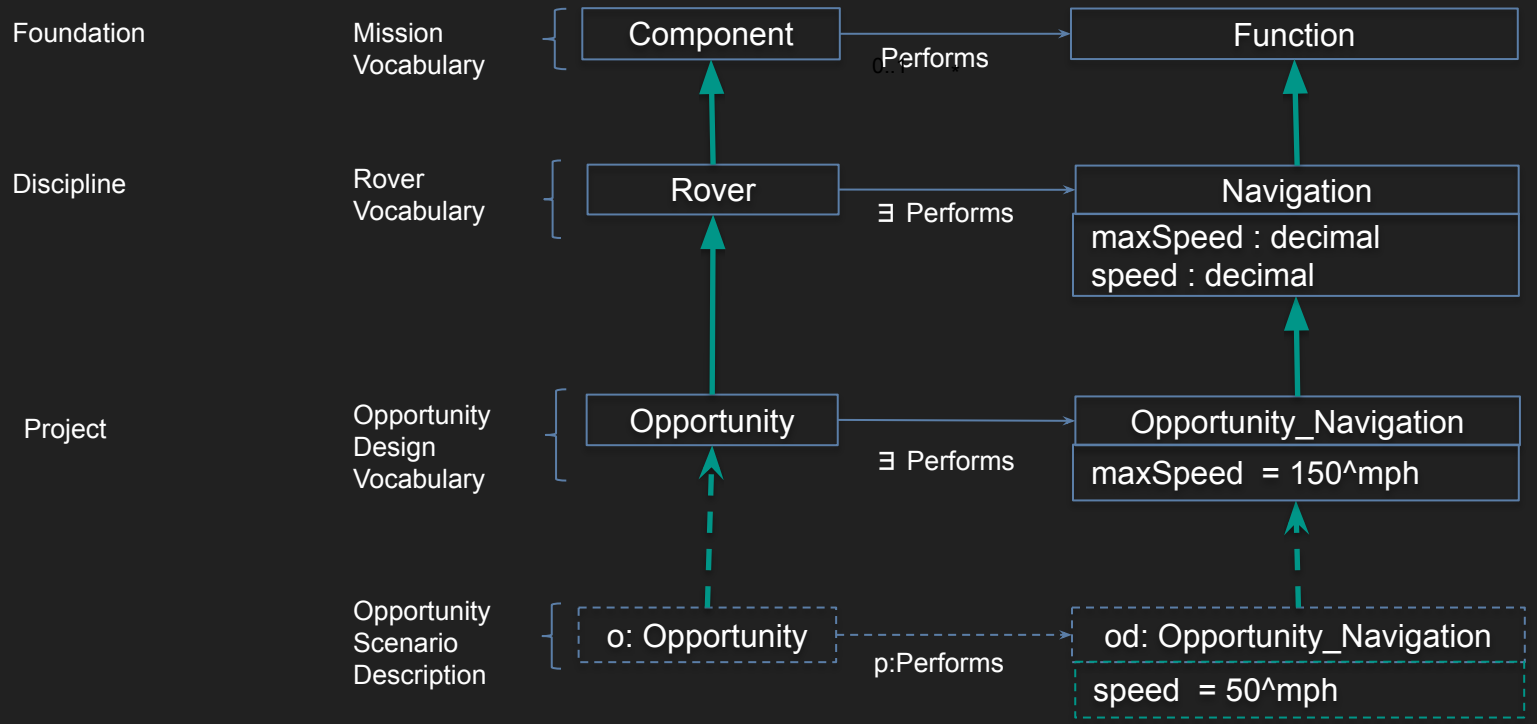


Information Architecture

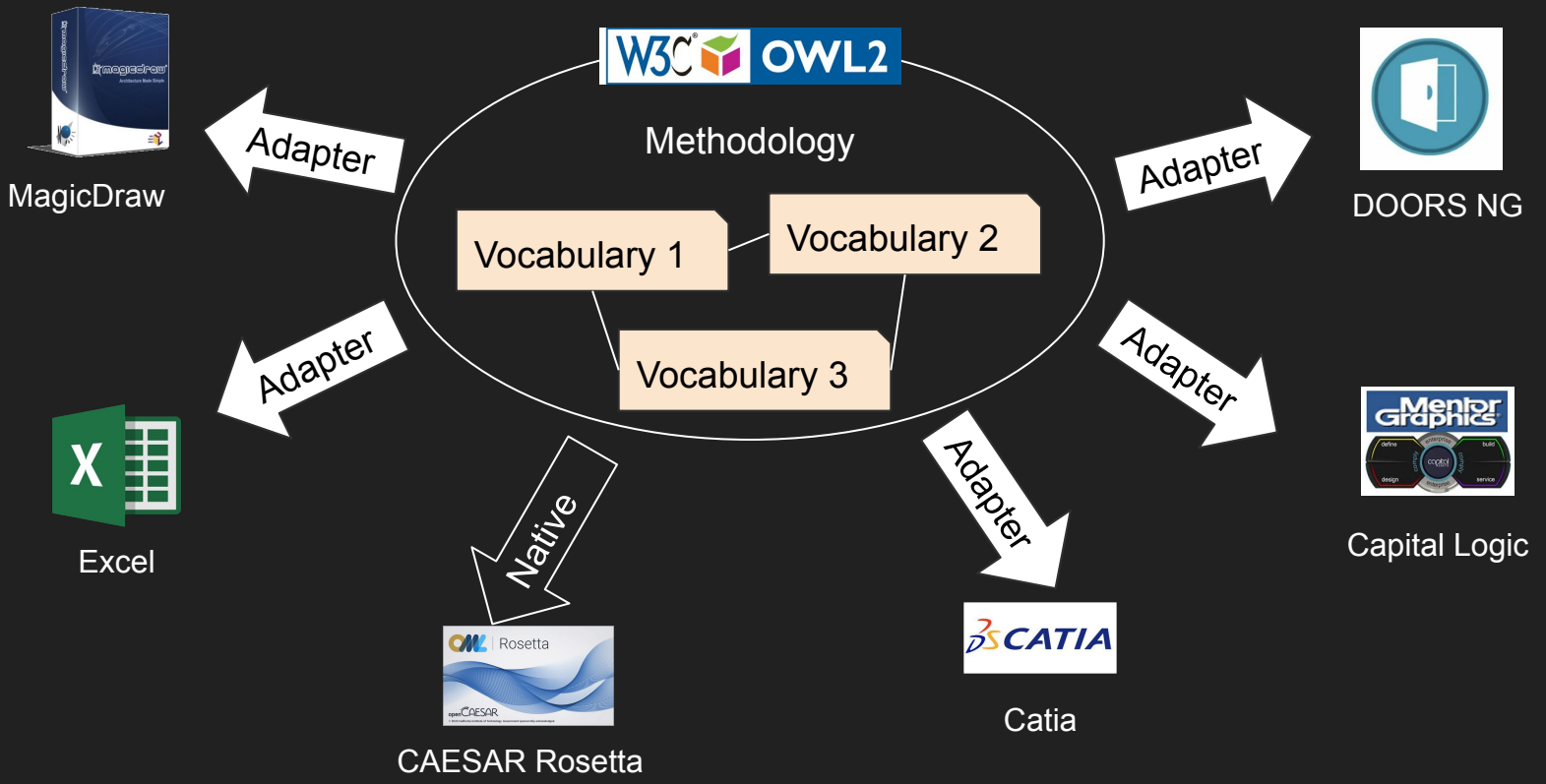
- Information is represented using W3C OWL2 DL ontologies
- Ontology can be either Vocabulary (T-box) or Description (A-box)
- Vocabulary is used to define a DSL syntax and logical semantics
- Description is used to assert information using a vocabulary
- A catalog of interrelated ontologies is called a dataset



