INCOSE Agile Systems Engineering Life Cycle Management (ASELCM) Pattern

Consistency Management as an Integrating Paradigm for Digital Life Cycle Management with Learning

Including Computational Model VVUQ and Applications for Semantic Technologies

INCOSE/OMG MBSE Patterns Working Group
04.12.2021 V1.3.1

Bill Schindel
schindel@ictt.com

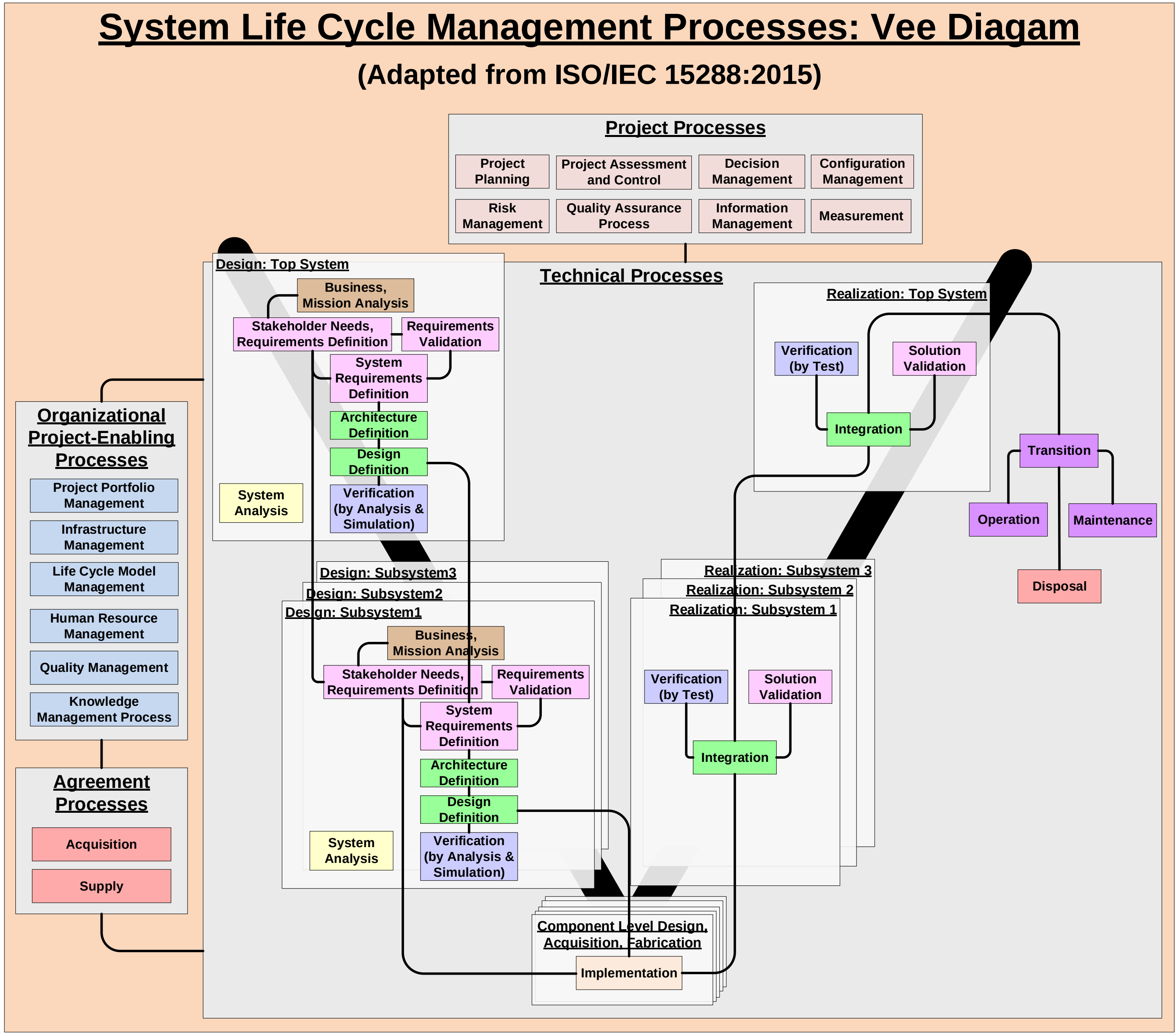
Contents

Purpose and Scope

- This material briefly summarizes a view of engineering (and more broadly, the whole system life cycle management cycle) from a perspective of "consistency management":
    - Embedded within familiar higher-level, traditional frameworks, such as ISO 15288, the SE "Vee" Model, and contemporary enterprise frameworks.
- While the notion of managing consistency is not new, a re-look at engineering/life cycle management through that perspective provides a valuable way to plan next generation digital ecosystems, analyze current challenges, plan improvement roadmaps, and understand connections of several INCOSE Patterns Working Group Projects.
- Rising contemporary interest in "digital engineering" using models increases the value of this perspective, because such models and related infrastructure tooling open new consistency management possibilities, along with <u>*more robust process integration*</u>.
- Two broad consistency management areas of applicability are summarized here: quantitative "VVUQ" simulation management and qualitative/semantic consistency management. Both of these areas apply very widely across the system life cycle.
- This is a conceptual summary. References are listed that provide additional detail.

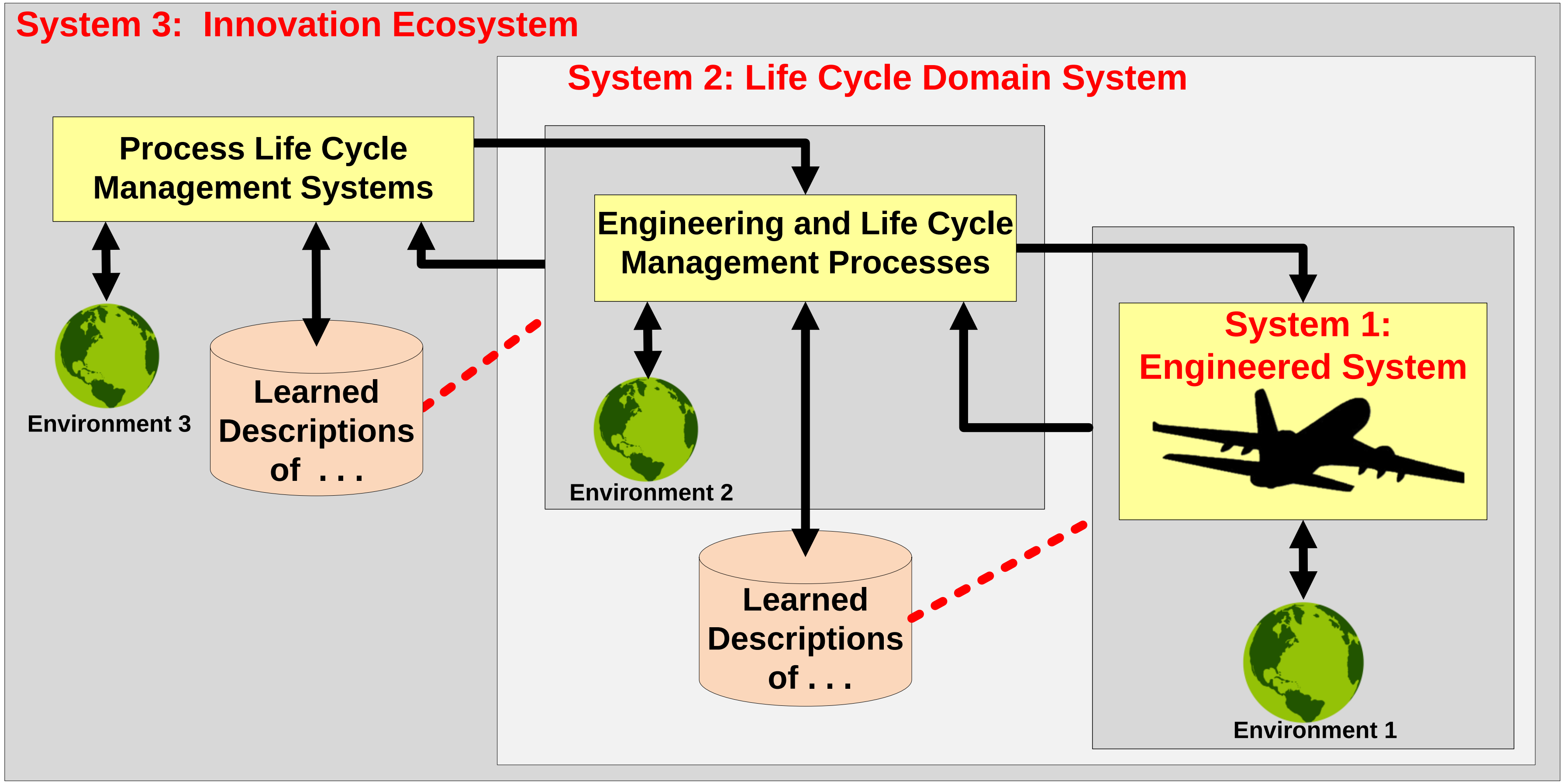
Managing the System Life Cycle

- Engineering a system is considered to be a limited subset of the overall life cycle management for a system.
- ISO15288, the basis of the INCOSE Systems Engineering Handbook, provides a widely familiar reference defining that larger system management life cycle, and the engineering subset within it--roughly, the ISO15288 “Technical Processes” of the Vee Diagram.
- The *overall* Life Cycle Management processes can be viewed from many different perspectives, one of which is the INCOSE ASELCM Pattern . . .



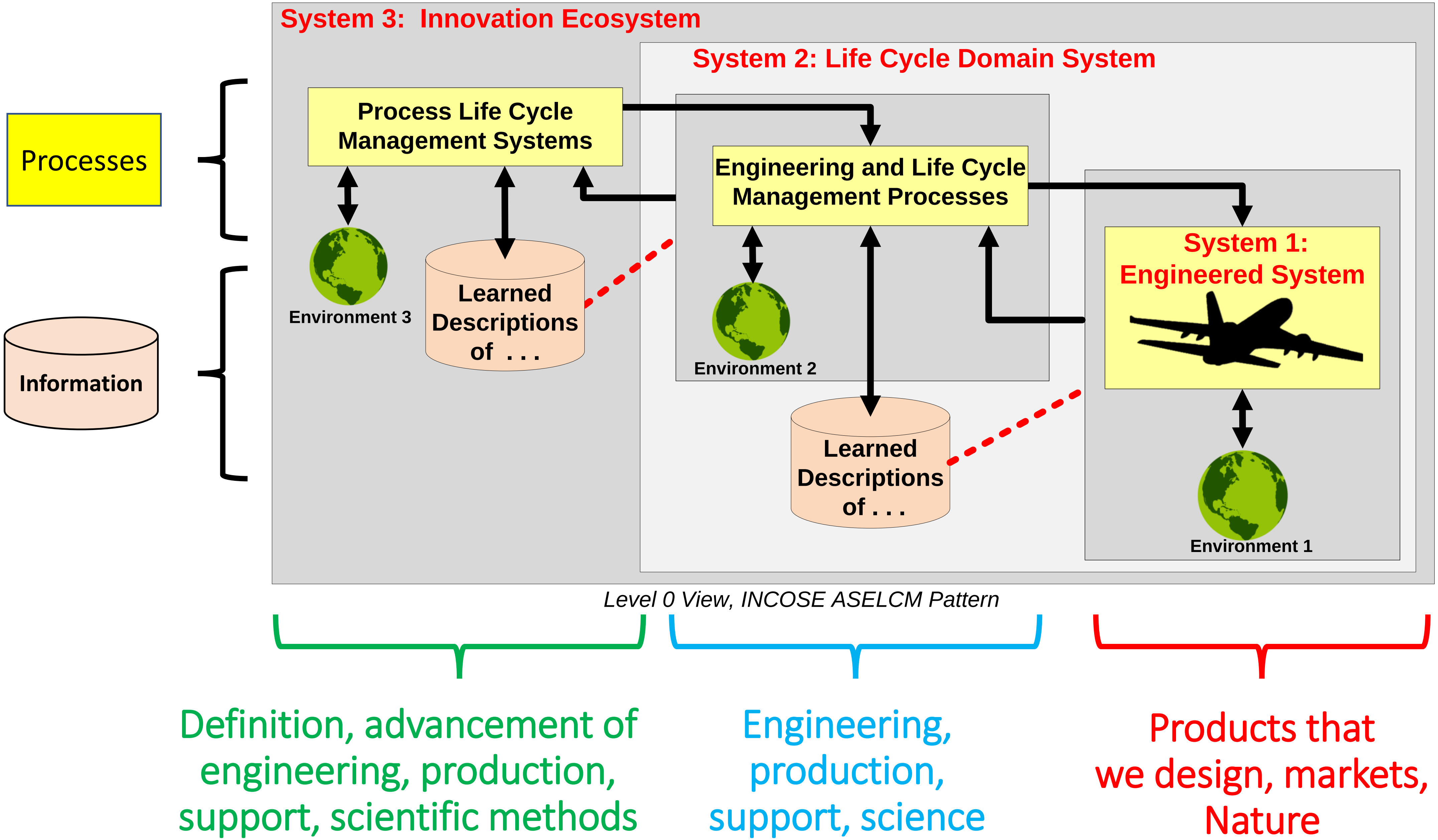
The ASELCM S*Pattern: Logical Architecture Levels 0-4

- Understanding the Level 0 summary logical architecture model of the ASELCM Pattern is the simplest place to start:



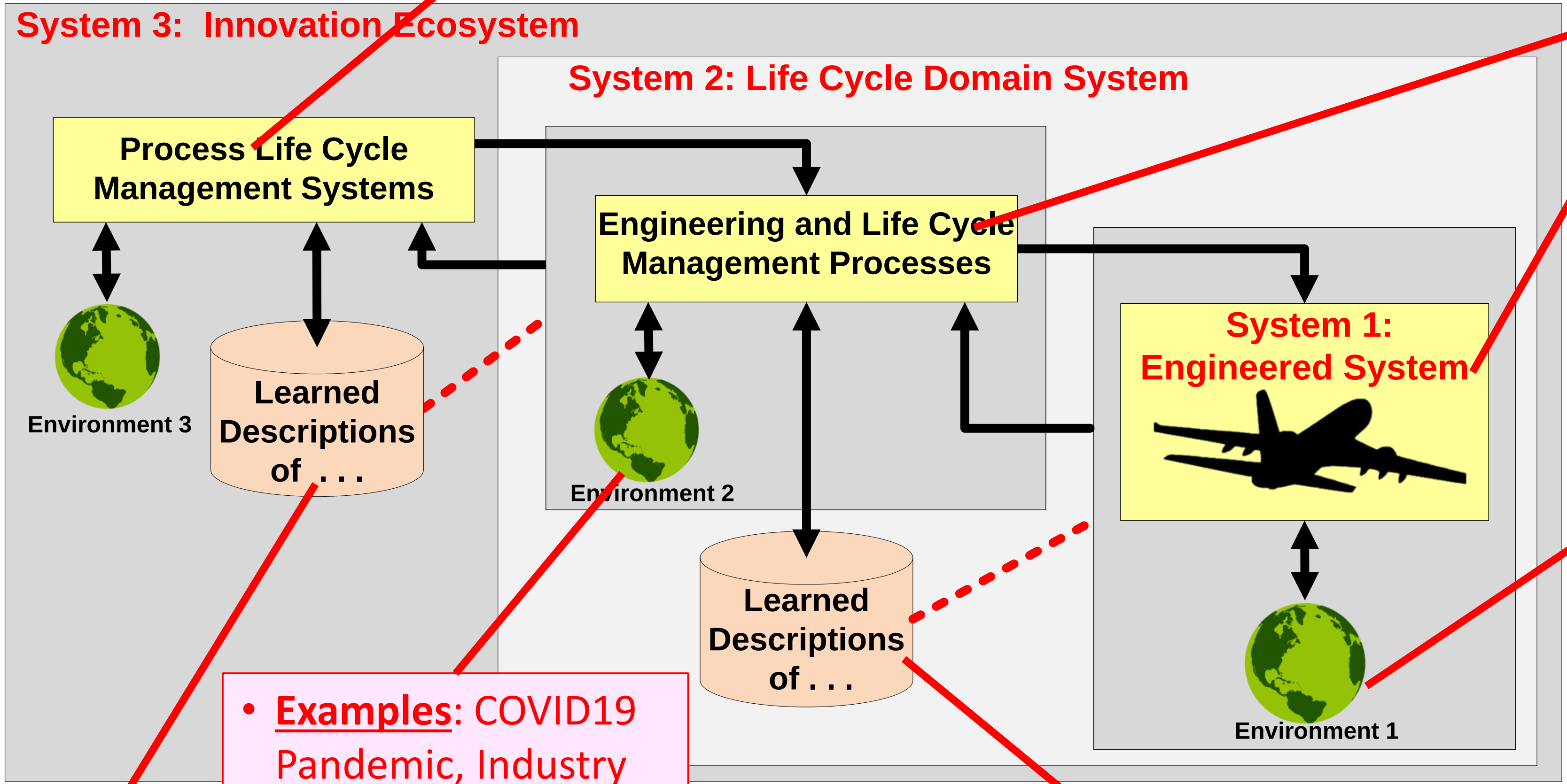
Level 0 View, INCOSE ASELCM Pattern

Simpler top level view of Ecosystem Pattern



- **Examples**: Engineering Education, Engineering Methods Owner, Engineering Tooling Architect, HR Department, Engineering Procedures Author, INCOSE, IEEE, ASME

- **Examples**: Systems Engineering Department, Senior Electrical Engineer, Design Review, Simulation Platform, Engineering Toolchains, Learning Machines, Manufacturing Process, Service Delivery Process, PLM system, Production MES.



OSE ASELCM Pattern

- **Examples**: Aircraft, landing gear, bearings, avionics.

- **Examples**: Atmosphere, weather, runways

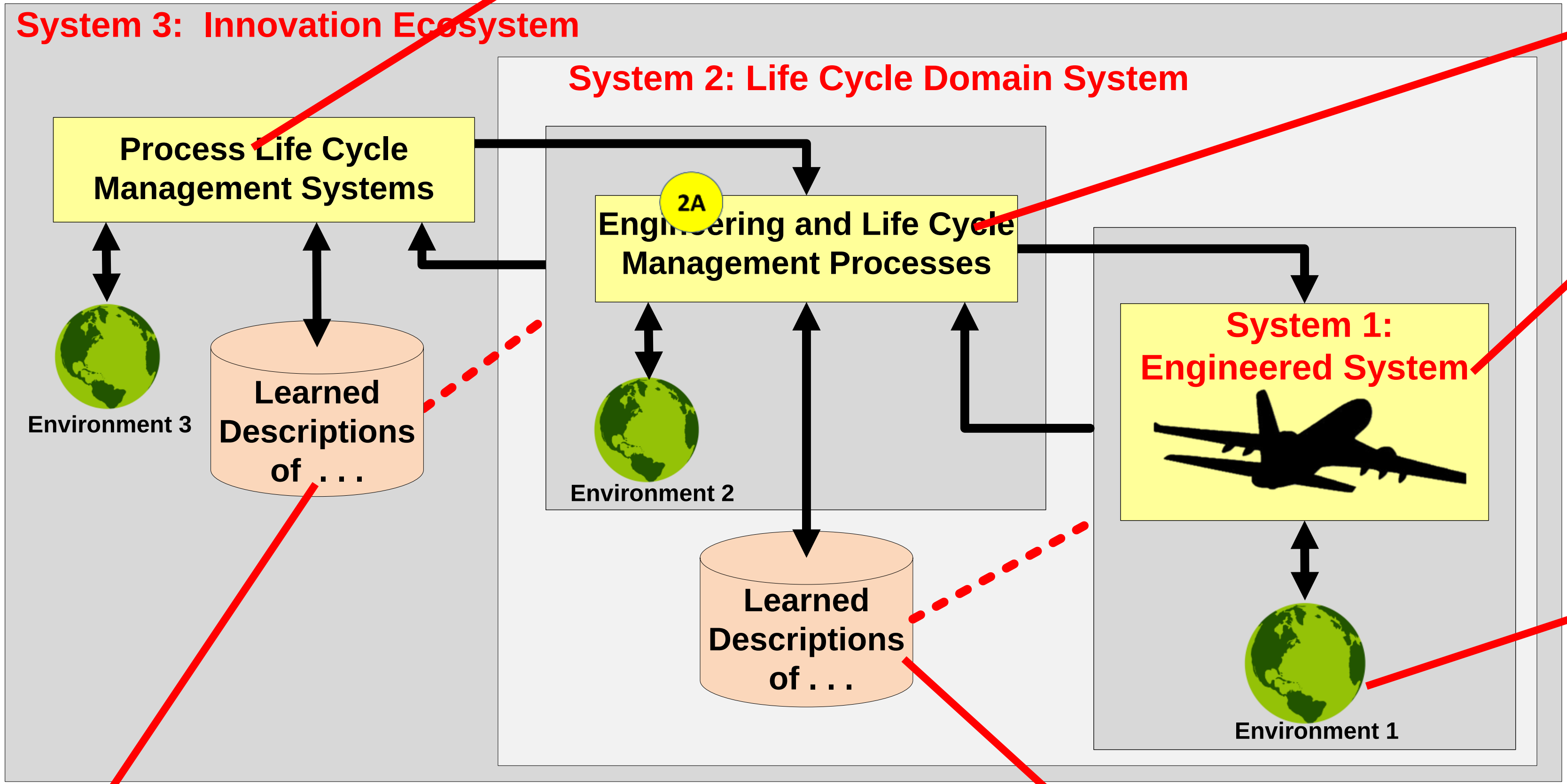
- **Examples**: COVID19 Pandemic, Industry Funding, Job Market

- **Examples**: Enterprise Procedures, Job Descriptions, Organization Charts, Policies, INCOSE Handbook, SEBoK, Methodology Primers, Personal & Tribal Process Knowledge

- **Examples**: Landing Gear Requirements, Designs, Schematics, MBSE Models, CFD Simulations, Part Prints, Production Recipes, Assembly Diagrams, Raw Materials Lists, Physics, Personal & Tribal Landing Gear Knowledge

- Systems & processes responsible to learn about, describe, understand System 2A and Environment 2, or to plan, engineer, develop, educate, deploy, integrate, install, maintain, or retire System 2A. People, tools, facilities.

- Systems & processes responsible to learn about, describe, understand System 1 and Environment 1, or to engineer, develop, fabricate, integrate, distribute, deploy, install, maintain, or retire System 1. Includes people, tools, facilities.



- Any engineered system, including manufactured products, service-providing systems; or any object of scientific study.
- Includes systems-of-systems, subsystems, or components.

