Potential INCOSE – ASME Collaborations and Interests in the MBE Space

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https://www.omgwiki.org/MBSE/doku.php?id=mbse:patterns:patterns

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ASME MBE Committee
Spring Meetings, 2021

Contents

Purpose and scope

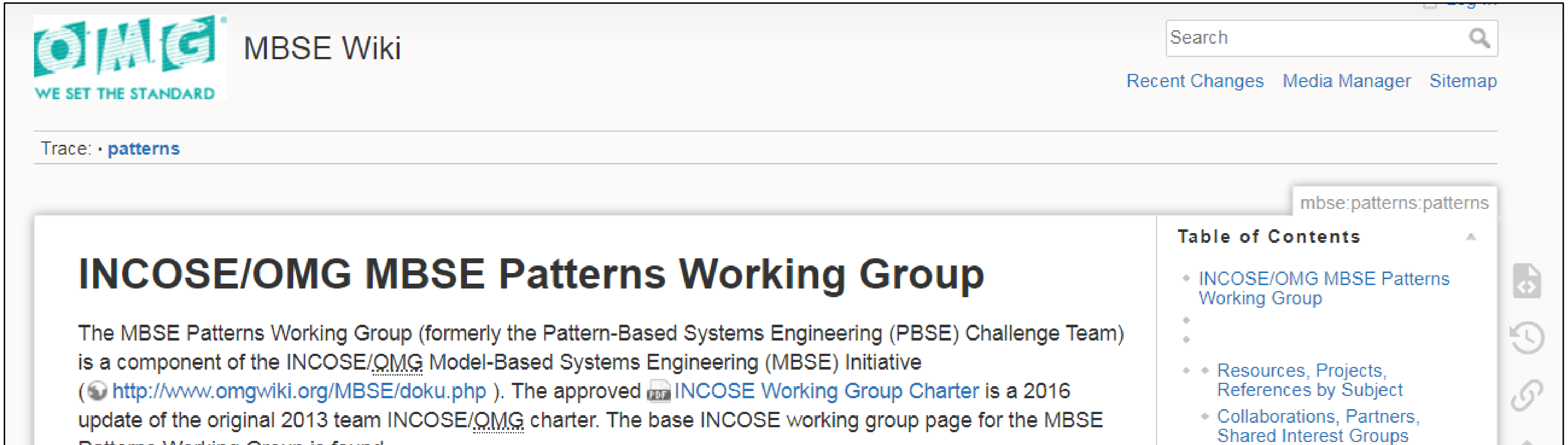
- Brief summary of some current and potential collaborations of mutual interest to INCOSE and ASME
- Extracts of a few model-based reference pattern projects from INCOSE MBSE Patterns Working Group that appear complementary to ASME MBE activities and interests
- Identify mutual interests for follow up

Known currently active ASME-INCOSE collaborations

- ASME VV50: WG on Managing Model Credibility over the Model Life Cycle:
  - Bill Schindel (ICTT System Sciences), chair of INCOSE-OMG MBSE Patterns Working Group, is an active member of ASME VV50 Committee since its origin in 2016.
  - Joined ASME to pursue this work; INCOSE learn from historical ASME work in computational model credibility (VV10, 20, 30); ASME learn system patterns approach.
  - Writing model-based pattern directly into the standard.
  - Joe Hightower, Boeing, is WG lead.
  - Currently meeting weekly; working on draft guideline for management of virtual model credibility over the life cycle of models, for 2021 balloting.
  - ASME VV50 and ASME MBE Committee share ASME Staff Secretary Fred Constantino.
- ASME PSD-1: Plant Systems Design
  - Michael deLamare (Bechtel), founding chair of INCOSE Critical Infrastructure Protection and Recovery Working Group, is an active member of ASME Plant Systems Design PSD-1 standards committee effort, chairing its Systems Engineering and Design Integration subcommittee.
  - Subject to a formal Standards Development Agreement between ASME and INCOSE.
  - Initial approval of PSD-1 standard expected in 2023.

INCOSE activities of potential interest to ASME MBE Committee

- The INCOSE-OMG MBSE Initiative originated in connection with the specification/realization of SysML (originally from OMG UML) and a set of related challenge teams and working groups.
- The MBSE Patterns Working Group was formed in 2013 as one of those teams under the INCOSE-OMG MBSE Initiative.
- An INCOSE Working Group, its web hosting remains on the OMG site of the MBSE Initiative: https://www.omgwiki.org/MBSE/doku.php?id=mbse:patterns:patterns



Patterns Working Group

- Concerned with:
  - Recurring/reusable, configurable, model-based "system level" patterns as descriptions of engineered products, socio-technical systems, or natural systems, including systems of engineering & other life cycle management domains (production, marketing/distribution, operation, sustainment, etc.).
  - Patterns as proxies for the information aspects of learning, including establishing and managing model trust and credibility over life cycles.
  - Configuration of general patterns to specific models, automated aids for same.
  - Typical descriptions of engineering, innovation, modeling, etc. (ISO15288, SEBoK, enterprise processes, etc.) tell us everything we would do if we did not have any previous knowledge of a domain, but are silent on specifics of *how to manage and combine what we already know with new knowledge*.
  - Shifting the historical balance of emphasis on SE process versus SE information.
  - Stronger ties to physical sciences' influence on the more mature engineering disciplines, as strengthened theoretical foundations for SE, which had a more ad hoc history than engineering disciplines based on phenomena-centric physical sciences.
- Agnostic as to modeling languages, tools, although we map and perform all our WG projects into and on them:
  - SysML, which emerged from the INCOSE-OMG MBSE Initiative, obviously used heavily, but not exclusively.