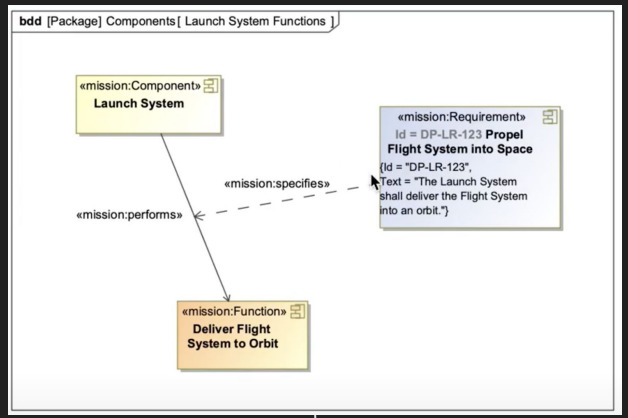
Example Semantic Web Based Architecture

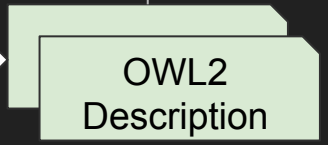


UC1: Methodology Based Authoring

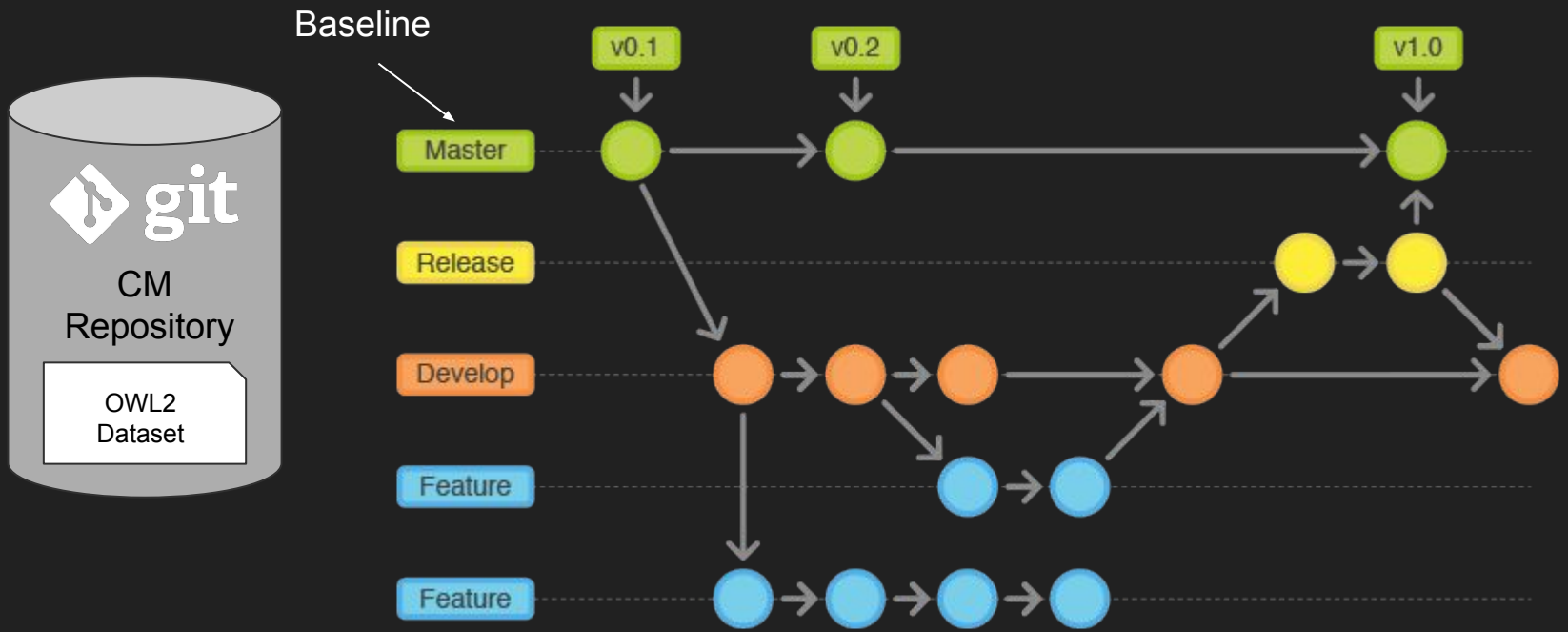


Normalizing Systems Engineering Information