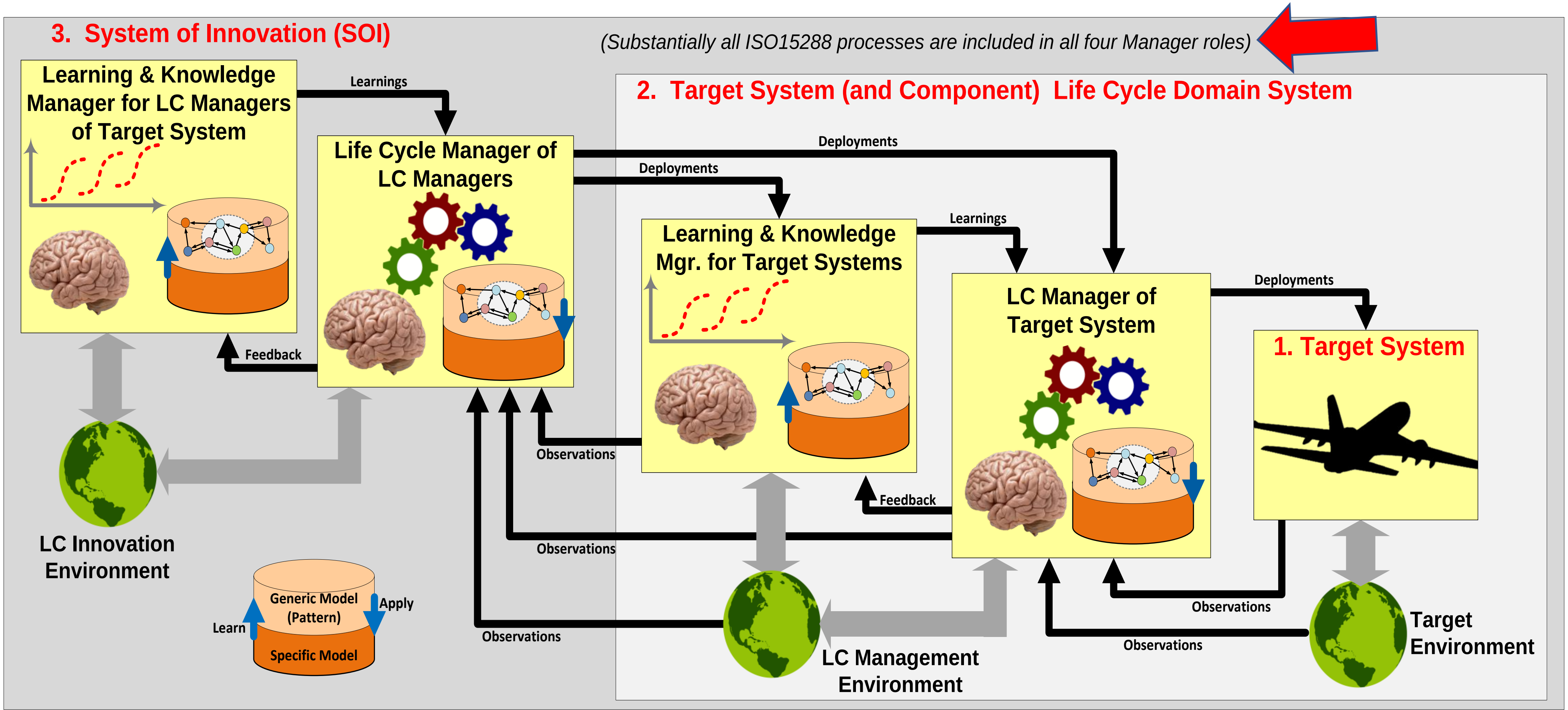
- The environment in which System 1 is operated, sustained, distributed, manufactured, or retired.
- Anything that directly interacts with System 1 during its life cycle.

Level 0 View, INCOSE ASELCM Pattern

- Accumulated knowledge of System 2A and Environment 2, including explicit procedures, work instructions, organization charts, models, implicit and tribal knowledge, captured empirical data or simulations, plans, prints, diagrams, prose, or other descriptions.

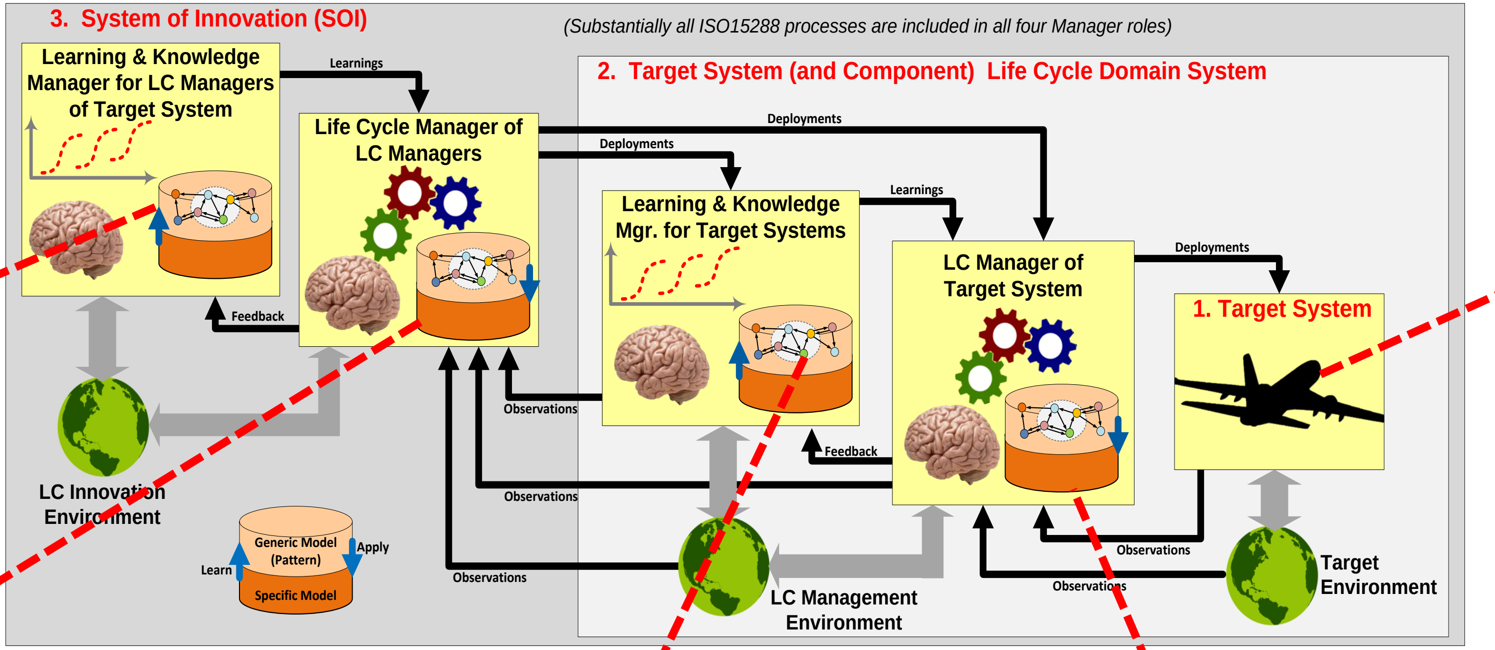
- Accumulated knowledge of System 1 and Environment 1, including explicit models, prose descriptions, implicit and tribal knowledge, captured empirical data or simulations, plans, prints, diagrams, prose, or other descriptions.

- Below--"Level 1" summary view of INCOSE Agile Systems Engineering Life Cycle Management (ASELCM) Pattern.
- This view of system life cycle management contemplates the 30+ ISO15288 processes from the perspective of *learning*, and the agility resulting from it.
- The ASELCM Pattern is a configurable, descriptive, not prescriptive, reference model, meant to describe any form of human or naturally-performed life cycle management—especially learning & agility aspects—good or bad.
- Substantially all the 30+ ISO15288 processes appear *inside* each of the four "manager" blocks:



ASELCM Pattern

ASELCM Pattern: Systems 1, 2, and 3



System 1: The real engineered system.

System 3: Configurable Patterns of System 2 projects and resources, learned over multiple projects.

System 3: Configured models of specific System 2 ecosystems (engineers, tools, methods, processes, etc.), ready to deploy in System 2 projects. Driver for organizational change management, improved methods and tools, education.

System 2: Configurable Domain Patterns for System 1 Models, learned over multiple projects.

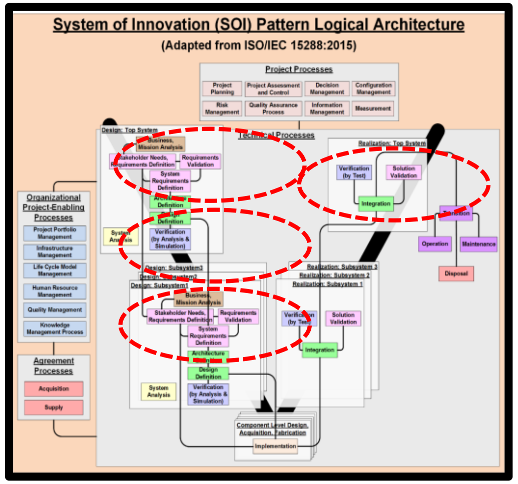
System 2: Configured models of specific System 1 & environment, configured for specific project uses--namely the ISO15288 life cycle management processes.

- **System 1:** The system of interest, being engineered or otherwise life cycle managed.
- **System 2:** The system of engineering and other life cycle management of System 1. Responsible to learn about System 1 and its environment.
- **System 3**: The system of engineering and other life cycle management of System 2. Responsible to learn about System 2 and its environment. Includes organizational change management, development of new System 2 methods & tools, etc.

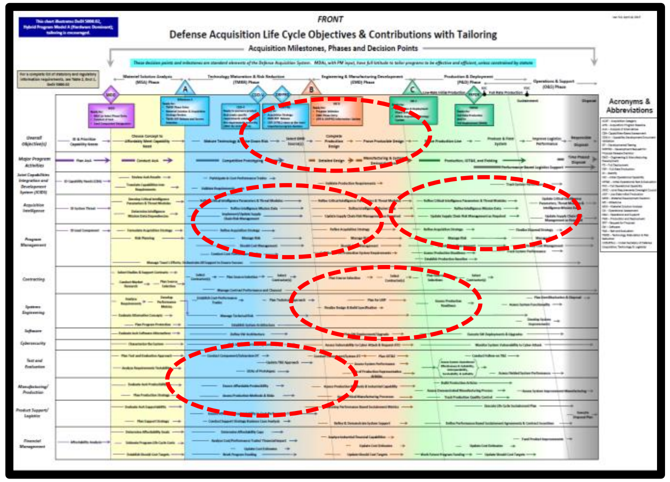
Enterprise-Specific Life Cycle Management Models

- Particularly in connection with interest in Digital Engineering, individual enterprises have publicly described their own Life Cycle Management Models that build on ISO15288 while leveraging digital models:

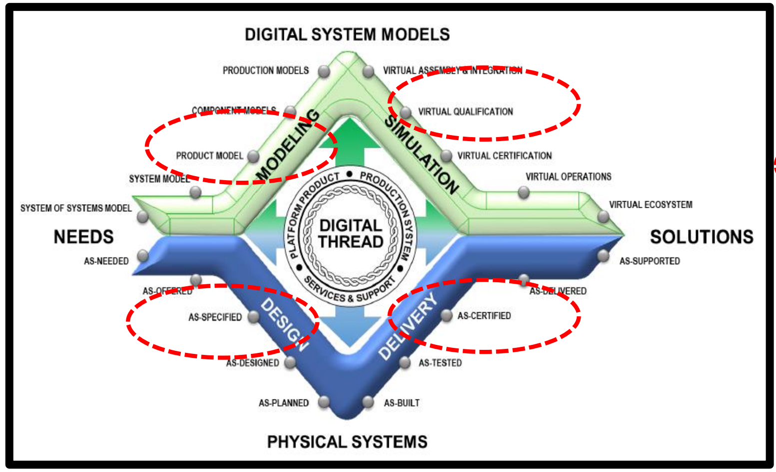
ISO15288 Life Cycle "Vee" Model[1]



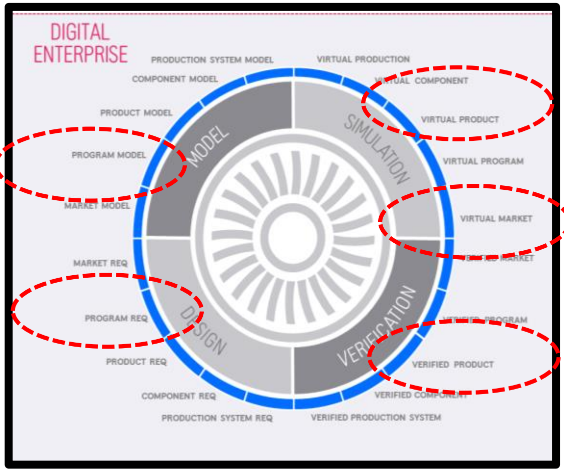
DoD 5000 Defense Acquisition Life Cycle Model[2]



Boeing "Diamond" Model[3]



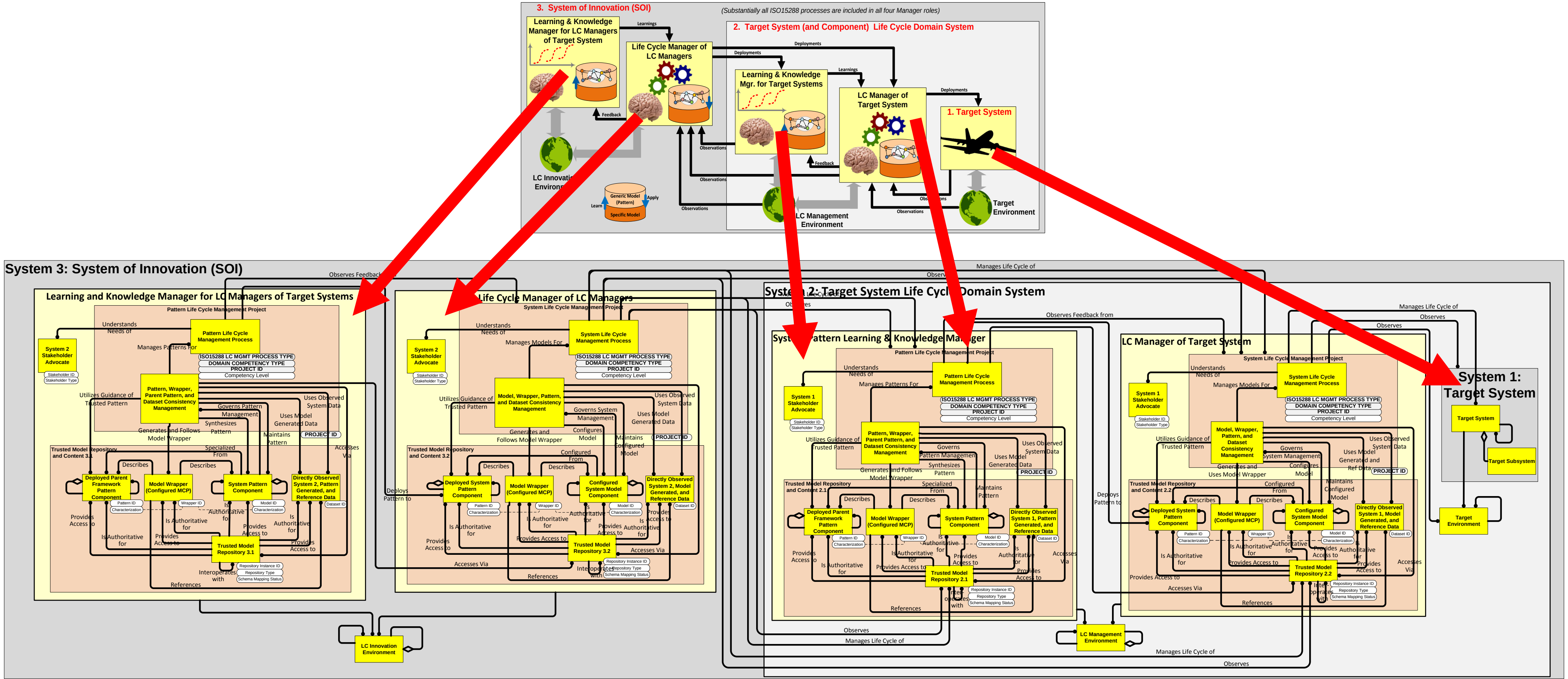
Rolls-Royce "O" Model[4]



Excerpted or adapted from: (1) ISO15288 and INCOSE SE Handbook; (2) DoD5000 Wall Chart; (3) AIAA Sci Tech, 01.2020, J. Hatakeyama; (4) AIAA DEIC Digital Twin Subcommittee, 04.08.19 Donaldson, Flay, French, Matlik, Myer, Pond, Randjelovic

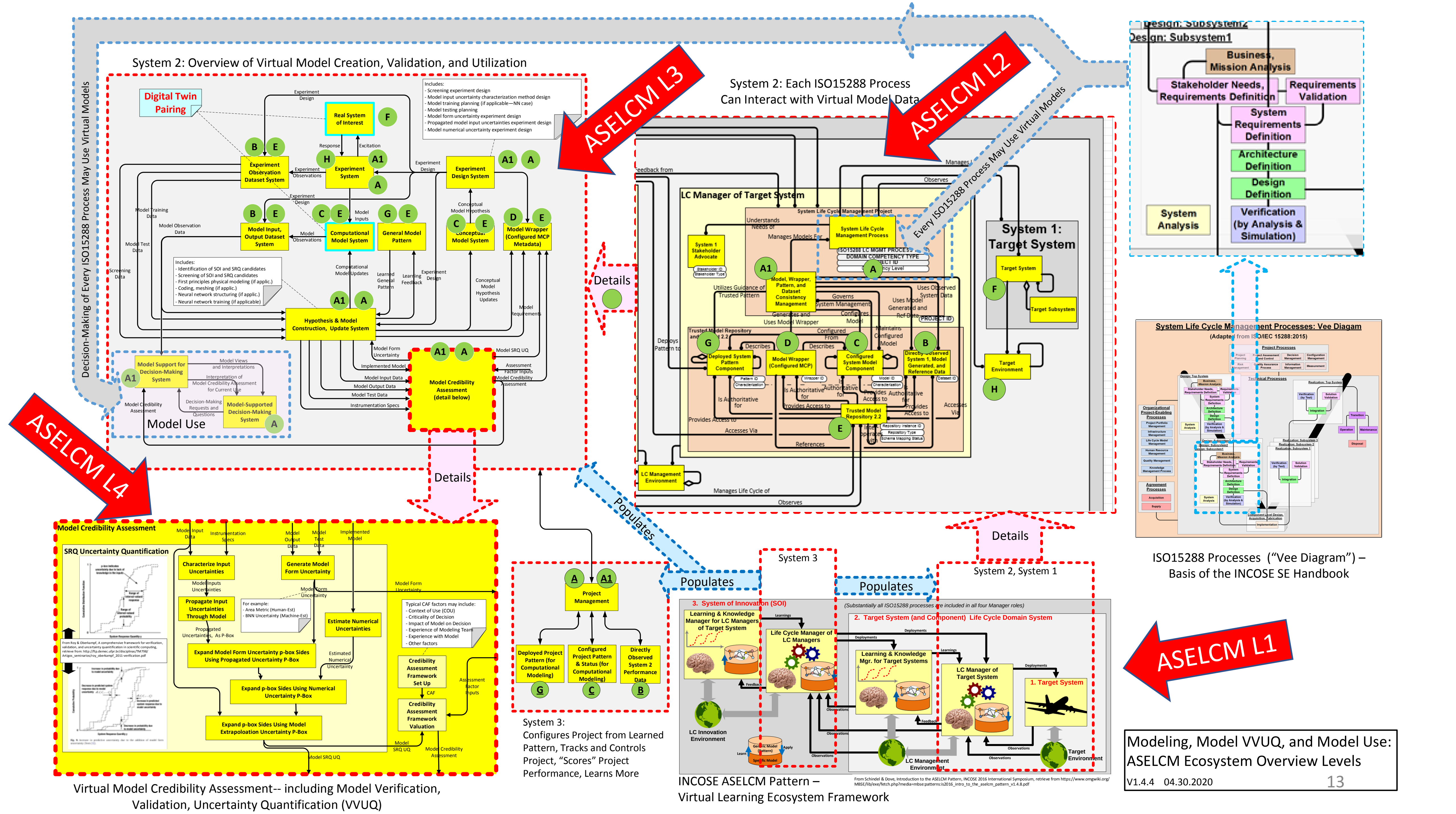
Consistency Management as a Digital Life Cycle Management Paradigm

- The ASELCM Pattern is a formal S*Pattern, and its logical architecture has four levels of progressively decomposed structural detail:



ASELCM Level 1

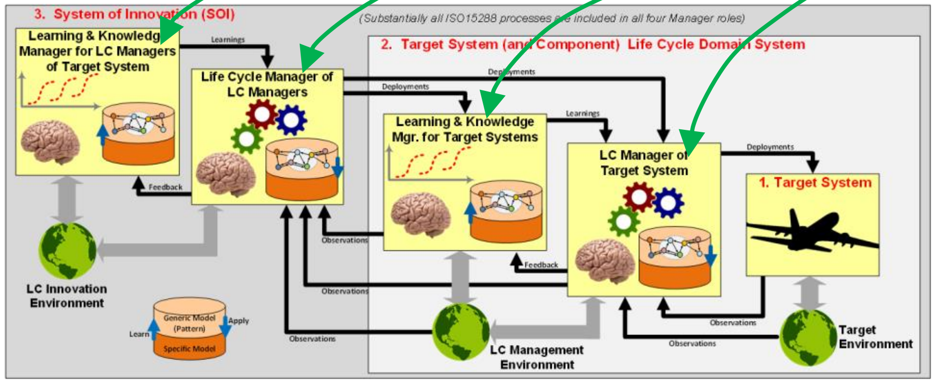
ASELCM Level 2



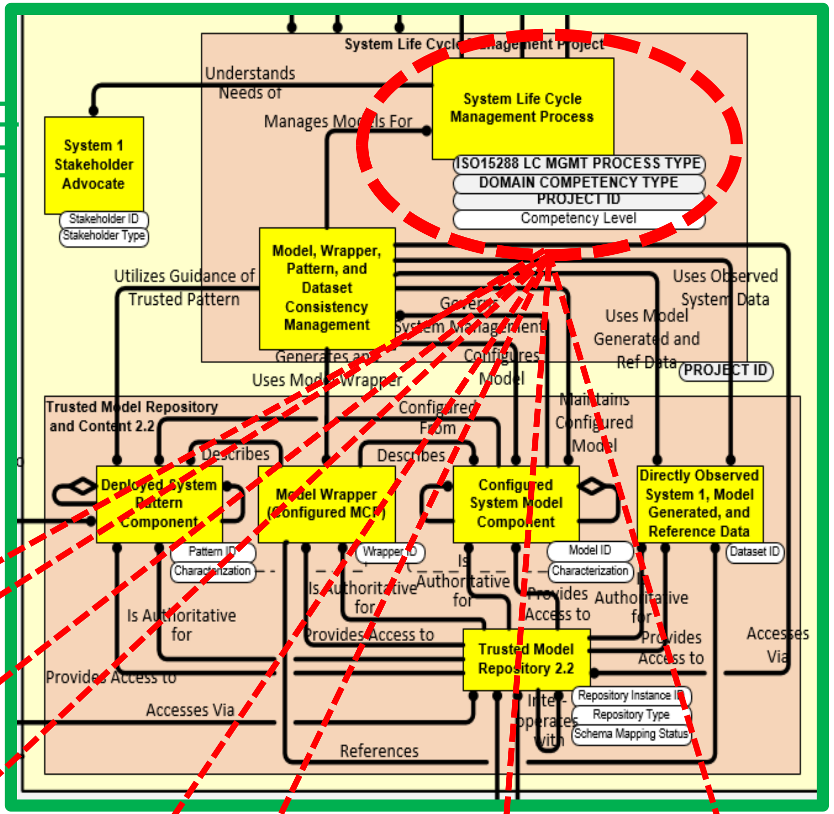
Modeling, Model VVUQ, and Model Use: ASELCM Ecosystem Overview Levels

V1.4.4 04.30.2020

Learning & Execution pattern appears 4 times in ASELCM Ecosystem Reference Pattern

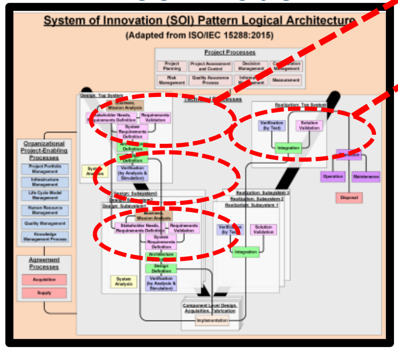


ASELCM Ecosystem Reference Pattern

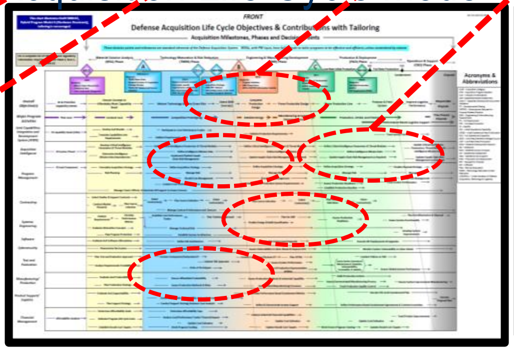


ASELCM Ecosystem Reference Pattern:
Configurable to *all* life cycle management models---

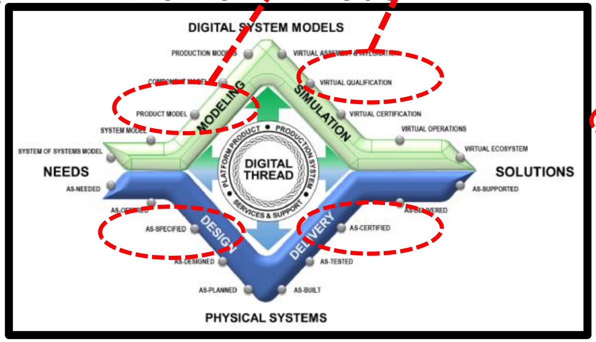
ISO15288 Life Cycle "Vee" Model[1]



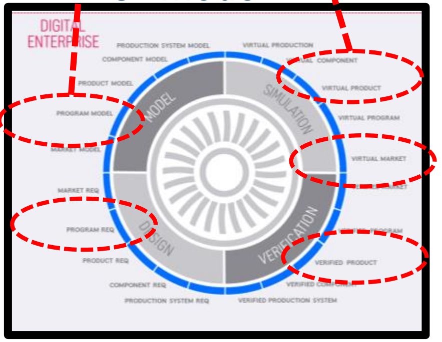
DoD 5000 Defense Acquisition Life Cycle Model[2]



Boeing "Diamond" Model[3]



Rolls-Royce "O" Model[4]



Excerpted or adapted from: (1) ISO15288 and INCOSE SE Handbook; (2) DoD5000 Wall Chart; (3) AIAA Sci Tech, 01.2020, J. Matakeyama; (4) AIAA DEIC Digital Twin Subcommittee, 04.08.19 Donaldson, Flay, French, Matlik, Myer, Pond, Randjelovic

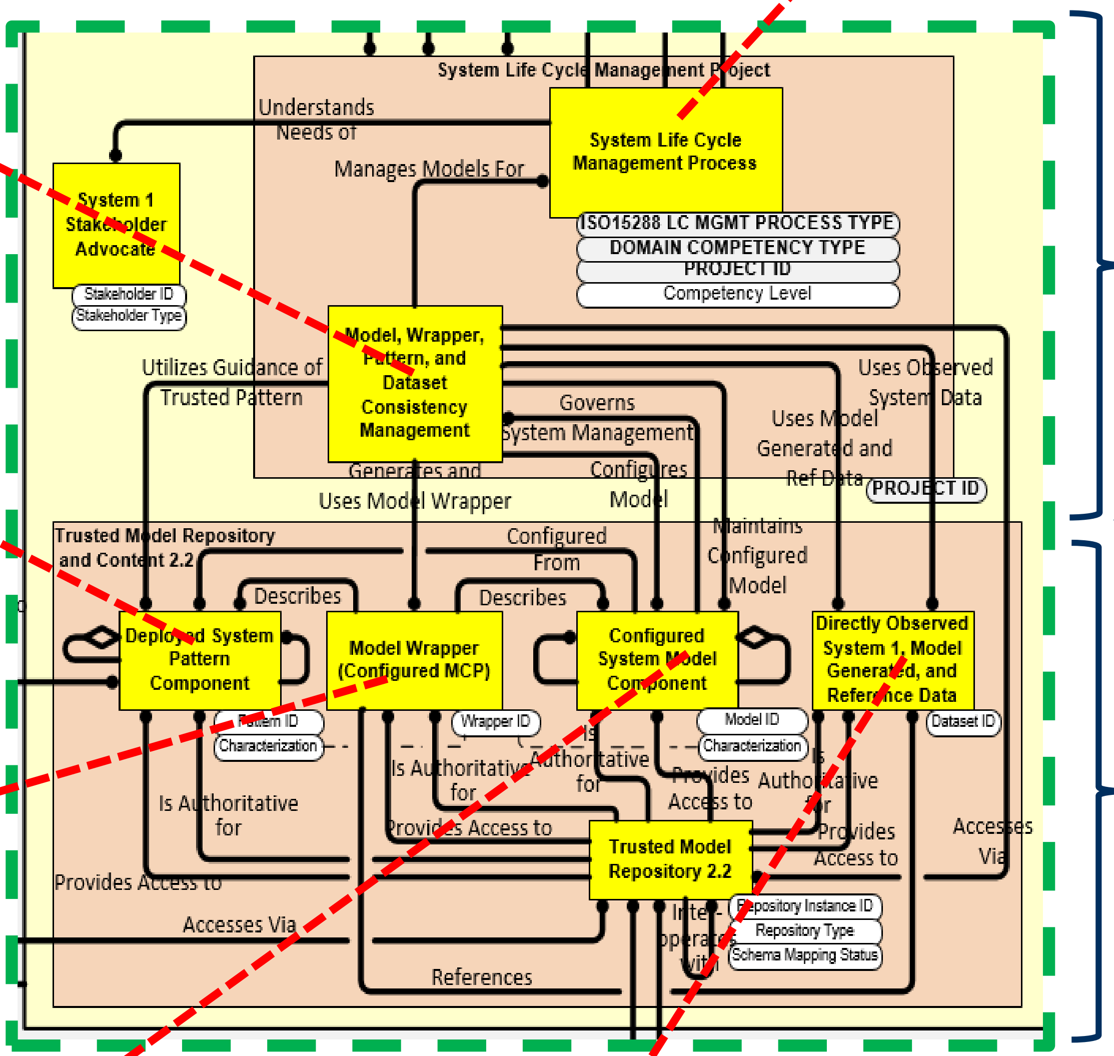
ASELCM Ecosystem Reference Pattern (Level 2)

Business Processes:
ISO15288 or otherwise

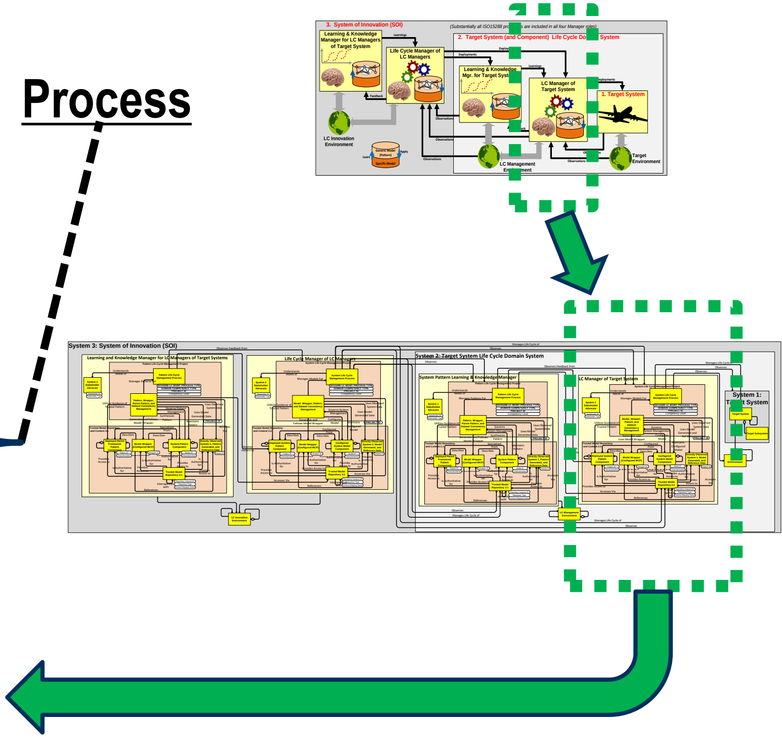
Consistency Manager Role: Manages the consistency of the four information sets below with each other as well as with several external areas.

Configurable Patterns
That can Generate or Validate Configured Models of System 1

Model Wrappers (MCP Metadata) Describing Models, Patterns, and Datasets.



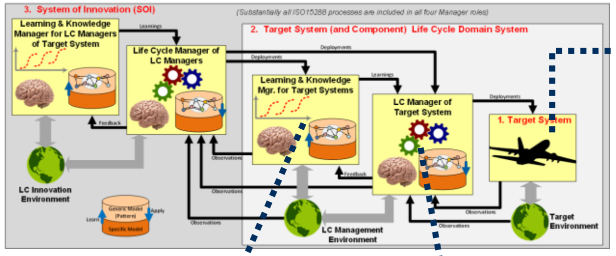
Process



Information

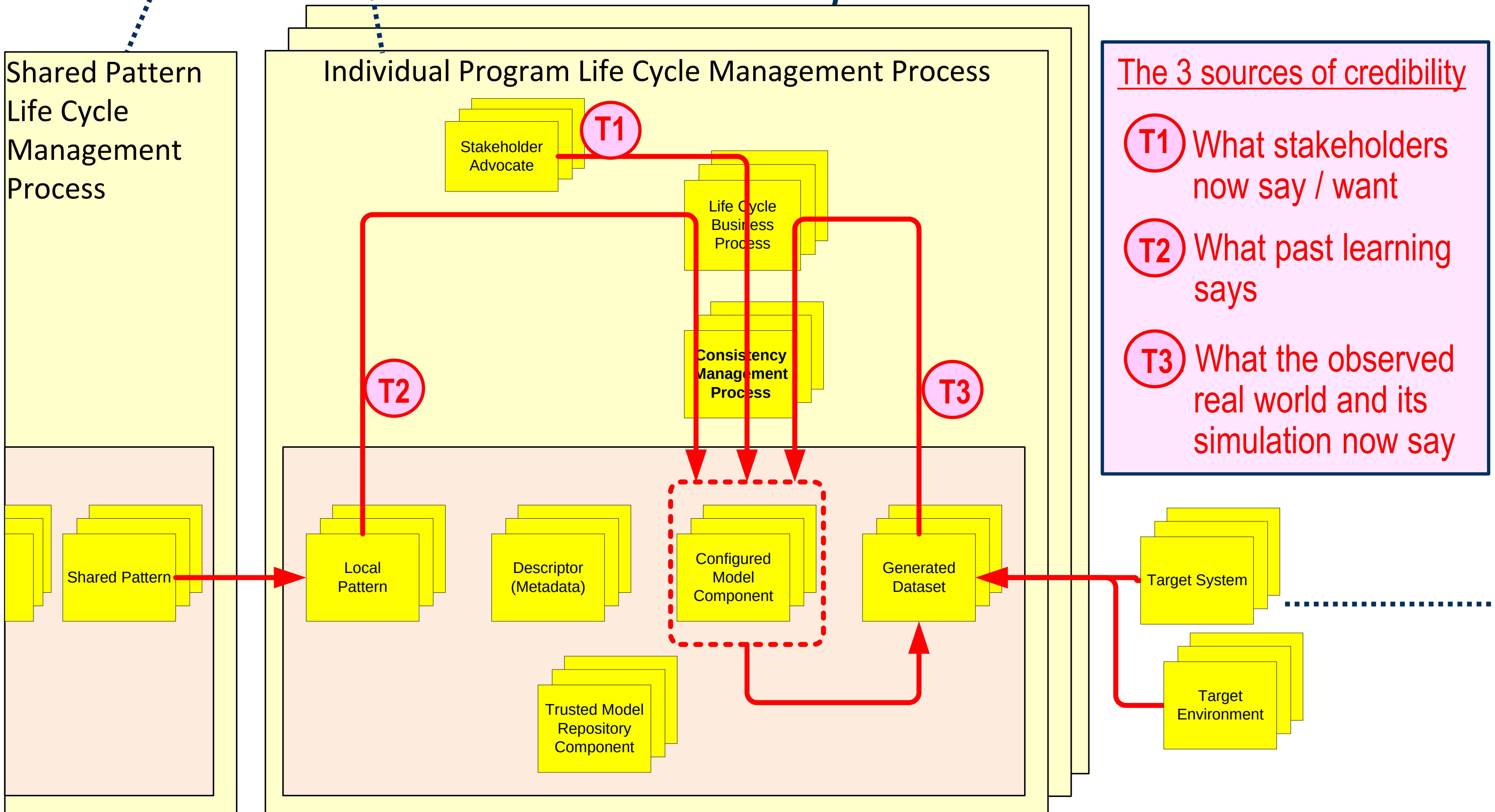
Configured Models:
Computational and other (MBSE, etc.) of System 1

Datasets Generated by Computational Models of System 1 (Simulations) and by Empirical Observations / Tests / Measurements of System 1 (Digital Twin Pair Data)



ASELCM Ecosystem Reference Pattern

Consistency Management, in multiple forms, occurs throughout the life cycle, to manage differences (inconsistencies) originating from 3 sources of authority; *it is at the abstract heart of life cycle management:*



Examples of Consistency Management

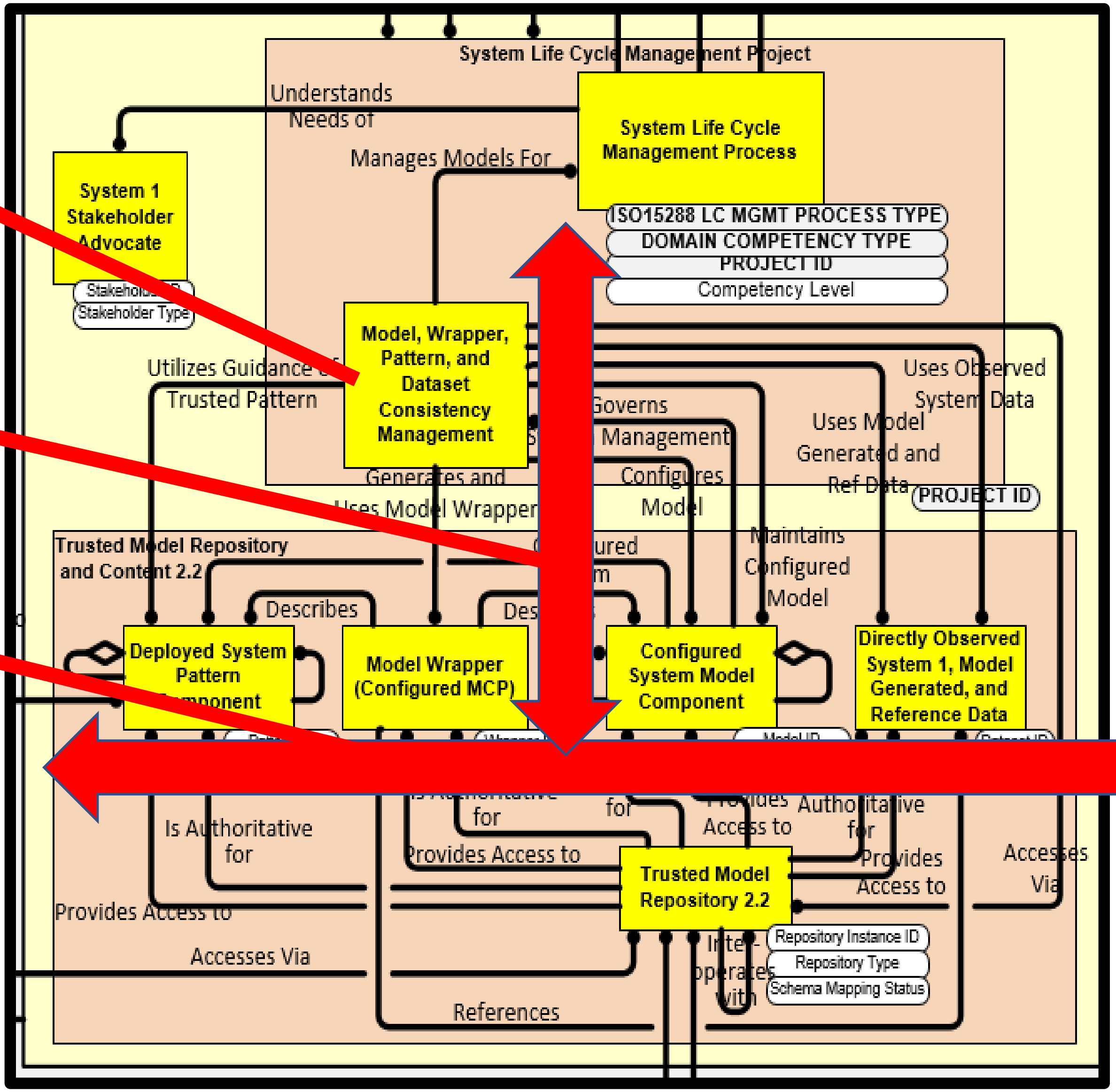
- By "consistency", we don't mean "equality", but rather a type of equivalence relation.
- There are many types of pair-wise consistency "gaps" traditional life cycles encounter:
  - Is my new system requirements model in agreement with past learning for this system type?
  - Is my simulation model of a proposed design credible as what a real lab prototype would do?
  - Are the supplier's sample parts consistent with the design model?
  - Is my system requirements model aligned with what the stakeholder wants?
  - Is the manufacturing model in line with the product model?
  - Are the real in-service systems being used as described by the operational system model?
  - And many others.
- This perspective sees model life cycle management as an effort to detect, manage, and resolve a series of "gaps"--just like system V&V, but for more consistency tuples.
- Also included are opportunities to learn and adapt, as we detect changes in the world of stakeholders, environments, competitors, technologies, and increasing knowledge.
- The ASELCM Level 2 Model focuses on a generalized role of "consistency management" which is concerned with supporting numerous types of consistency implied . . .

Consistencies across Models, Patterns, Datasets, as well as with external Stakeholders and Real World.