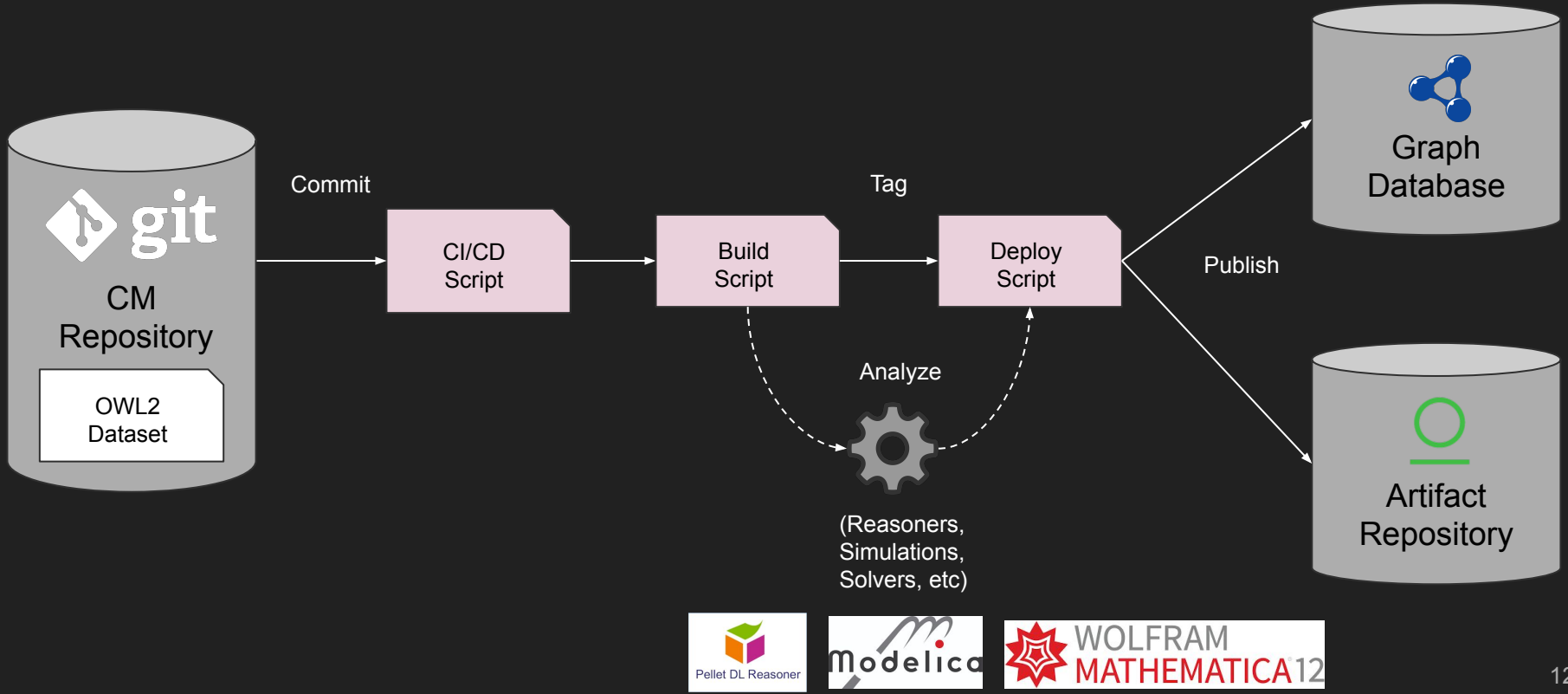




UC2: Information Configuration Management

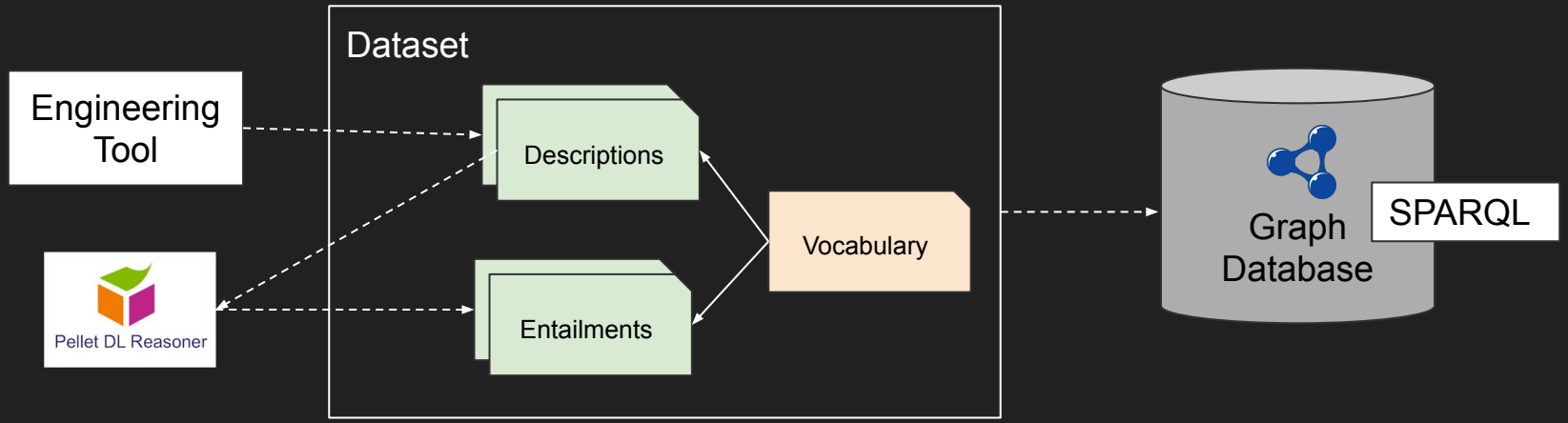


UC3: Continuous Integration and Delivery



Information Analysis

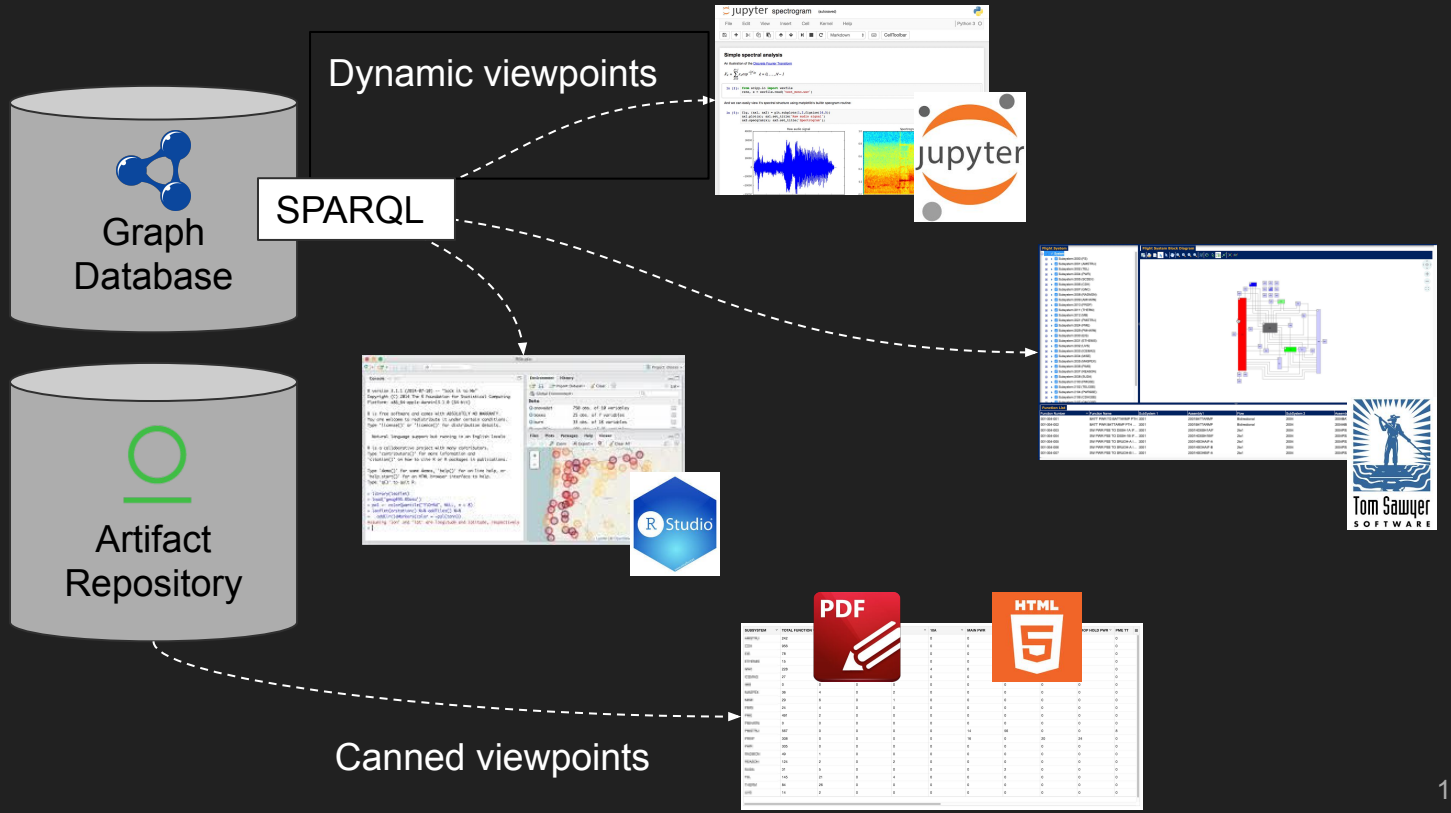
- OWL2-DL Ontologies can be checked for consistency using DL Reasoners
- Reasoner enriches a dataset with entailments using semantic rules
- Dataset can be loaded to a graph database with a SPARQL query endpoint