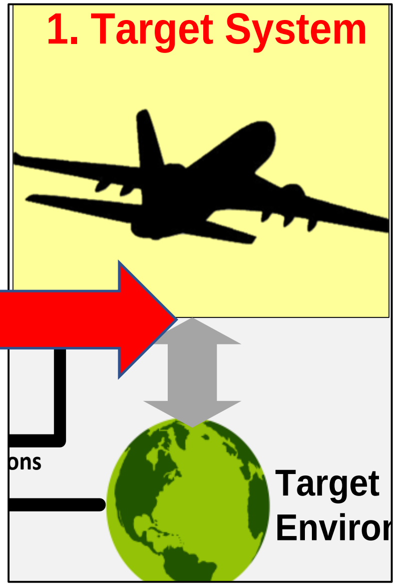
Consistency Management Role

Vertical consistencies of information with Business Processes & Stakeholders

Horizonal consistencies across information types as well as with external real world



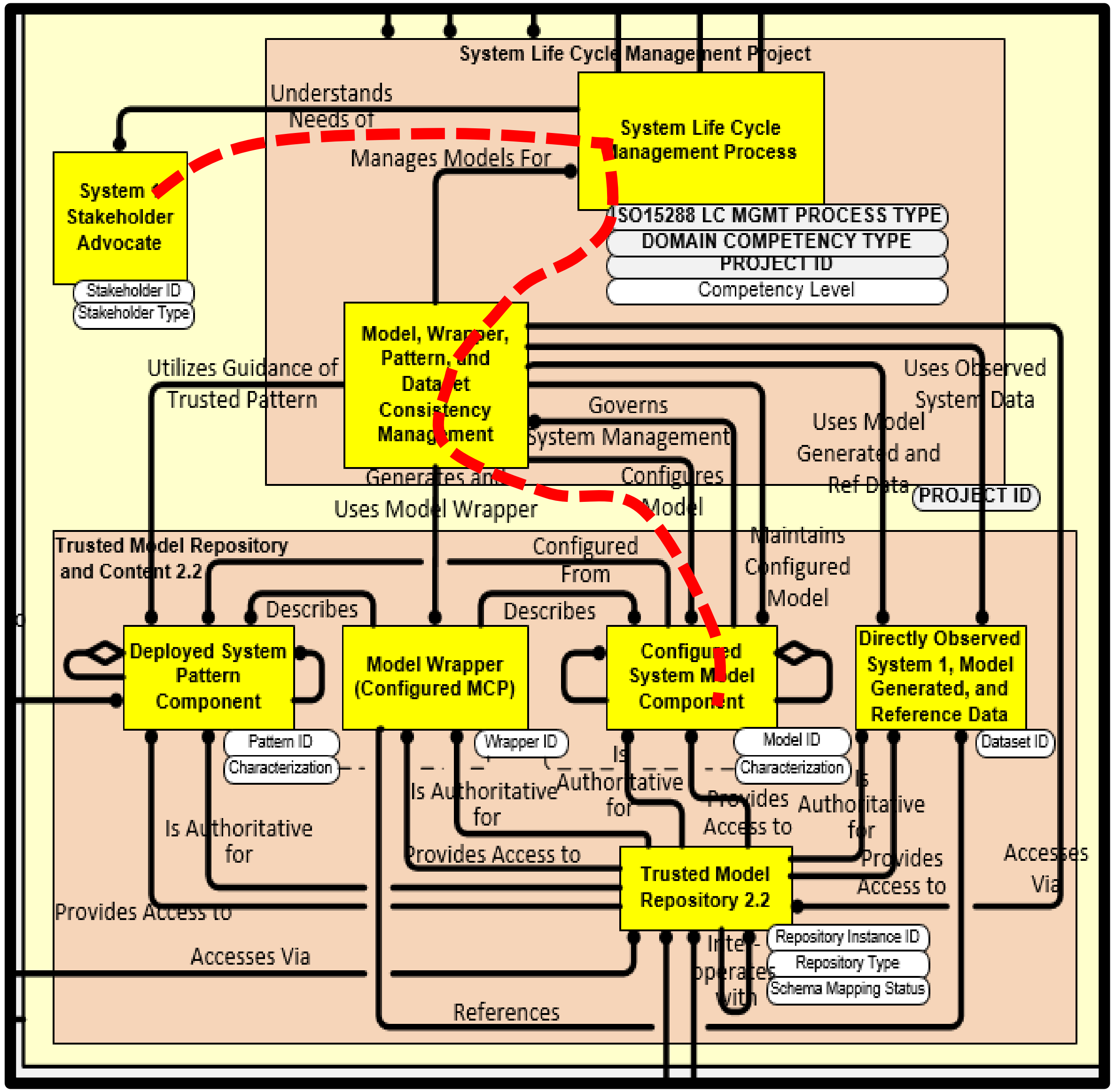
Real World



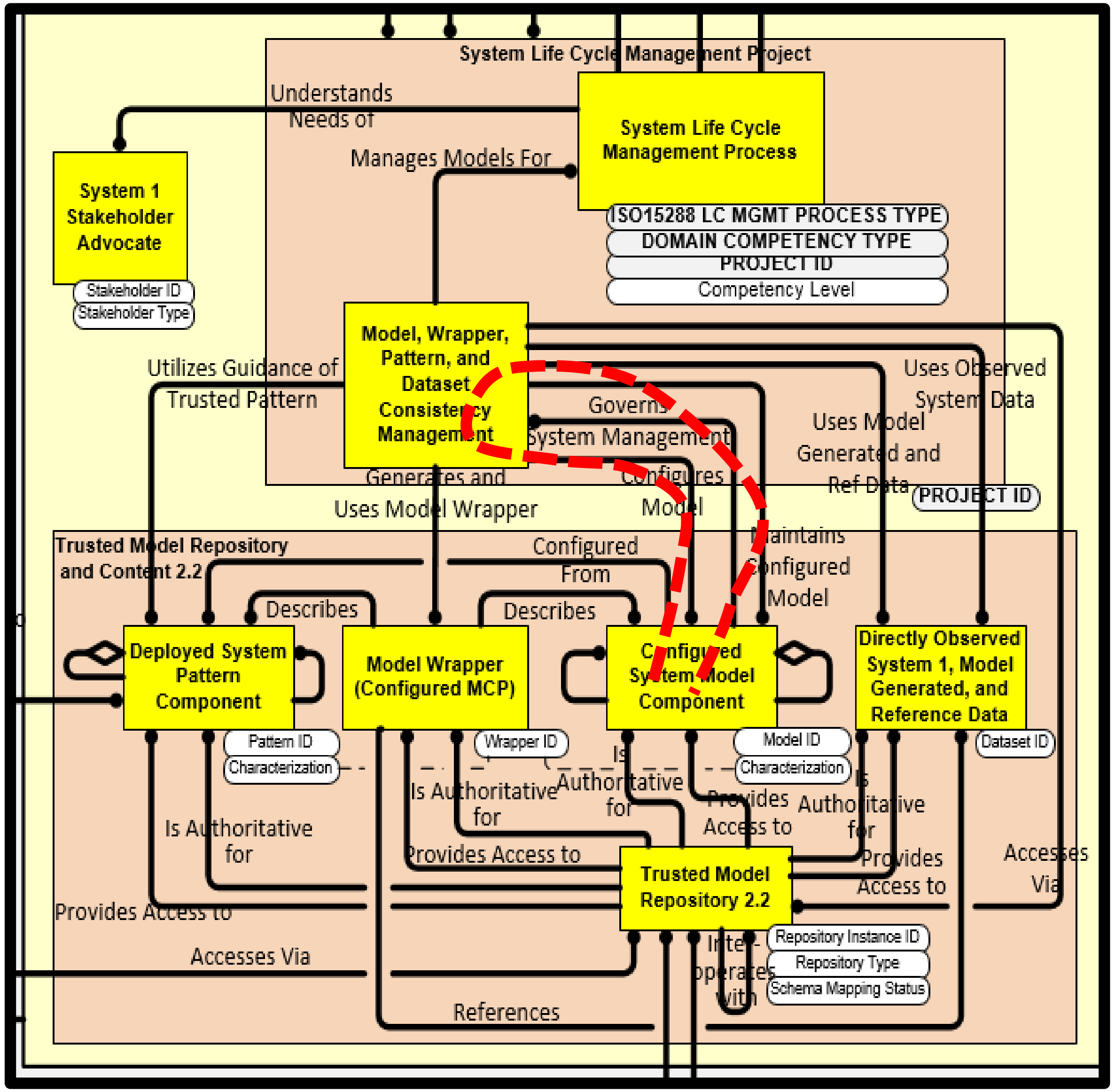
Consistency Management as a Central Paradigm for Digital Engineering

- All the following cases of Consistency Management (and more) are <u>*already historically performed*</u> (well or not so well) by human labor and/or automated aids, even when the information involved is in human brains or prose specs.
- The recognition of Consistency Management is not new with the arrival of models, but . . .
- Current interest in Digital Engineering presents the opportunity to plan better solutions to the following cases of consistency management, as well as others . . .

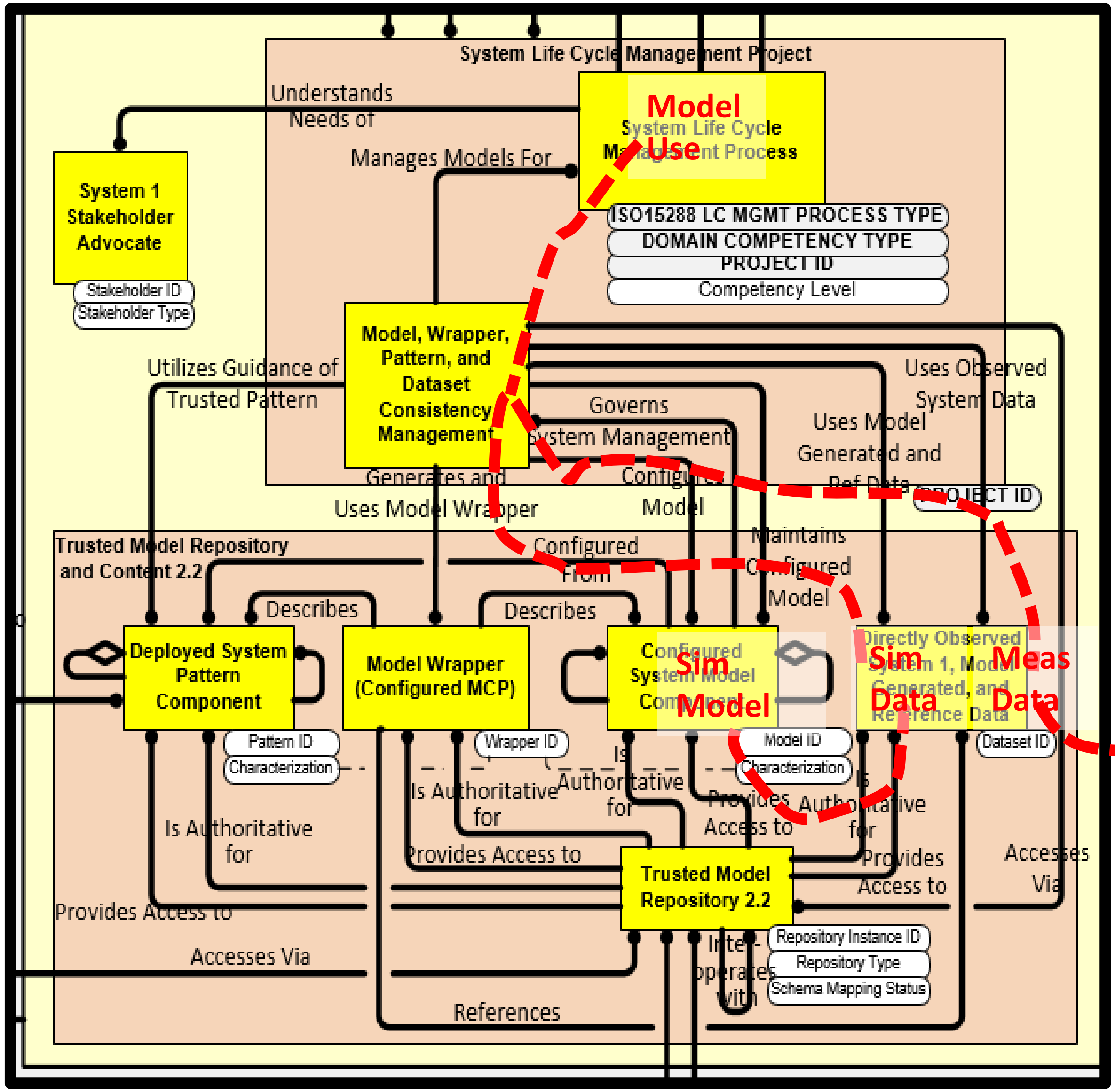
Are the customer's expectations represented (well enough) by the modeled requirements?

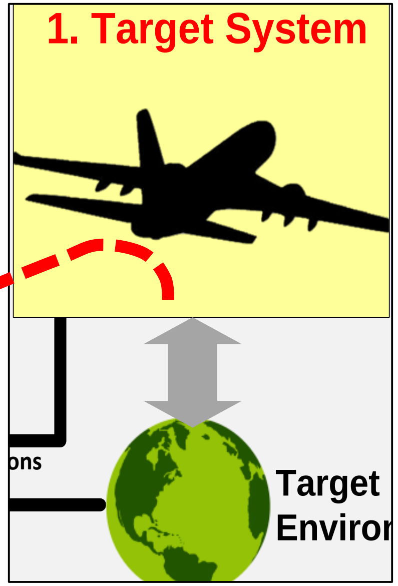


Are the product requirements consistent with the product design?

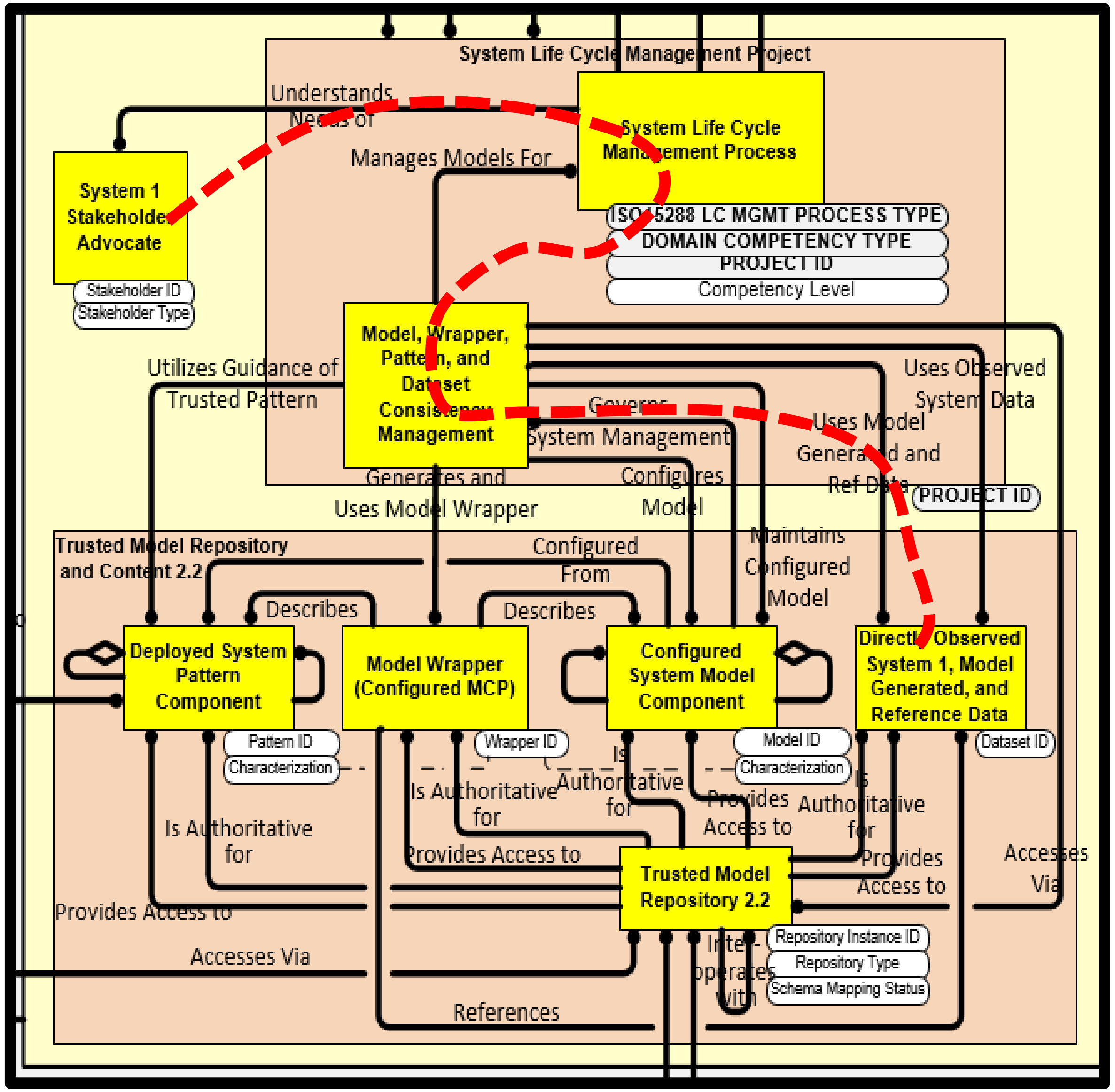


Is the simulation model consistent (enough) with the physical system? (i.e., Model VVUQ)

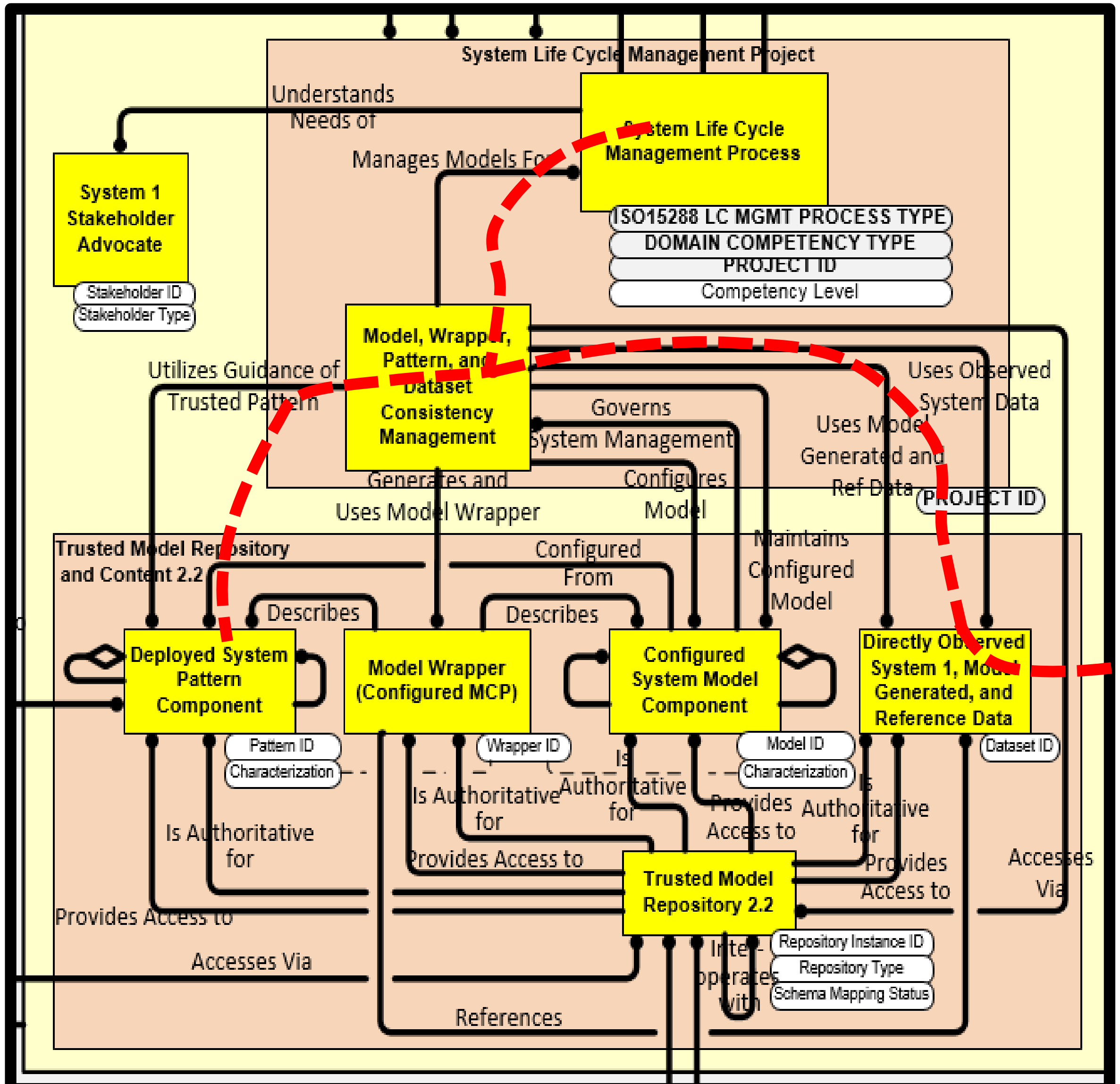


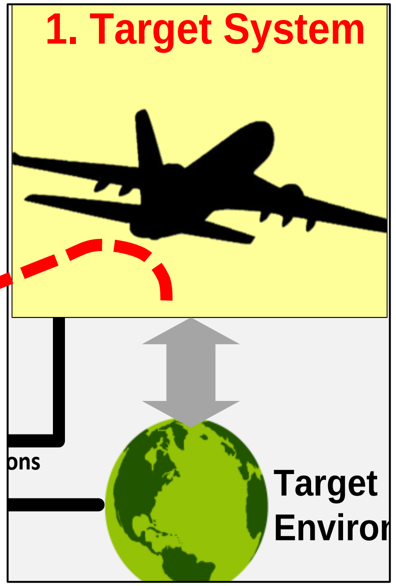


Is the simulation consistent with system performance that the customer expects?

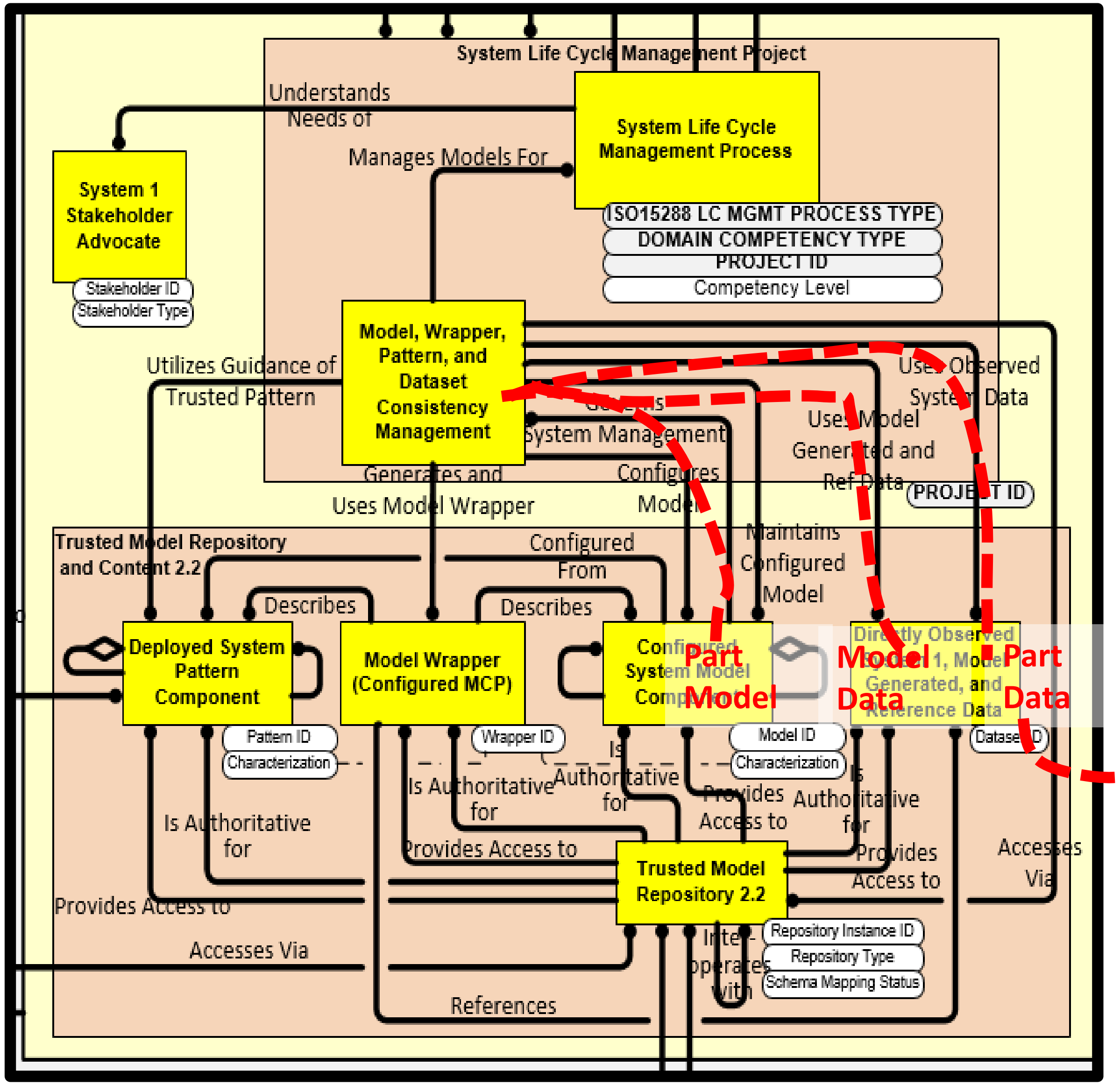


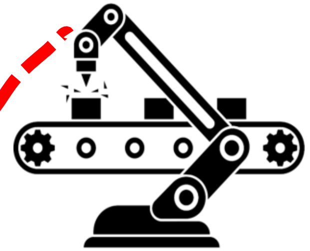
Is the customer sustainment service based on information consistent with learned product operating characteristics?