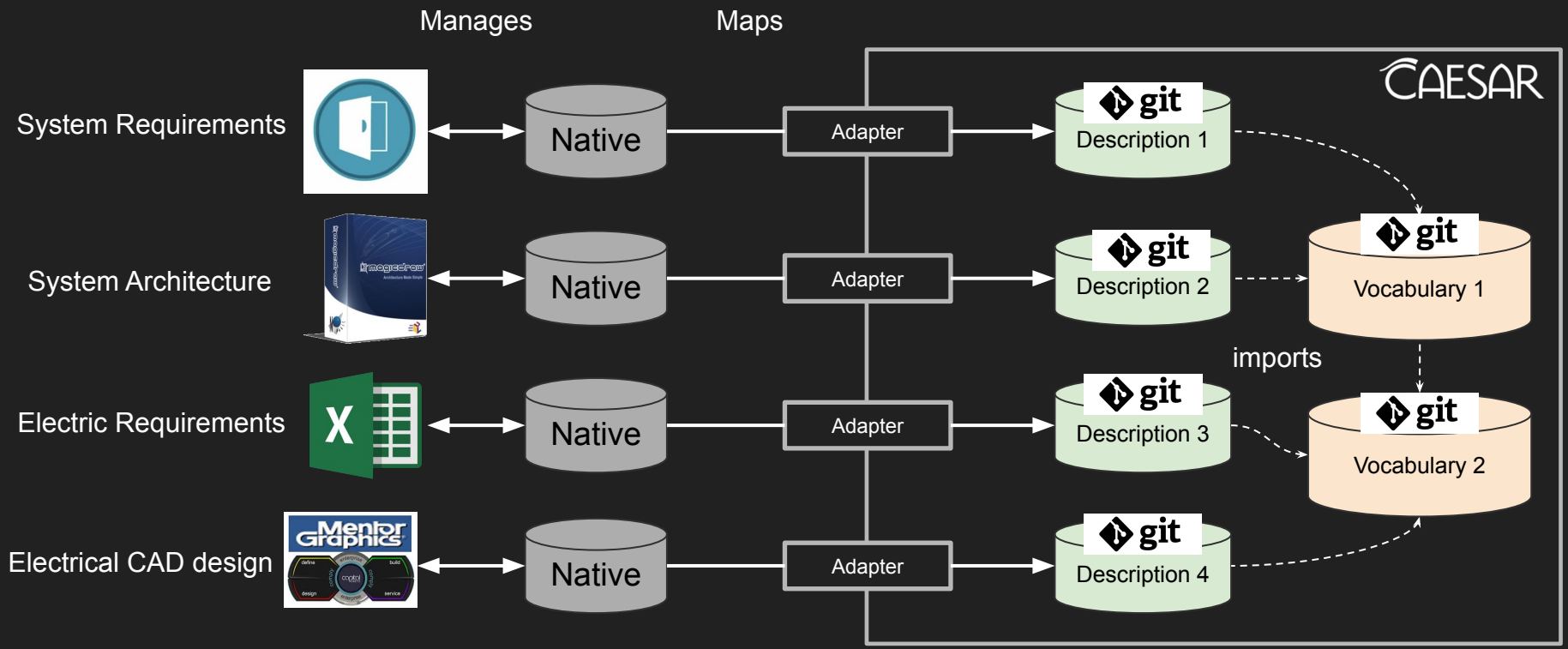
UC4: Framing Stakeholder Concerns

Historical info can be reloaded from any commit in the CM repository

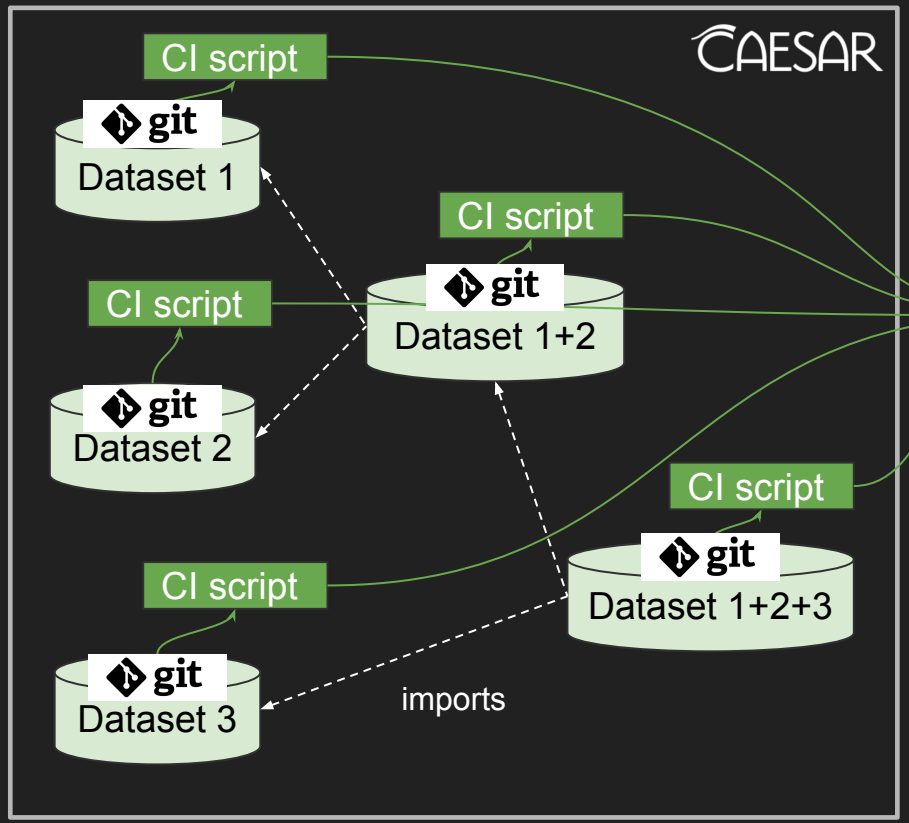
Every artifact is stored with its full provenance info