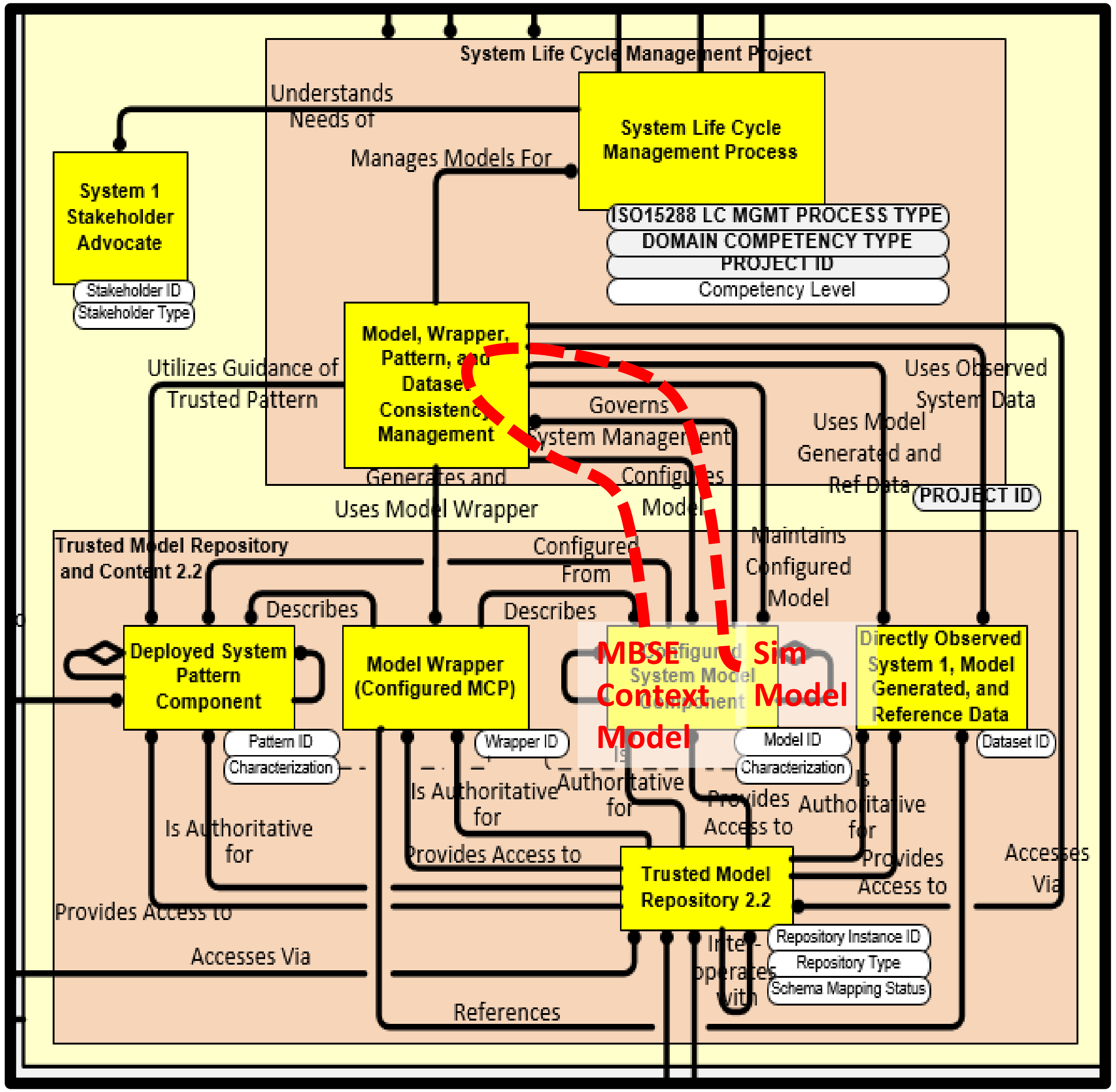


Are the incoming supply chain parts consistent with modeled inspection criteria?

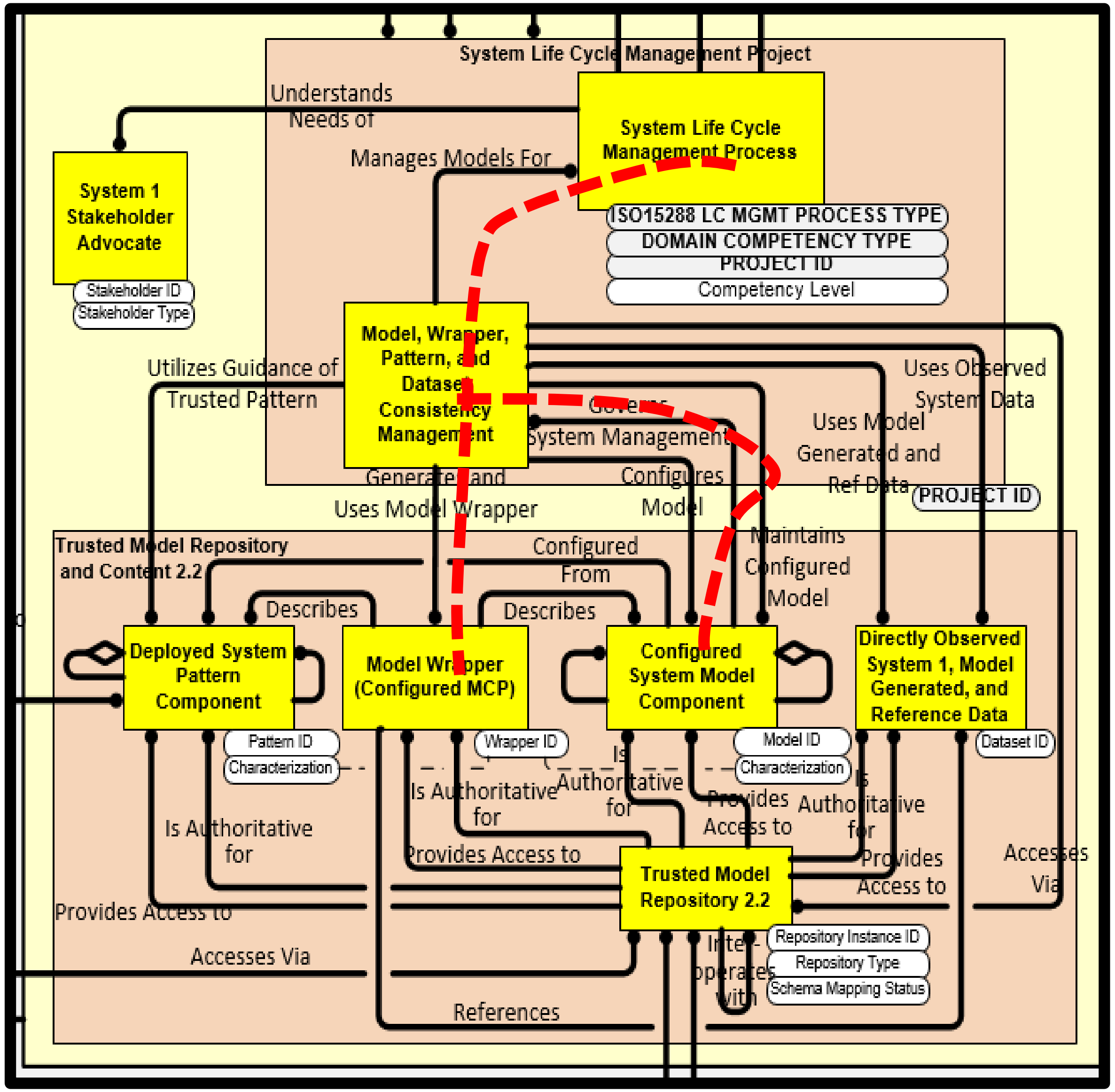




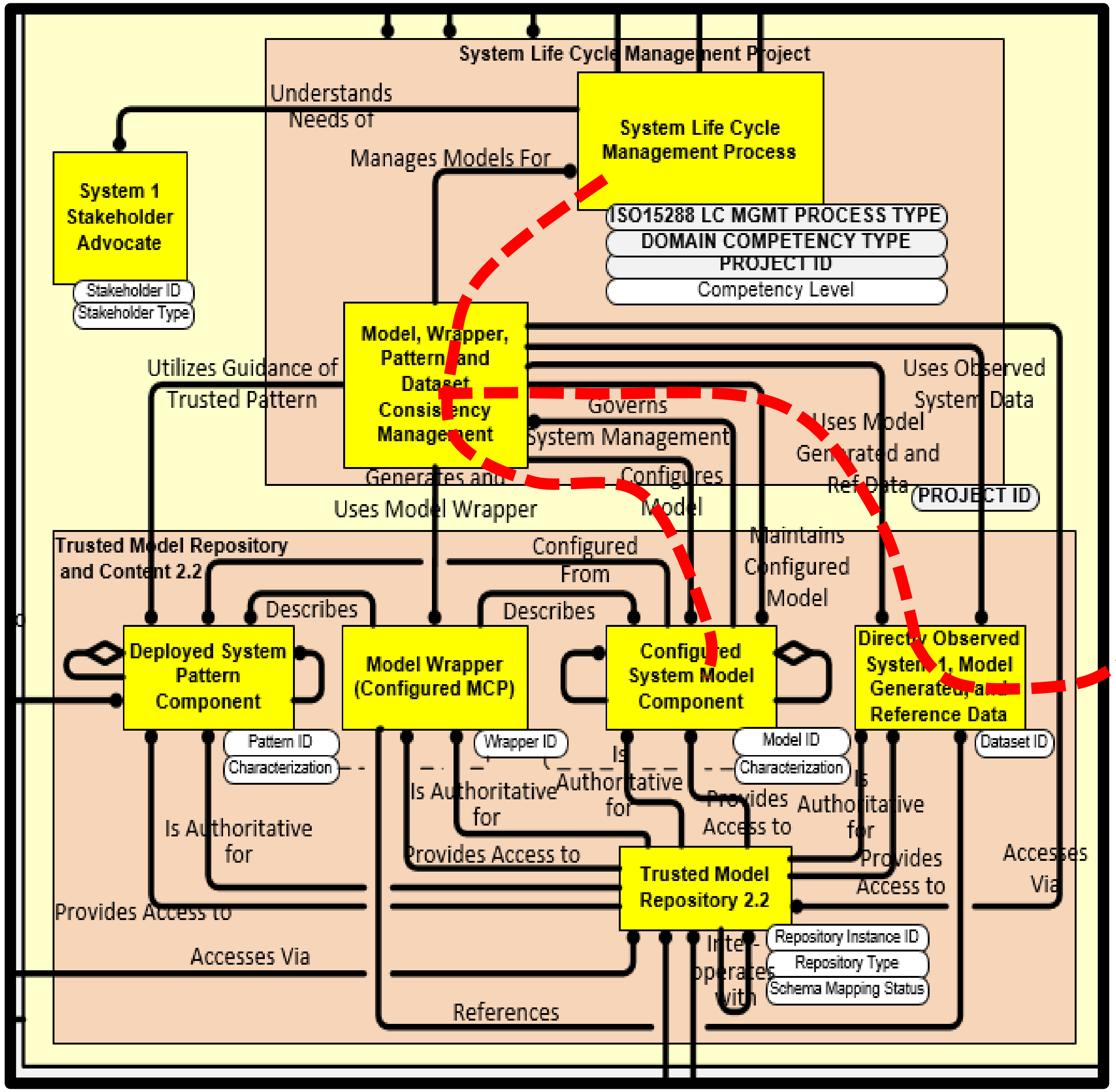
Is the component simulation model consistent with the overall MBSE model?

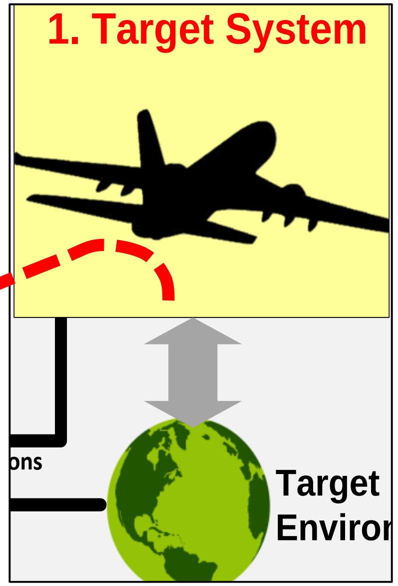


Is there already a credible simulation model available for the business purpose at hand?

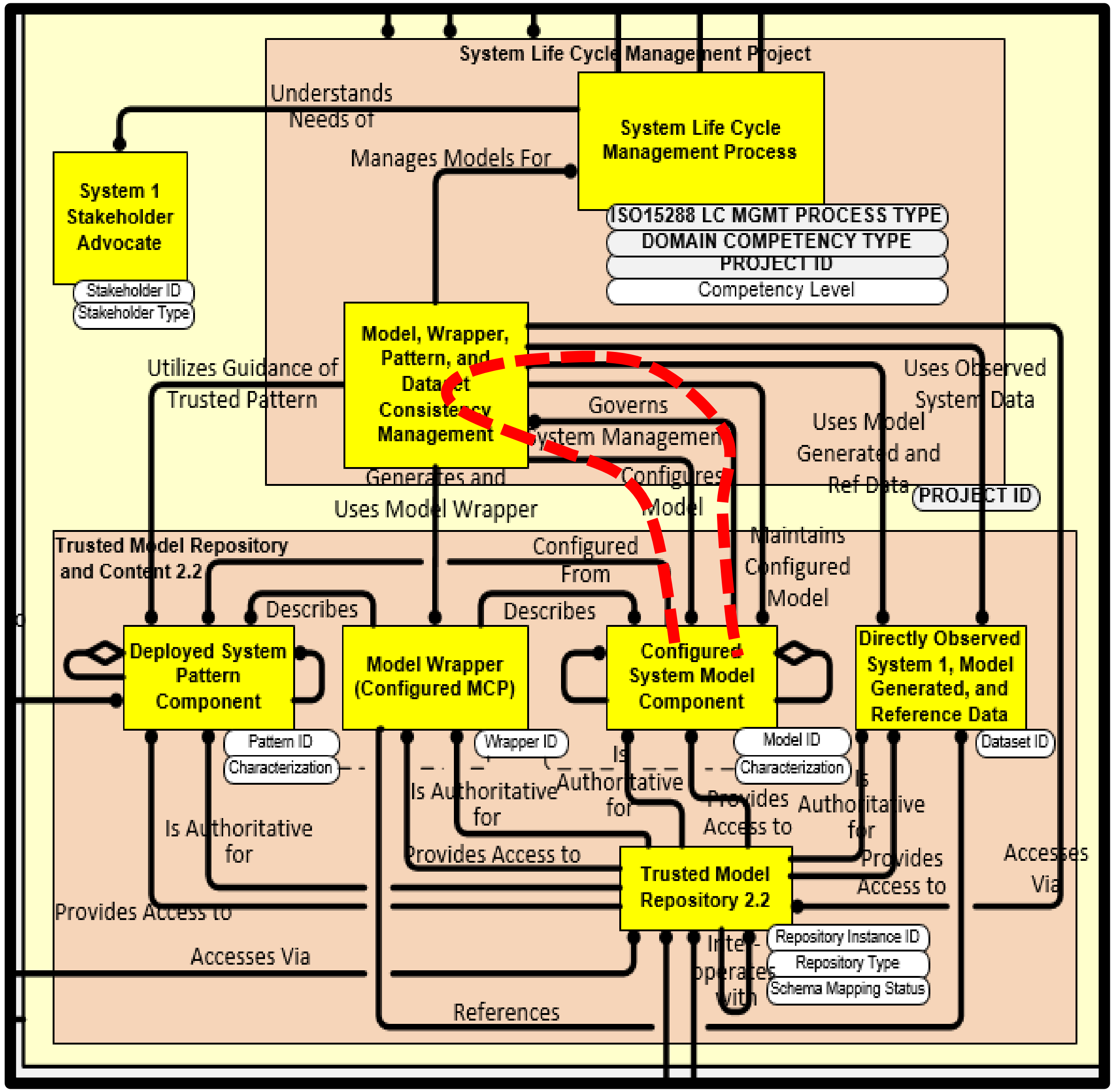


Is the “As Designed” Model consistent (enough) with the “As Used” Observations?

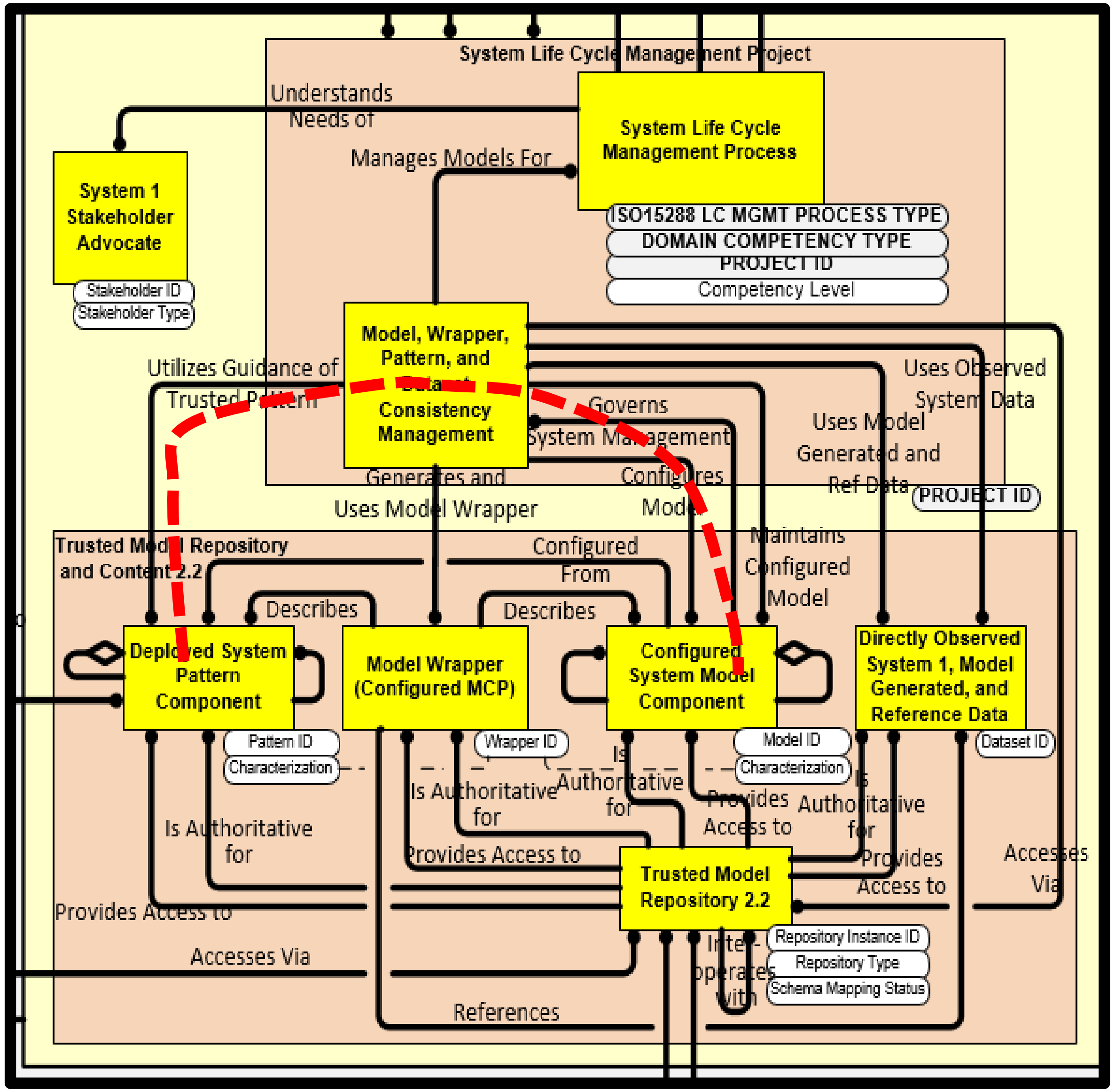




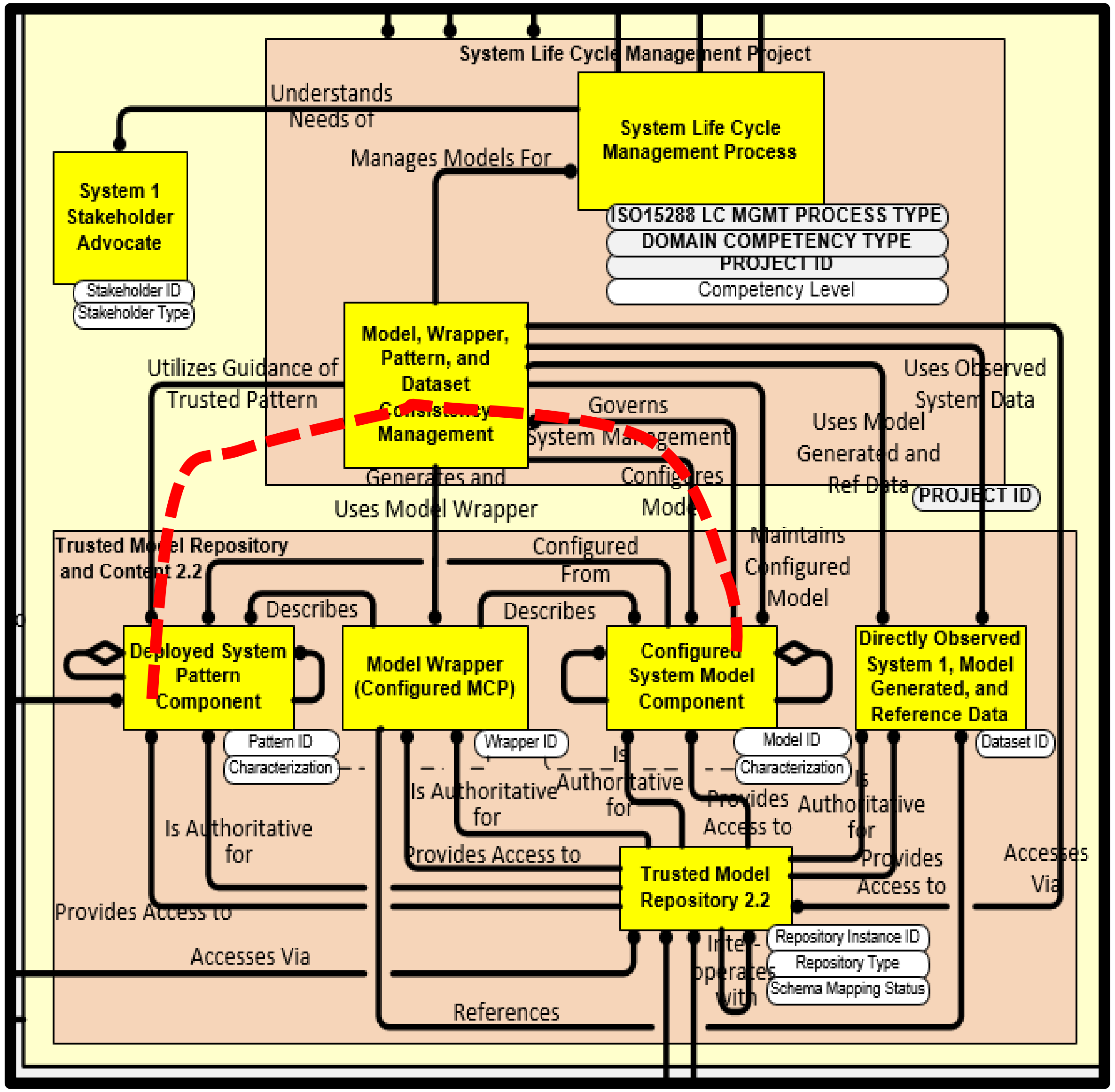
Is the Tier 1 Airframe Customer model consistent (enough) with the As Designed Subsystem Supplier Model?