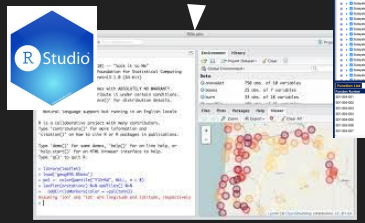


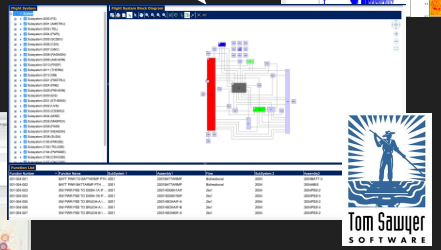
UC5: Federation of Information Datasets



UC6: Incremental Integration of Federated Datasets

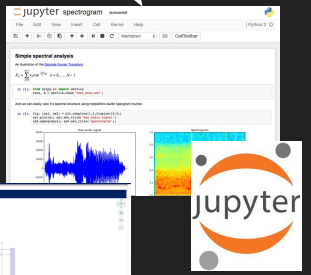




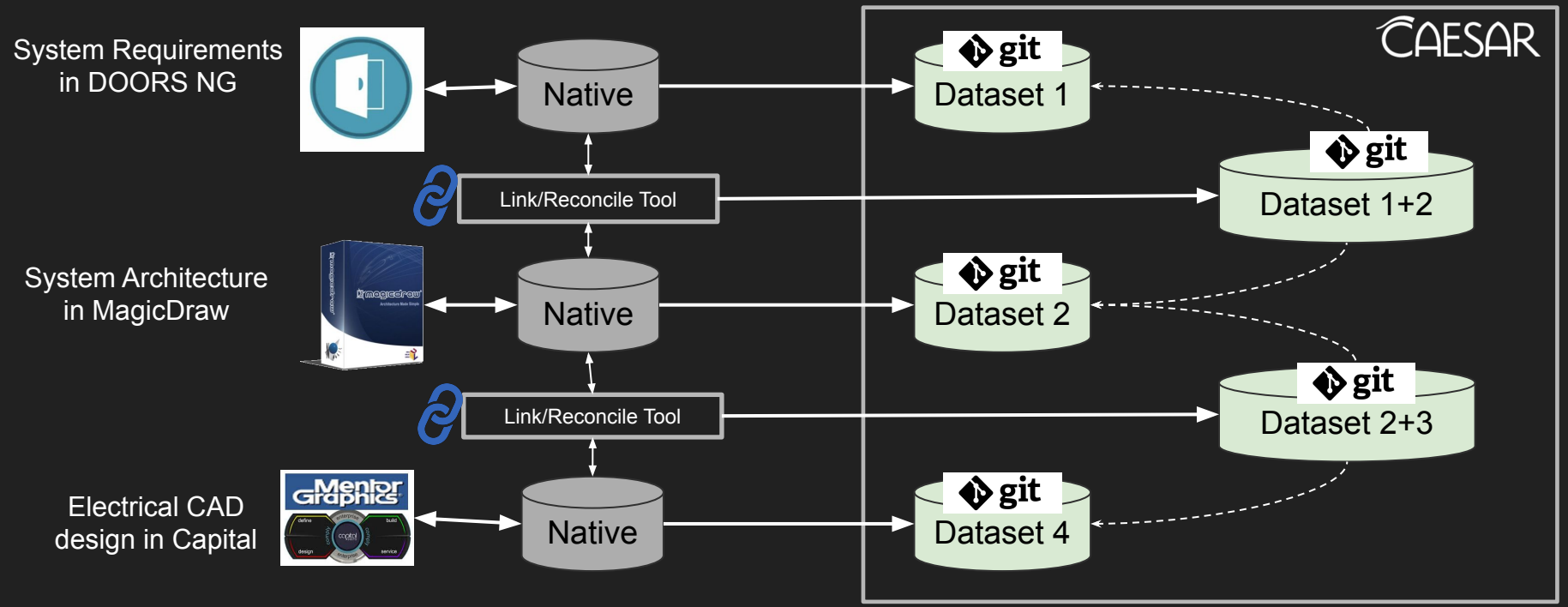


Artifact Repository

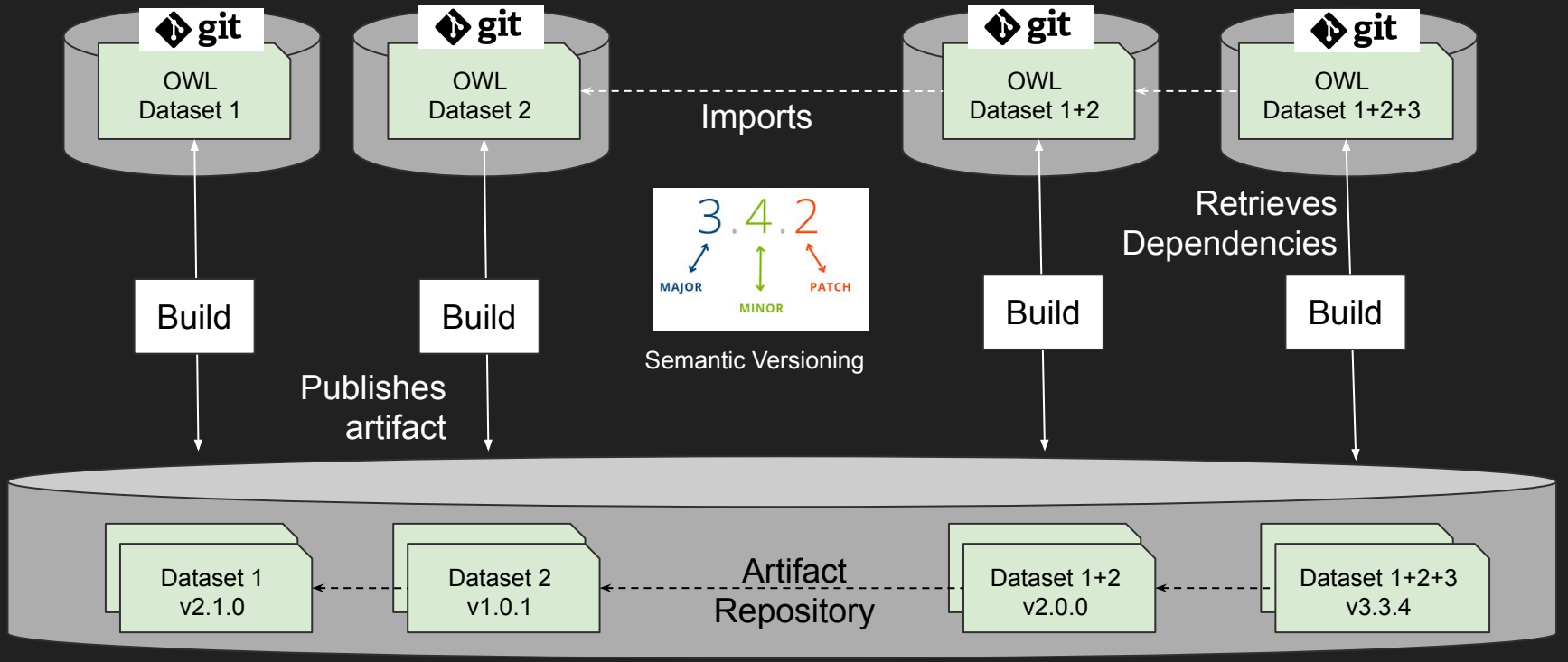
Graph Database



UC7: Linking and Reconciliation

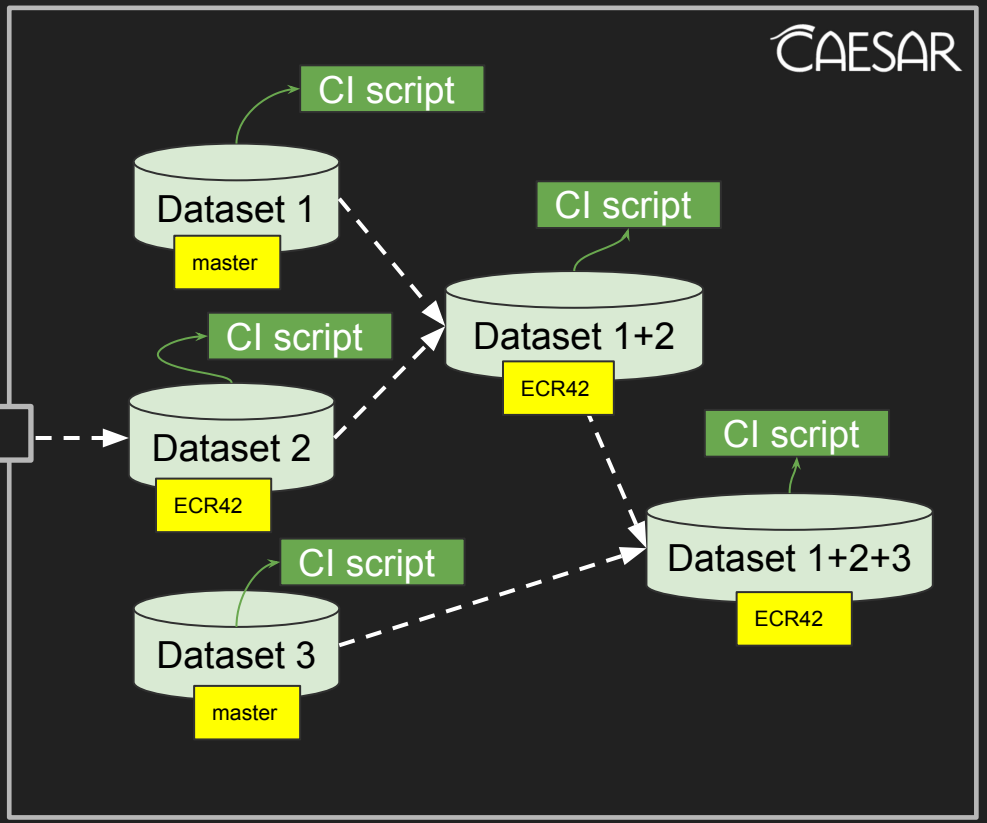