Does the System Model reflect what we have learned from past projects' results?



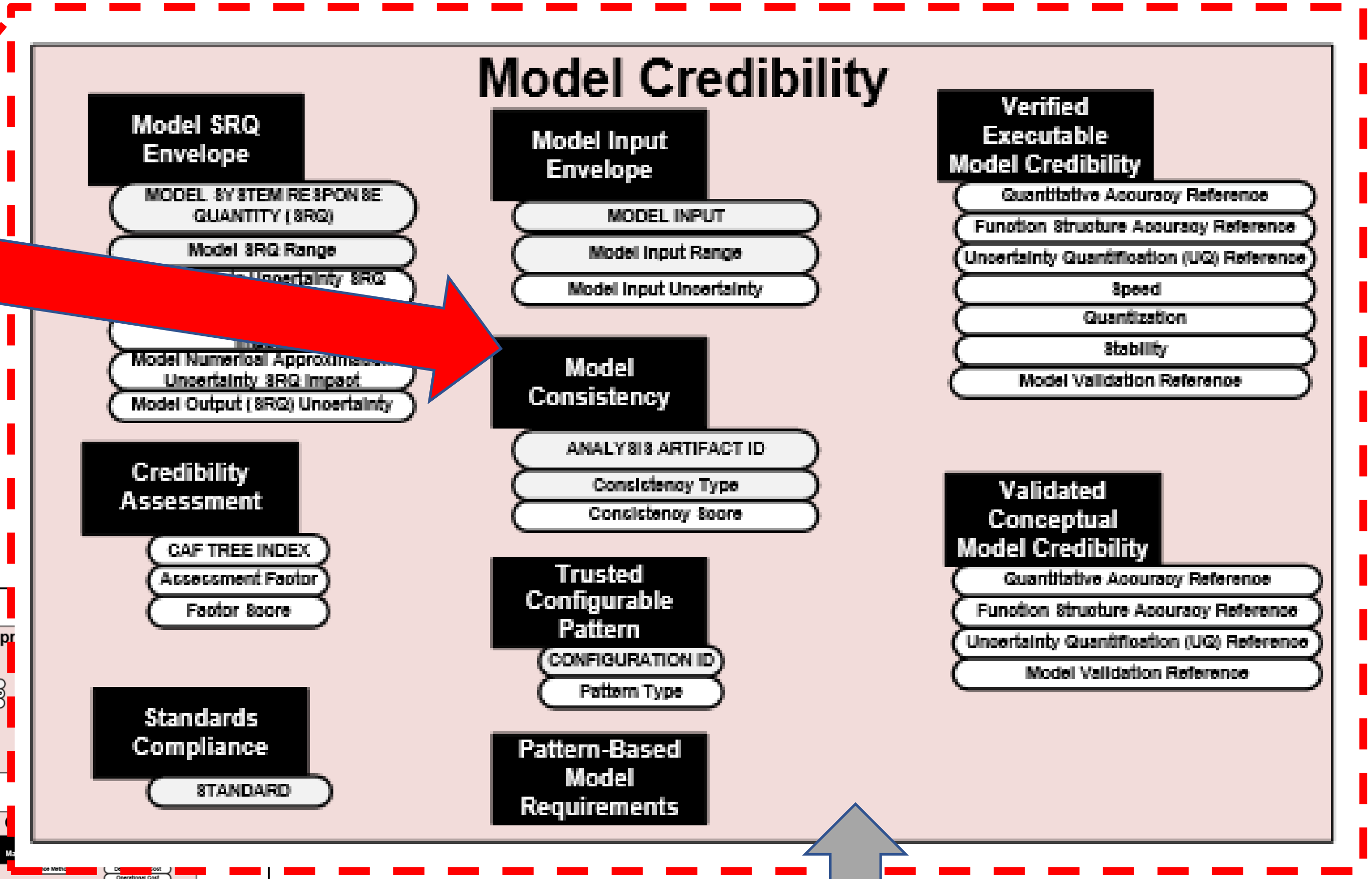
Is the current project's system Model consistent with customer/industry standard ontologies/frameworks?

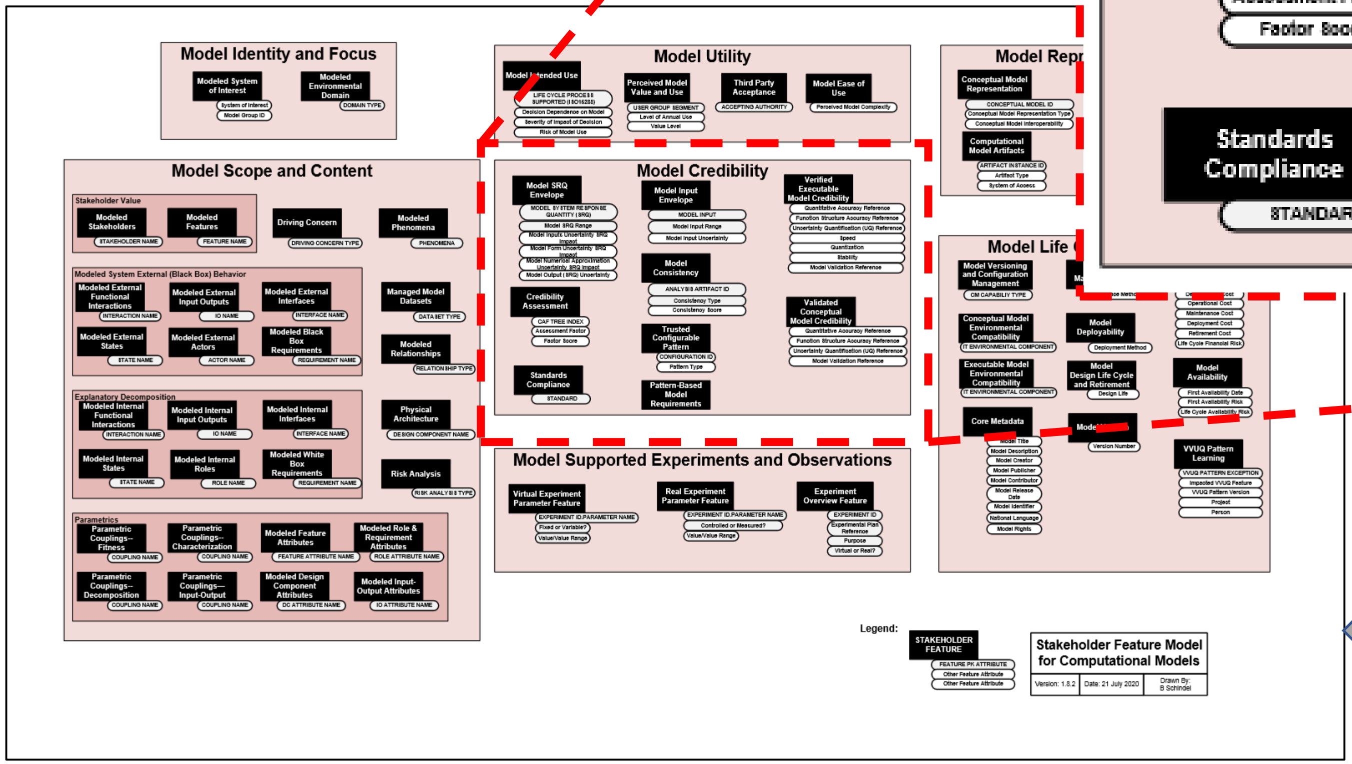


Risk Management, Model Consistency Tracking and the Model Wrapper

- At any given time in the life cycle of a product, answers to the above “consistency” questions can inform us of nature and extent of technical risks that may need our attention.
- Even though the nature of different consistency gap criteria is quite diverse, a more uniform approach to display and management of that “dashboard” can help a program manager and team understand and address current issues.
- A persistent record of that current situation is provided by the Model Wrapper(s), which include metadata describing the credibility, status, and consistency of Models, Patterns, and Datasets with each other and the external world . . . .

Model Consistency Tracking in Model Metadata (Model Wrapper)





Model Credibility Feature Group

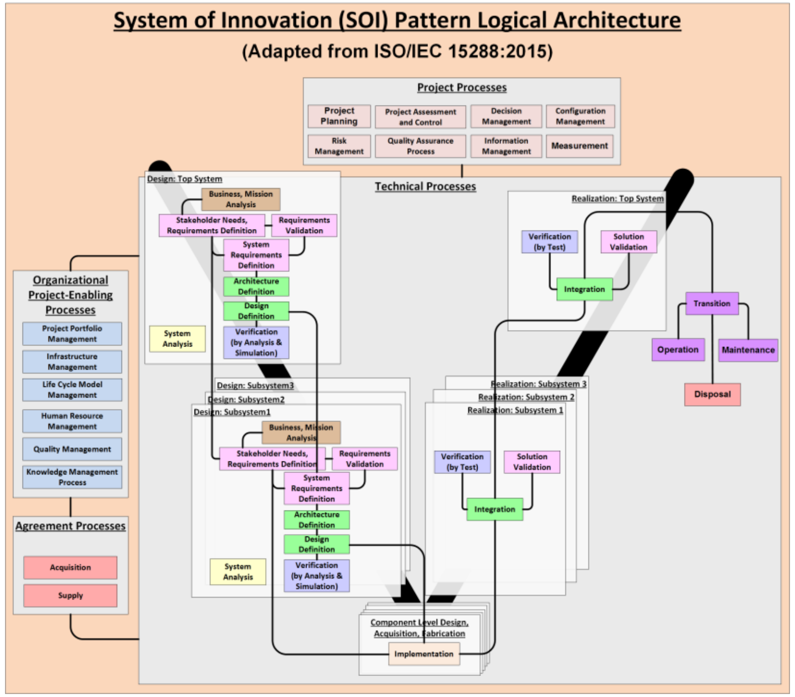
Model Wrapper (MCP) Features

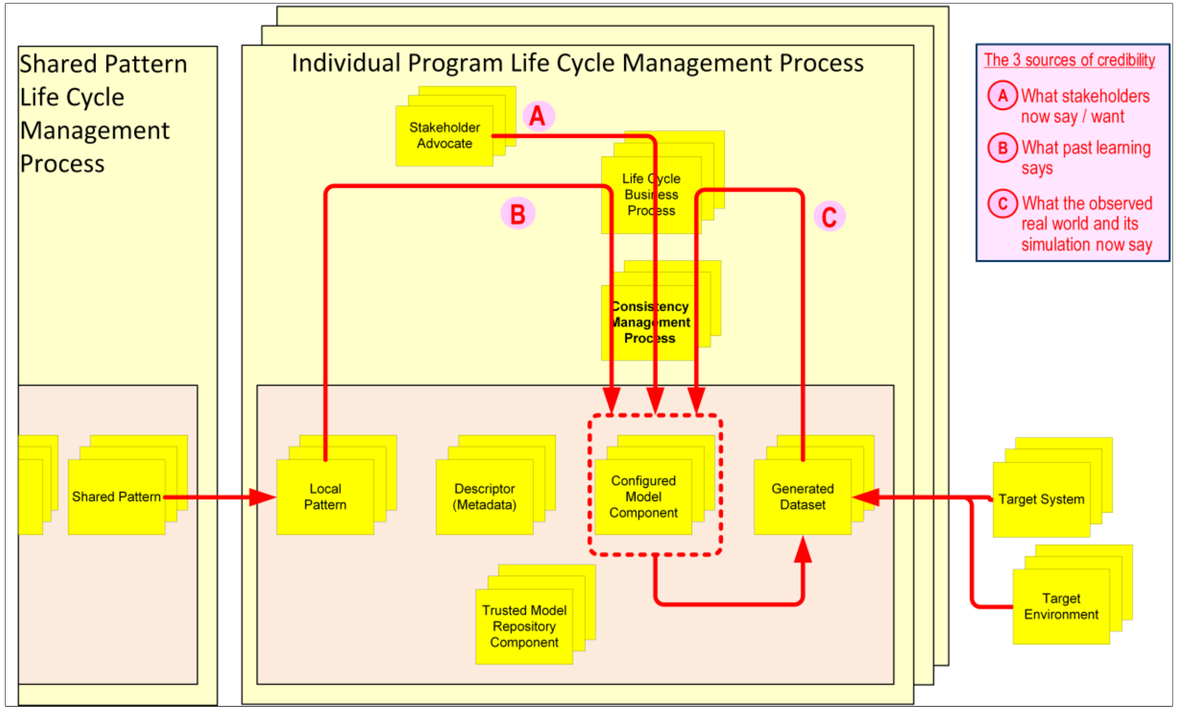
Digital Thread Integration of Artifacts in Model Consistency Management

- Assembly of business artifacts (documents or otherwise) as a means of documenting needed consistencies over the life cycle has been around for many years.
- In Automotive, Aerospace, Medical Devices, and other domains, quality management systems, formal or de facto standards, guidance and common practices for product development and life cycle management have advanced some locally common use of business artifacts (documents, drawings, models, digital files, etc.).
- Many of these traditional artifacts address issues so fundamental that their continued appearance (in some form) should not be in question—even though the way that they are generated, used, and evolved, and the time and effort to do so, along with their effectiveness, can all be advanced by the digital ecosystem.

Digital Thread Integration of Artifacts in Model Consistency Management

- Prominent examples include those built on well known QMS standards:
  - Aerospace Industry: AS 9100 quality management system standards
  - Automotive industry: ISO 16949, Production Part Approval Process (PPAP), Measurement System Analysis (MSA)
  - Medical device industry: ISO 13485 quality management for medical devices
  - As well as US Defense Acquisition guidance under DoD 5000.
- The following summarizes how the “traditional” artifacts associated with these and other examples are naturally integrated into any evolving digital ecosystem’s Digital Thread, using the ASELCM Pattern’s “consistency management” framework of the preceding pages, along with the Model Wrapper (MCP).





Type 1 Inconsistencies:

- Mission-to-Stakeholder Reqs
- Stakeholder Reqs-to-System Reqs
- Flowdown Reqs to System Reqs
- System Reqs-to-System Design
- Design Feedback to System Reqs
- BB Reqs to Decomposed WB Reqs
- WB Reqs-to-Design Components
- Numerous others, aligned with (configurable) ASELCM Features.

Type 2 Inconsistencies:

Each of the Type 1 inconsistencies implies need to adjust the respective information—but, there are many possible adjustments. Related decisions are informed by the **three sources of credibility**:

- Past experience patterns (formal; informal know-how; etc.)
- Empirical observation of real S1
- Model simulations, model analysis

However, those sources frequently themselves conflict.

So, they are additional sources of inconsistency at each Type 1 point.

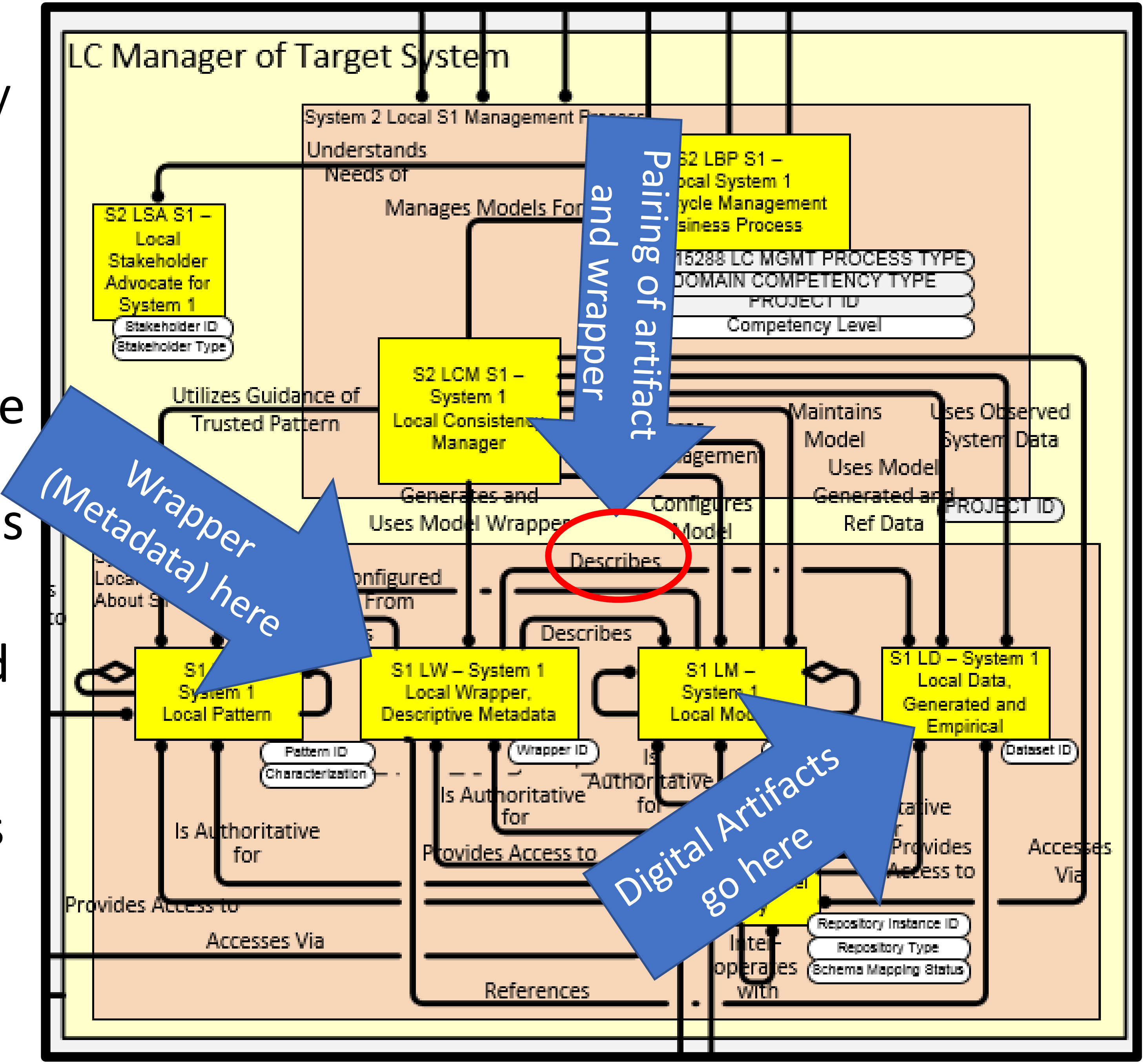
ASELCM Pattern represents **management of these consistencies**.

Digital Thread Integration of Artifacts in Model Consistency Management

- “Traditional artifacts” still needed by a business process will be some digital equivalents of part drawings, system product requirements, failure modes and effects analyses (FMEAs), etc.
- While these may be generated from underlying models or other means in a new or future digital ecosystem, “snapshots” of these artifacts are still important to representing key consistencies (or inconsistencies) at a given point in time.