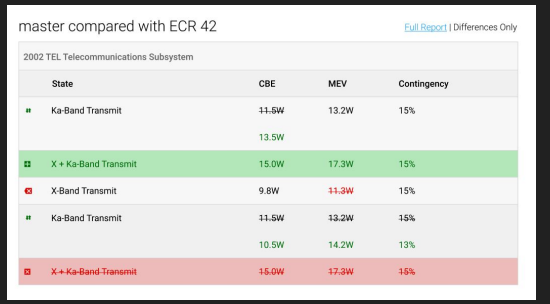
UC8: Dependency Management



UC9: Analyzing Change Impact

System Architecture in MagicDraw



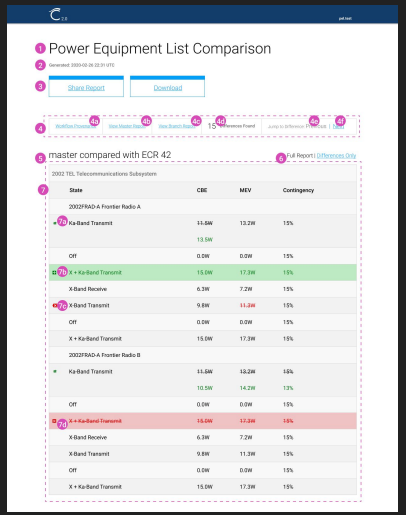


master compared with ECR 42

Full Report | Differences Only

2002 TEL Telecommunications Subsystem

	State	CBE	MEV	Contingency
	Ka-Band Transmit	~~11.5W~~ 13.5W	13.2W	15%
	X + Ka-Band Transmit	15.0W	17.3W	15%
	X-Band Transmit	9.8W	~~11.3W~~	15%
	Ka-Band Transmit	~~11.5W~~ 10.5W	~~13.2W~~ 14.2W	~~15%~~ 13%
	~~X + Ka-Band Transmit~~	~~15.0W~~	~~17.3W~~	~~15%~~



Power Equipment List Comparison

Share Report | Download

master compared with ECR 42

Full Report | Differences Only

2002 TEL Telecommunications Subsystem

openCAESAR

Blog: https://opencaesar.github.io/

Github: https://github.com/opencaesar

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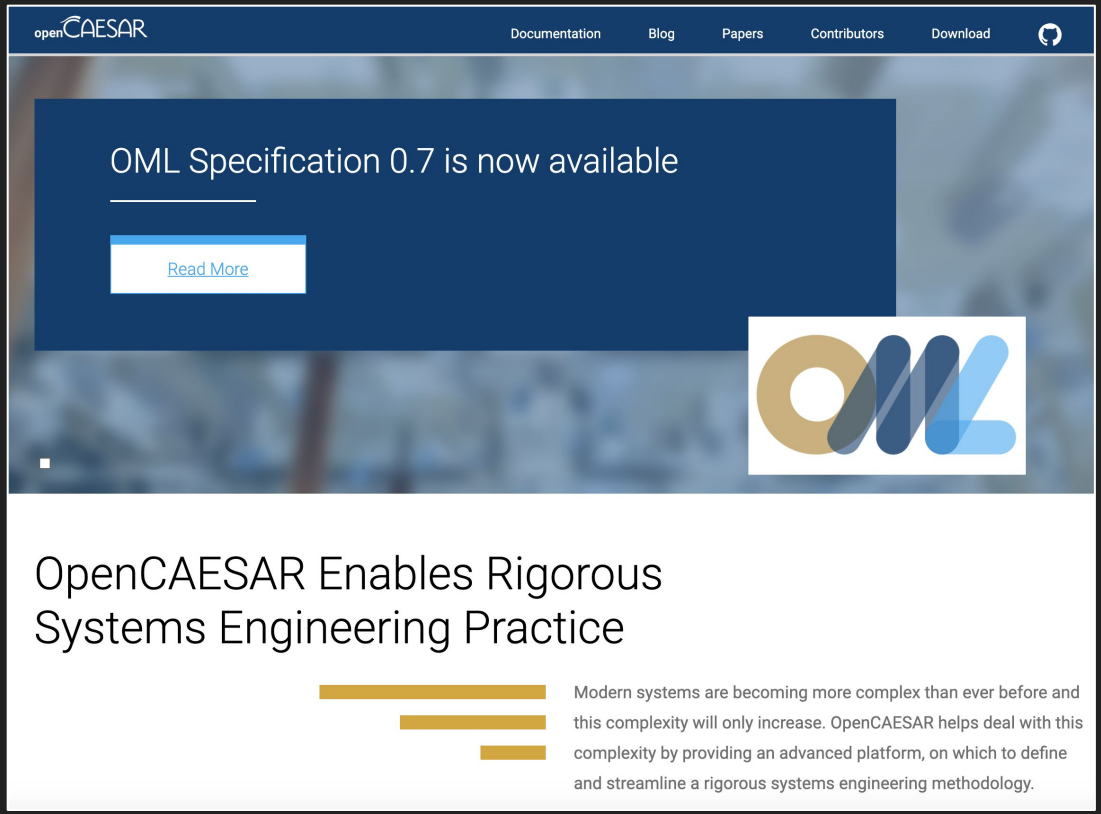

THANK YOU !