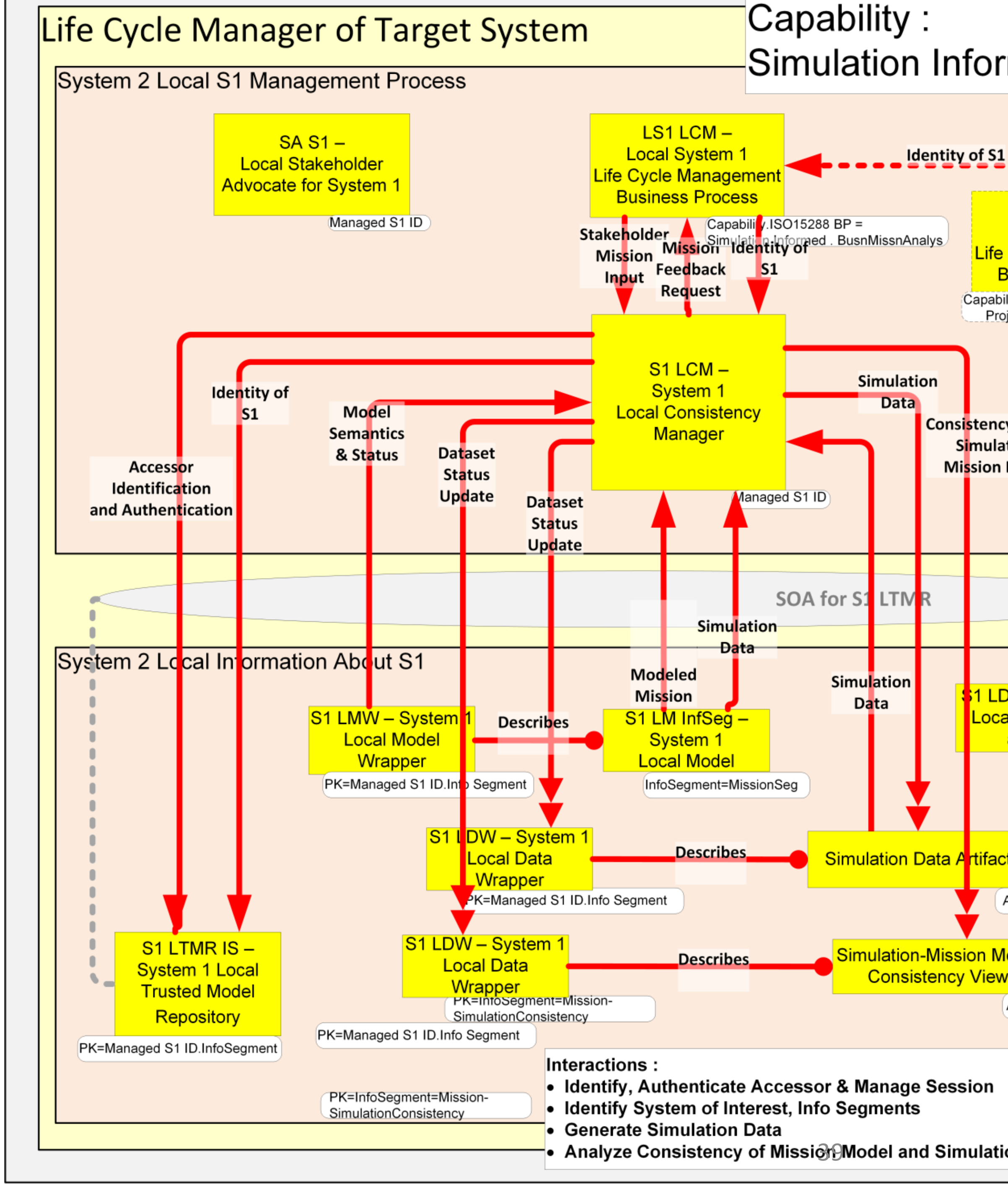
Digital Thread Integration of Artifacts in Model Consistency Management

- Whatever their method of generation or detail content, older or newer flavors of Digital Artifacts are part of the Local Data role in the ASELCM Level 2 framework.
- Each such (diverse) Digital Artifact is paired with a Local Wrapper containing the “metadata” which describes the nature of its wrapped Digital Artifact in a comparatively uniform way.
- The Wrapper for a Digital Artifact is thus a “gasket” matching it up with the Digital Ecosystem’s information and processes.



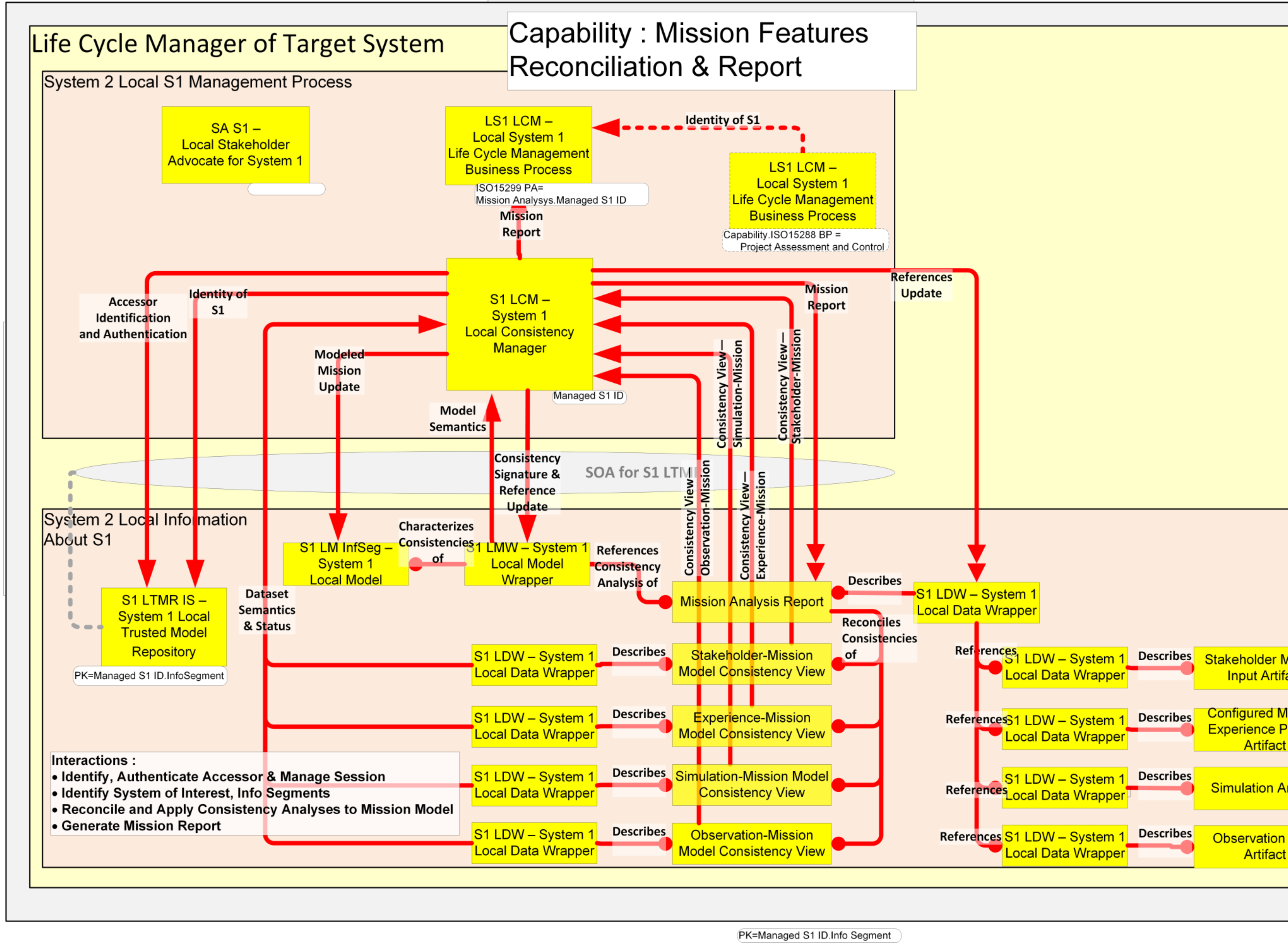
Example of analyzing a Type 1 Inconsistency

- The Local Model is analyzed for type 1 consistency between its Mission Information Segment and Stakeholder Requirements.
- This is one of several IS15288-related consistency checks that can be configured in or out of the ASELCM Pattern.
- The related interactions show capture and consistency comparison of Mission level requirements and related simulation of the system of interest.



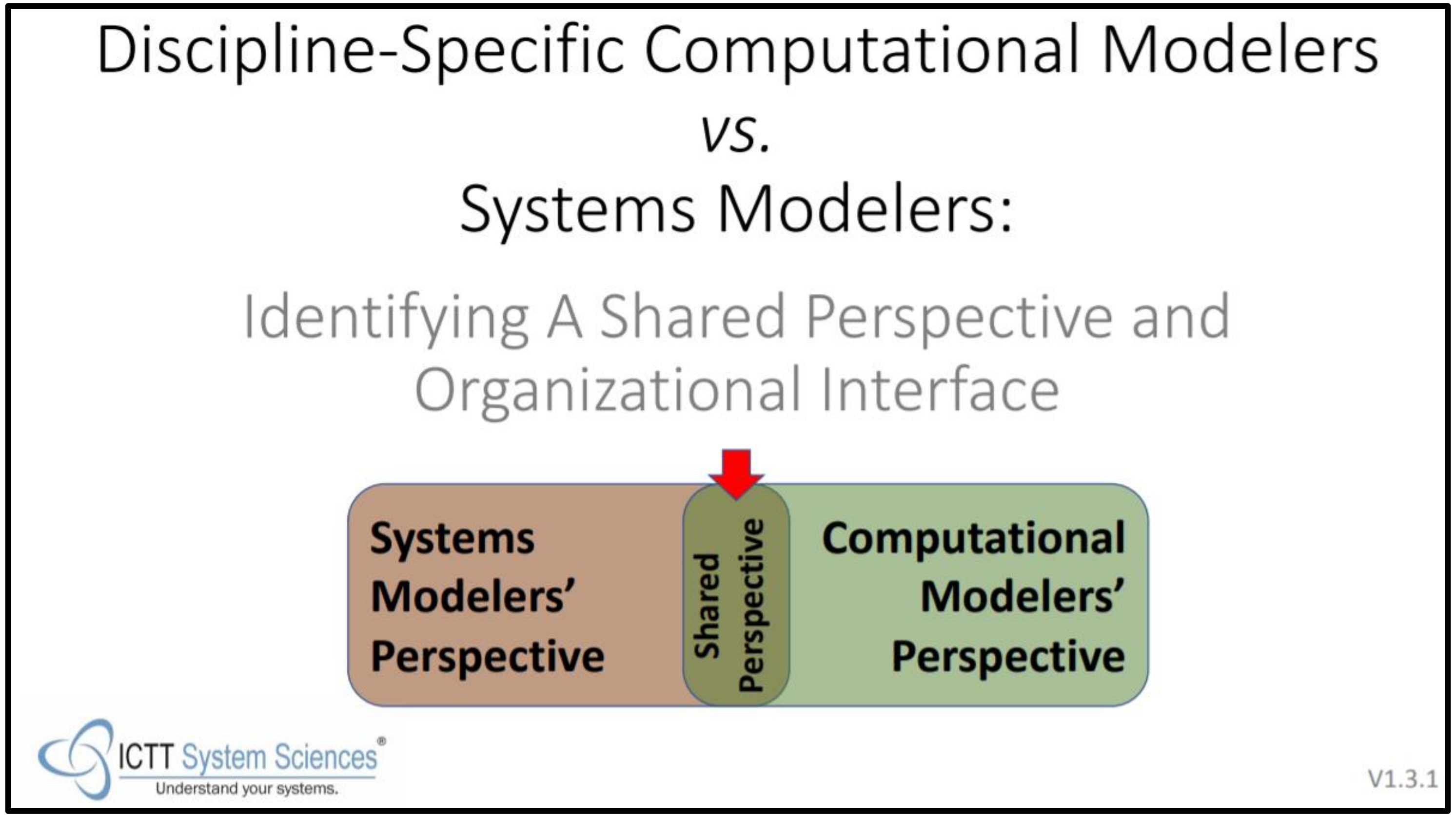
Example of reconciling both types of inconsistency

- After capturing analysis of several sources of information about Mission, the resulting analyses are synthesized into a single update to Mission model.
- The individual analyses as well as the synthesis report are all captured together as datasets, using a web of linked wrappers.



Integrating Qualitative and Quantitative Consistency Management

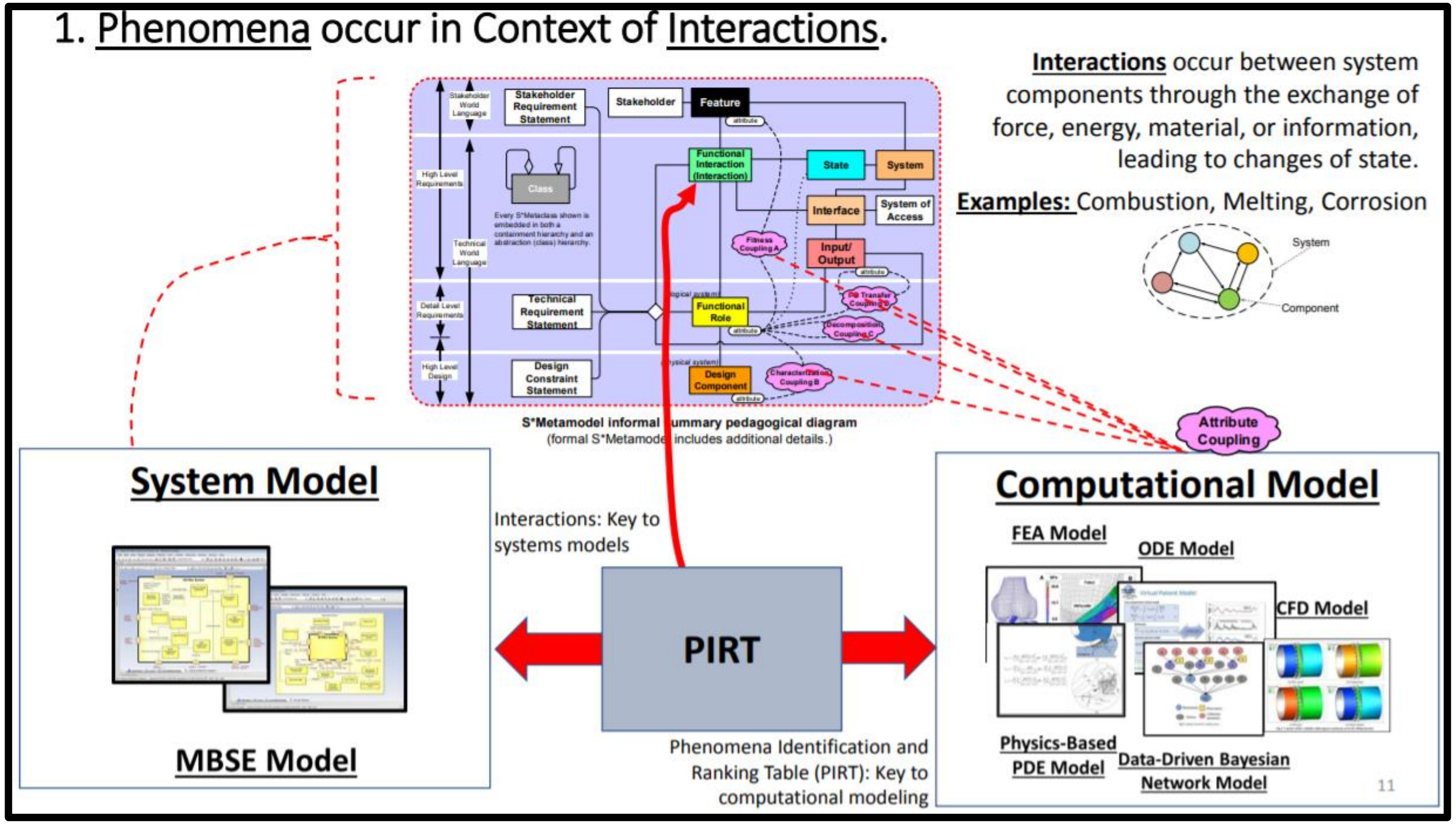
The computational modeling (simulation) and system descriptive/MBSE modeling communities sometimes have difficulties talking to each other because of different mental frameworks. This is not an IT problem!



https://www.omgwiki.org/MBSE/lib/exe/fetch.php?media=mbse:patterns:common_ground_seam_v1.3.1.pdf

Integrating Qualitative and Quantitative Consistency Management

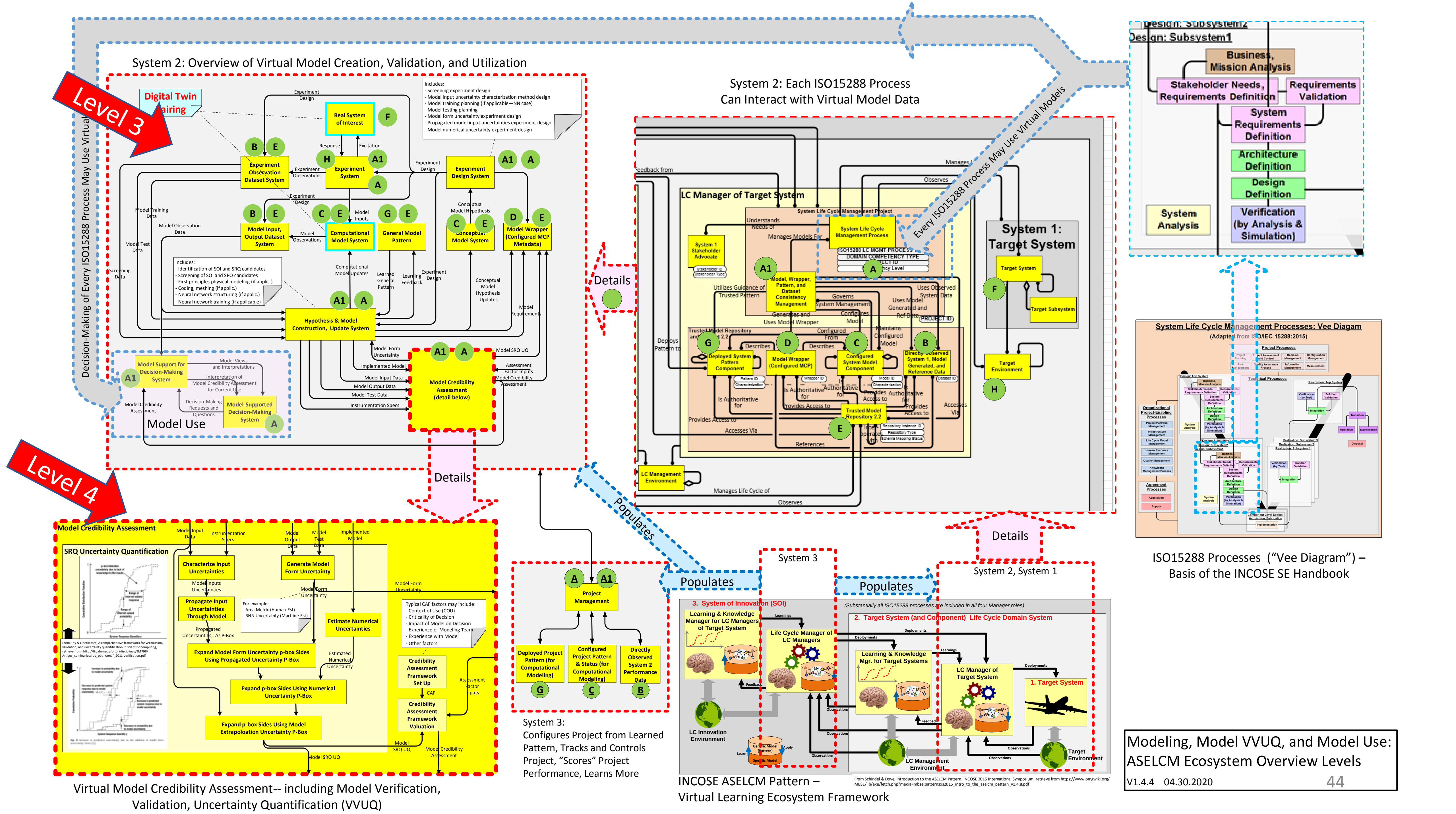
In addition to integrating information and tooling, Consistency Management offers a larger-scale way to integrate key aspects of these two practices into a coordinated enterprise activity.



https://www.omgwiki.org/MBSE/lib/exe/fetch.php?media=mbse:patterns:common_ground_seam_v1.3.1.pdf

Quantitative Consistency: Numerical Simulation Model VVUQ Subset

- Activity on the quantitative aspect of model consistency is reflected by Computational Model VVUQ/Credibility work going on through collaboration of:
    - ASME VV50 Standards Subcommittee
    - V4 Institute
    - INCOSE MBSE Patterns Working Group
    - INCOSE – NAFEMS Systems Modeling and Simulation Working Group
    - ASSESS Initiative
- Level 3 and Level 4 of the INCOSE ASELCM Pattern reflect additional details related to that interest.

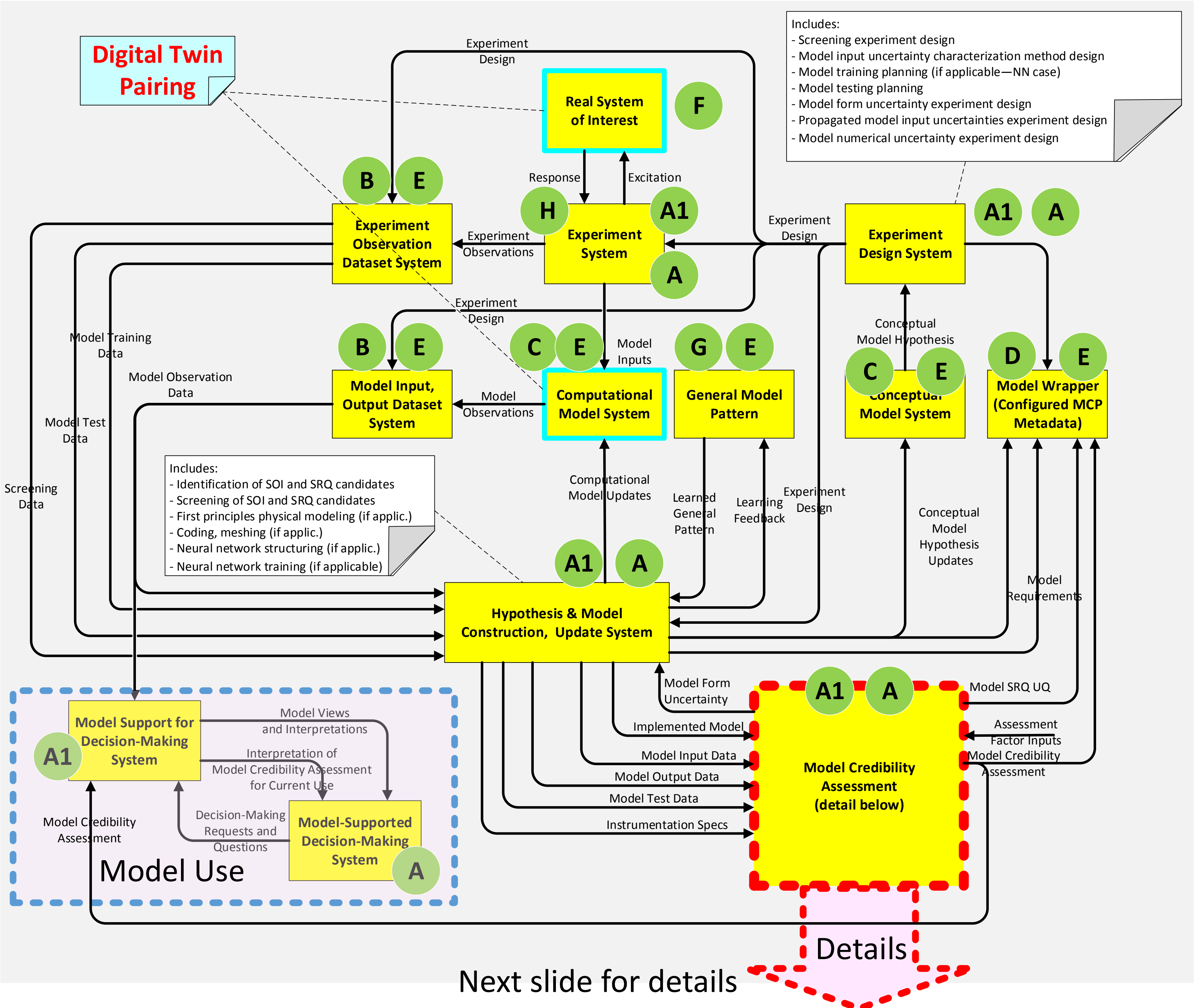


Modeling, Model VVUQ, and Model Use: ASELCM Ecosystem Overview Levels

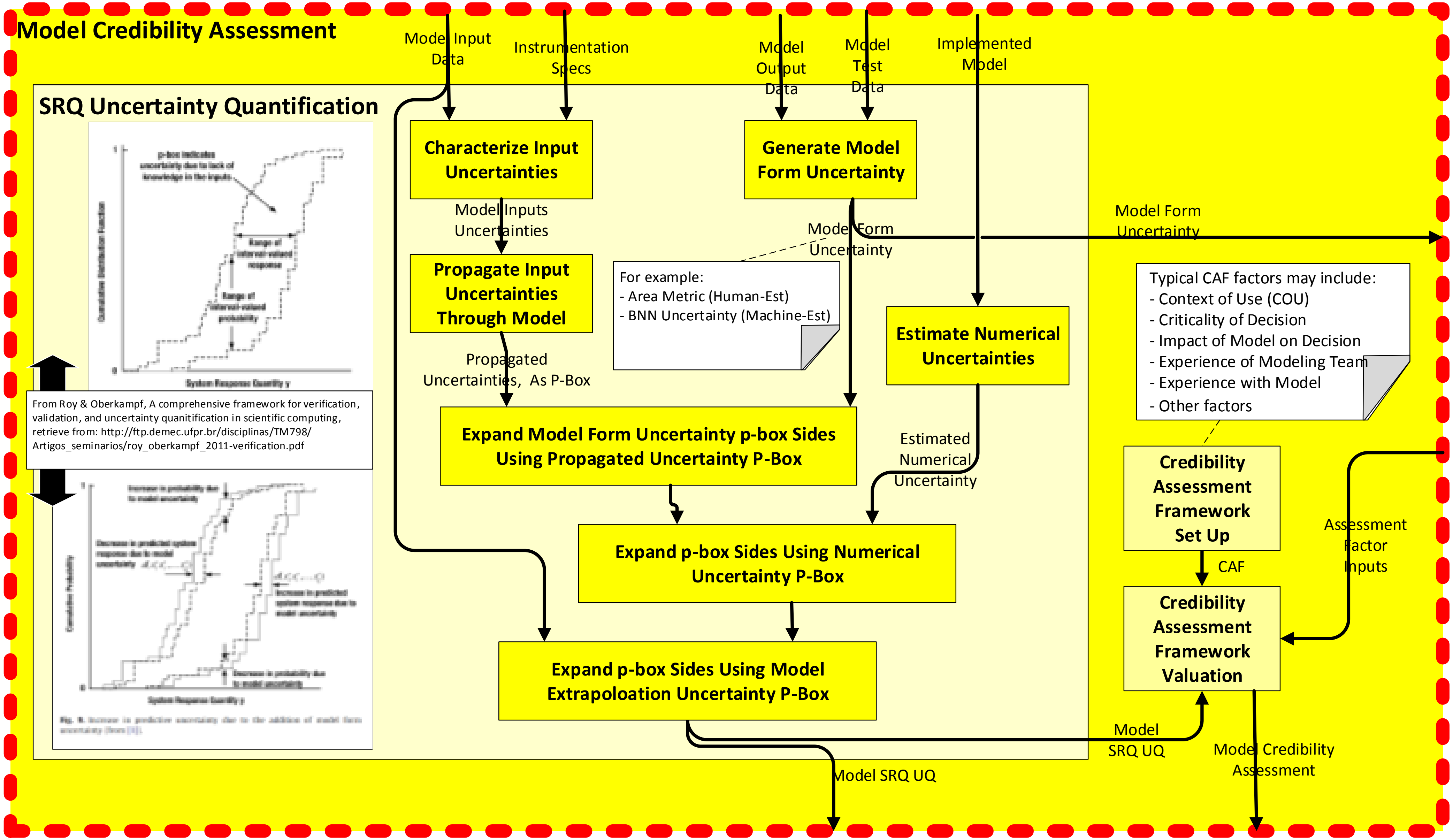
V1.4.4 04.30.2020

ASELCM Ecosystem Reference Pattern
(Level 3)

Overview of Virtual Model Creation, Validation, and Utilization



ASELCM Ecosystem Reference Pattern (Level 4)



Virtual Model Credibility Assessment-- including Model Verification, Validation, Uncertainty Quantification (VVUQ)

Qualitative (Semantic) Consistency: Semantic Technology Amenable Subset

- Activity on the qualitative (semantic) aspect of model consistency is reflected by Semantic Technologies for Systems Engineering (ST4SE) Project of the INCOSE/OMG MBSE Patterns Working Group.
- This collaboration includes participants from NASA JPL, the OMG SysML V2.0 Submission Team, ICTT System Sciences, and Stevens Institute.
- The related INCOSE Technical Product Plan (TPP) and Level 3 of the INCOSE ASELCM Pattern reflects additional details related to that interest.

The Patterns WG ST4SE Project

A pilot example pattern the ST4SE project is pursuing is the Interface Pattern, dating to earlier Patterns WG Interface Pattern effort that also included SAIC and US Navy members.

Consolidation of Model Materials from:
INCOSE Patterns WG Interface Project (2017-18)
and ST4SE Interface Pattern Activities (2018-19)

January, 2020 V2.1.1

INCOSE

INCOSE Semantic Technologies for Systems Engineering (ST4SE)
Deliverables Technical Product Plan (TPP)

1 PROJECT NAME

Semantic Technologies for Systems Engineering (ST4SE) Project (see also Exhibit 1)

2 PROBLEM STATEMENT

MBSE models can be generated from, or validated against, model-based MBSE Patterns, as practiced by the INCOSE MBSE Patterns Working Group. This reduces effort and cycle time in re-generating and re-validating high credibility models and re-correcting oversights and discoveries that have been made in the past by others. The related problem to be addressed is that MBSE is frequently viewed as many engineers learning modeling languages and tools and creating models for their projects "from scratch" or from accumulated informal experience. As demand increases for model-based representations but simultaneously for validation and verification of authoritative models of critical systems for related high impact decisions, this is not a competitively sustainable paradigm. A key part of the problem statement is that "everyone creating their own models" is a currently dominant paradigm in the emerging MBSE practice, so that demonstration and facilitation of the MBSE Pattern alternative is needed. Addressing that need, this project is an outgrowth of INCOSE MBSE Patterns Working Group external INCOSE partner interactions with OMG (for SysML V2.0), NASA JPL (Mission Ontology and Semantic Technologies), ASME (Model V&V Standards Committee VV50 Model Life Cycle Working Group), V4 Institute (Virtual Model capability advancement and the ASELCM Pattern), and ASSESS (application of Model Characterization Pattern).

3 TARGET AUDIENCE

The target audience includes (1) MBSE Model Authors, (2) MBSE Model Users, (3) Engineering Leaders who influence methods and practices, and (4) System Acquirers and Owners who influence methods and practices. The INCOSE Patterns Working Group already involves some outside of U.S. participants. The initial domain of interest is System Engineering itself (Systems 2 and 3 of the ASELCM Pattern discussed below), as opposed to individual product or other engineered system domains.

4 PRODUCT CONCEPT & PROPOSED SOLUTION

Figure 1 is an OV-1 level context reference diagram used in the MBSE Patterns Working Group.

The project's initial deliverables are model-based semantic patterns (data content at the top of the pyramid in Figure 1) of use to address the above problem statement, along with documentation and examples of use in various environments of use. Those environments, while not the deliverable of this project, include use of Semantic Technologies.

"Semantic Technologies" refers to information technologies (language standards, automated tooling, and related methodologies) that are concerned with explicated meaning represented by model data structures. Examples include OMG SysML® modeling language and tools, W3C OWL DL web ontological language and tools, and automated semantic reasoners or other Semantic Web technologies.

INCOSE-TP-2020-001-02 V2.0 Page 1 of 31

Qualitative (Semantic) Consistency: Semantic Technology Amenable Subset

- One of the most basic semantic consistency issues is about whether a given model's semantics/asserted meaning are consistent with a more general model-based pattern's content:
  - That is, the consistency of a specific model with a more general model-based rule (pattern).
  - If we consider that such general patterns may not only be domain patterns (e.g., rules, for system product lines), but also other patterns such as metamodels, language definitions, etc., then we can see that this kind of consistency is important for many reasons.

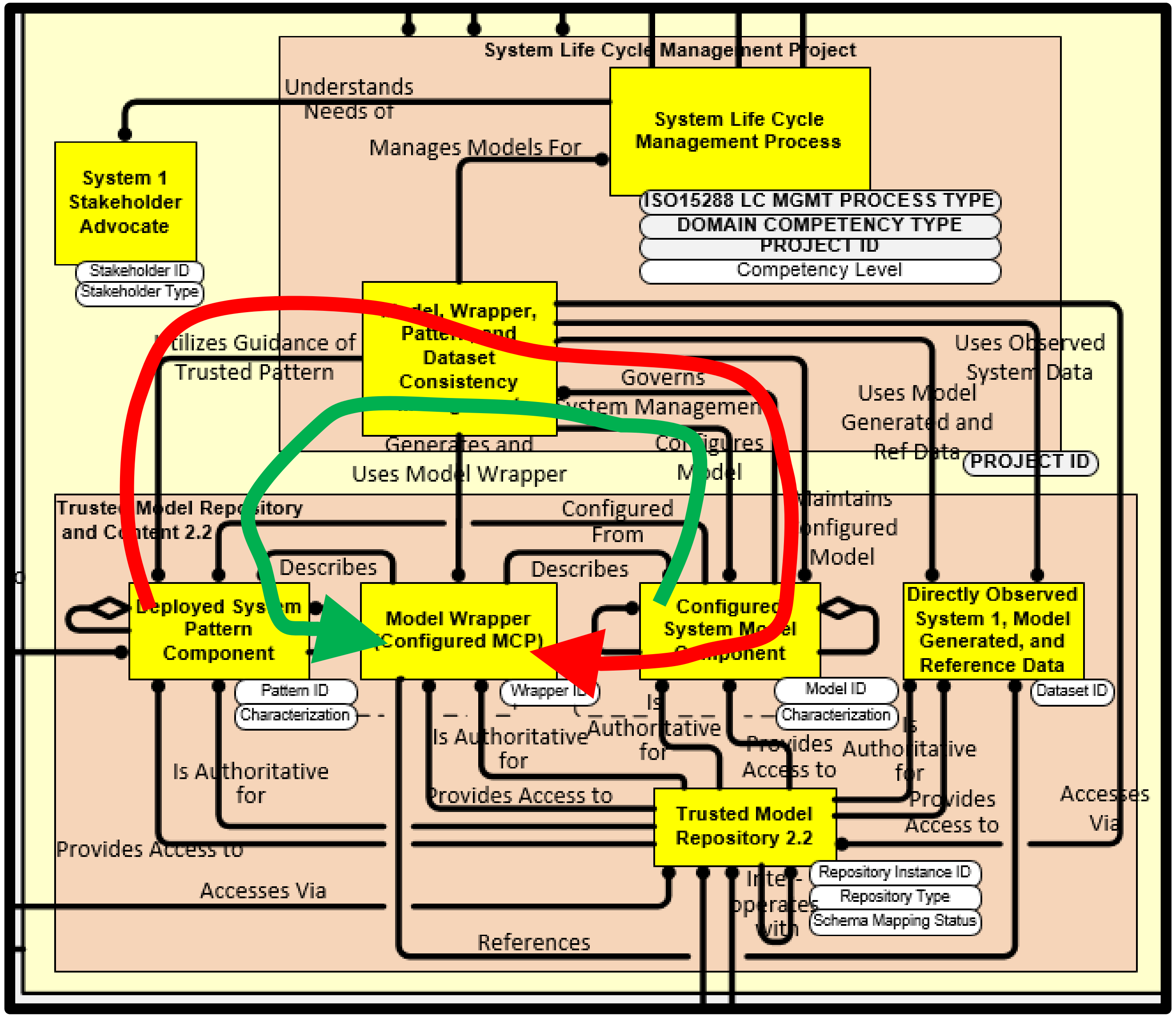
Qualitative (Semantic) Consistency: Semantic Technology Amenable Subset

The ST4SE project demonstrates two different kinds of "sequences" that are often encountered in engineering situations:

(1) Model Generation: I want to generate, using automation, a specific model from a general model-based pattern, configured based on local project needs, knowing that the resulting model will consistent with that pattern. (Practiced in past by Patterns Working Group.)

(2) Model Checking: I already have a manually-constructed model, and want to use automation to check the consistency of that model with a known pattern. (Practiced in past by NASA JPL.)

Forward (Construct Model from Pattern) and Reverse (Check Model Against Pattern)

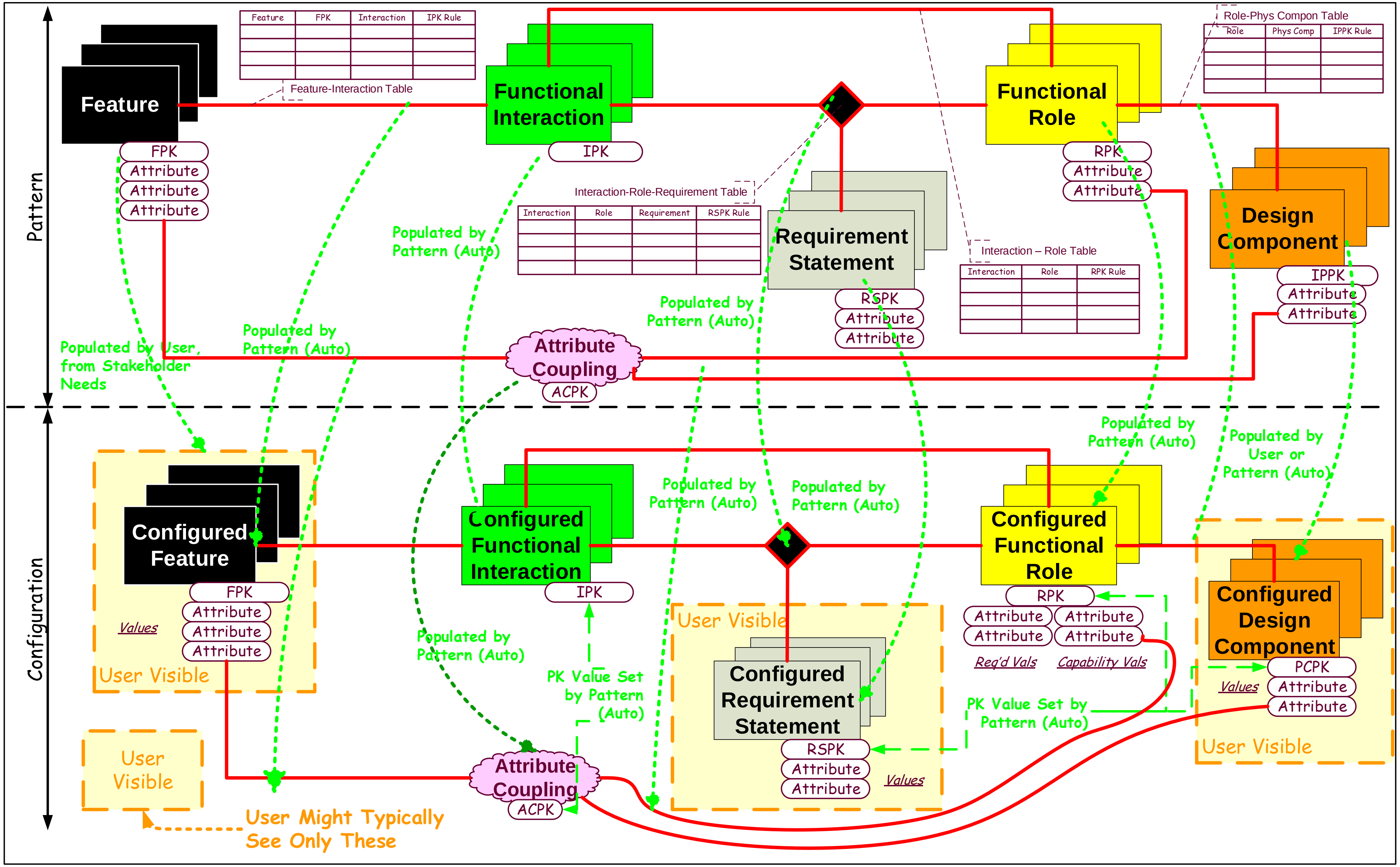


Demonstrating Model-Pattern Consistency, by two methods:

1. Generate configured MBSE Model from governing MBSE Pattern.
2. Analyze manually-created MBSE Model against MBSE Pattern.

Both are to post resulting consistency metadata in Model Wrapper

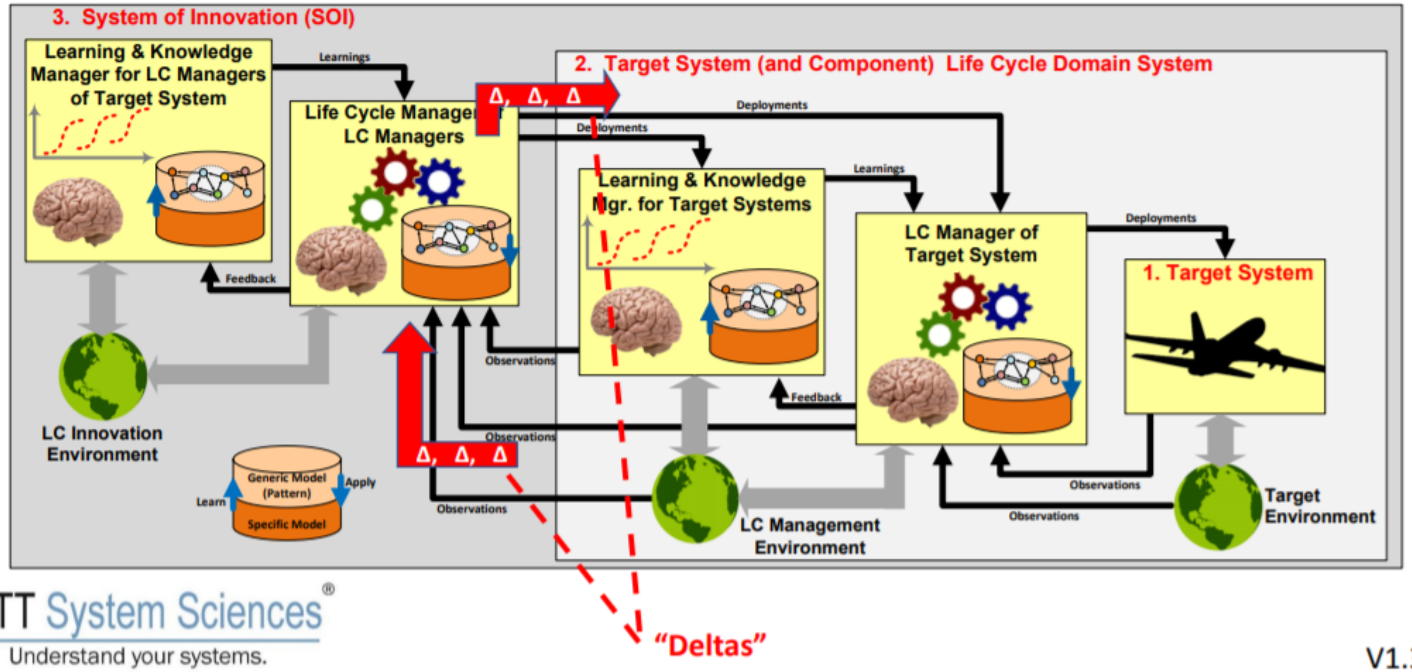
Forward Direction: Configuring Model from Pattern



The Configurable ASELCM S*Pattern Planning and Analysis Framework

Provides a neutral, systematic means of analyzing current ecosystems, planning future ecosystems, and generating incremental release trains to get there:

Attachment I: Example Use of ASELCM Pattern for Analyzing Current State, Describing Future State, and Constructing Incremental Release Roadmap to Future



ICTT System Sciences®
Understand your systems.

V1.3.3

https://www.omgwiki.org/MBSE/lib/exe/fetch.php?media=mbse:patterns:example_evolutionary_roadmap_v1.3.3a.pdf

References

1. "Introduction to the INCOSE Agile Systems Engineering Life Cycle Management (ASELCM) Pattern", 2016. https://www.omgwiki.org/MBSE/lib/exe/fetch.php?media=mbse:patterns:is2016_intro_to_the_aselcm_pattern_v1.4.8.pdf
2. J. Hatakeyama, "Model Based Engineering –the MBE Diamond Revisited", Presented at AIAA SciTech, January, 2020.
3. Donaldson, Flay, French, Matlik, Myer, Pond, Randjelovic, "Rolls-Royce O Model", Presented at AIAA DEIC Digital Twin Subcommittee, 04.08.19.
4. Roy & Oberkampf, "A comprehensive framework for verification, validation, and uncertainty quantification in scientific computing", retrieve from: http://ftp.demec.ufpr.br/disciplinas/TM798/Artigos_seminarios/roy_oberkampf_2011-verification.pdf
5. "INCOSE Semantic Technologies for Systems Engineering (ST4SE) Project: Deliverables Technical Product Plan (TPP)", January, 2020. https://www.omgwiki.org/MBSE/lib/exe/fetch.php?media=mbse:patterns:incose_patterns_wg_st4se_project_tpp_v2.0_signed.pdf
6. Model Characterization Pattern: https://www.omgwiki.org/MBSE/lib/exe/fetch.php?media=mbse:patterns:model_characterization_pattern_mcp_v1.9.3.pdf
7. "Methodology Summary: Pattern-Based Systems Engineering (PBSE), Based On S*MBSE Models" https://www.omgwiki.org/MBSE/lib/exe/fetch.php?media=mbse:patterns:pbse_extension_of_mbse--methodology_summary_v1.6.1.pdf