INCOSE Patterns Working Group

- Numerous projects as collaborations with other technical societies and other INCOSE WGs:
  - ASME, NAFEMS, IFSR, ISSS, SAE, ASSESS, NCDMM/V4I, etc.
  - Outreach is particularly important in the case of shared patterns, ontological frameworks, reference architectures, etc., because of different communities' diverse historical perspectives and their impacts.
- Three areas of potential interest selected and summarized here:
  - Approach to <u>model-based configurable patterns</u>: Appendix A
  - ASELCM <u>Innovation Ecosystem Pattern</u>: Appendix B
  - <u>Model Characterization Pattern</u> (Model Wrapper): Appendix C

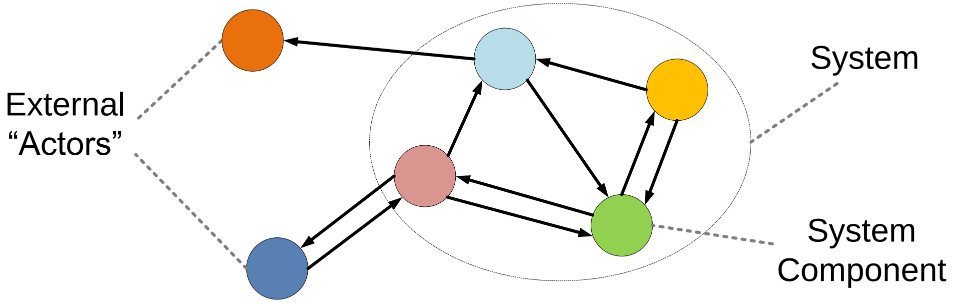
Appendix A: Excerpts from S*Patterns approach

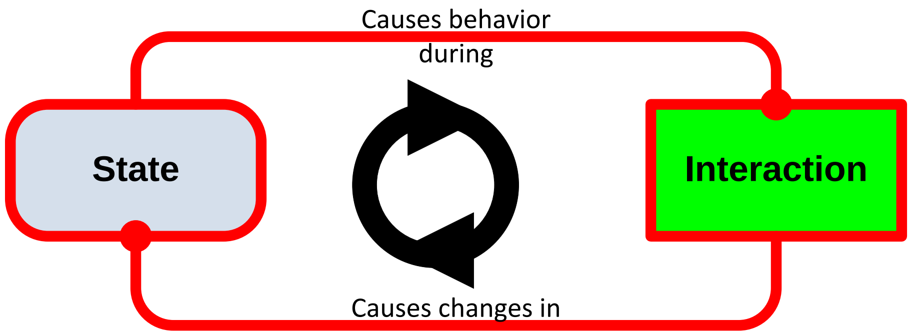
Why of possible MBE interest:

1. ASME MBE work already underway appears to have all the needs typically found for model-based configurable patterns.
2. In the 4/20 meeting, Will noted that SysML language and tooling provides so much freedom that people can go in diverse directions, need for idioms, interest in suggestions as to recommended methods.
3. Pattern based approach is the basis of the two pattern projects discussed here in Appendix B and C: The Ecosystem Pattern and the Model Characterization Pattern.
4. Various modeling questions heard during the 4/20-4/21 meetings.

The System Phenomenon

- In the perspective described here, by system we mean a collection of interacting components:





- Where interaction means the exchange of energy, force, mass, or information, . . .
- . . . through which one component impacts the state of another, . . .
- . . . and in which the state of a component impacts its behavior in current or future interactions.
- The resulting system has emergent state parameters that characterize its behavior as a whole during interactions within still larger systems.

Representing System Patterns: S* Metamodel Framework

- What is the smallest amount of information we need to represent systems, including their fixed and variable pattern regularities?
  - Some people (e.g., C. Alexander) used <u>prose</u> to describe system regularities.
  - This is better than before, but usually not enough to deal with the spectrum of issues in complex systems.
  - Much of the physical sciences is about this representation, and inspires S*Metamodel.
- We use S* Models, which are the minimum model-based information necessary for purposes of engineering and science:
  - This is not a matter of modeling language—your current favorite language and tools can readily be used for S* Models.
  - The minimum <u>underlying information classes</u> are summarized in the S* Metamodel, for use in any modeling language.
- The resulting system model is made configurable and reusable, thereby becoming an S* <u>Pattern</u>.

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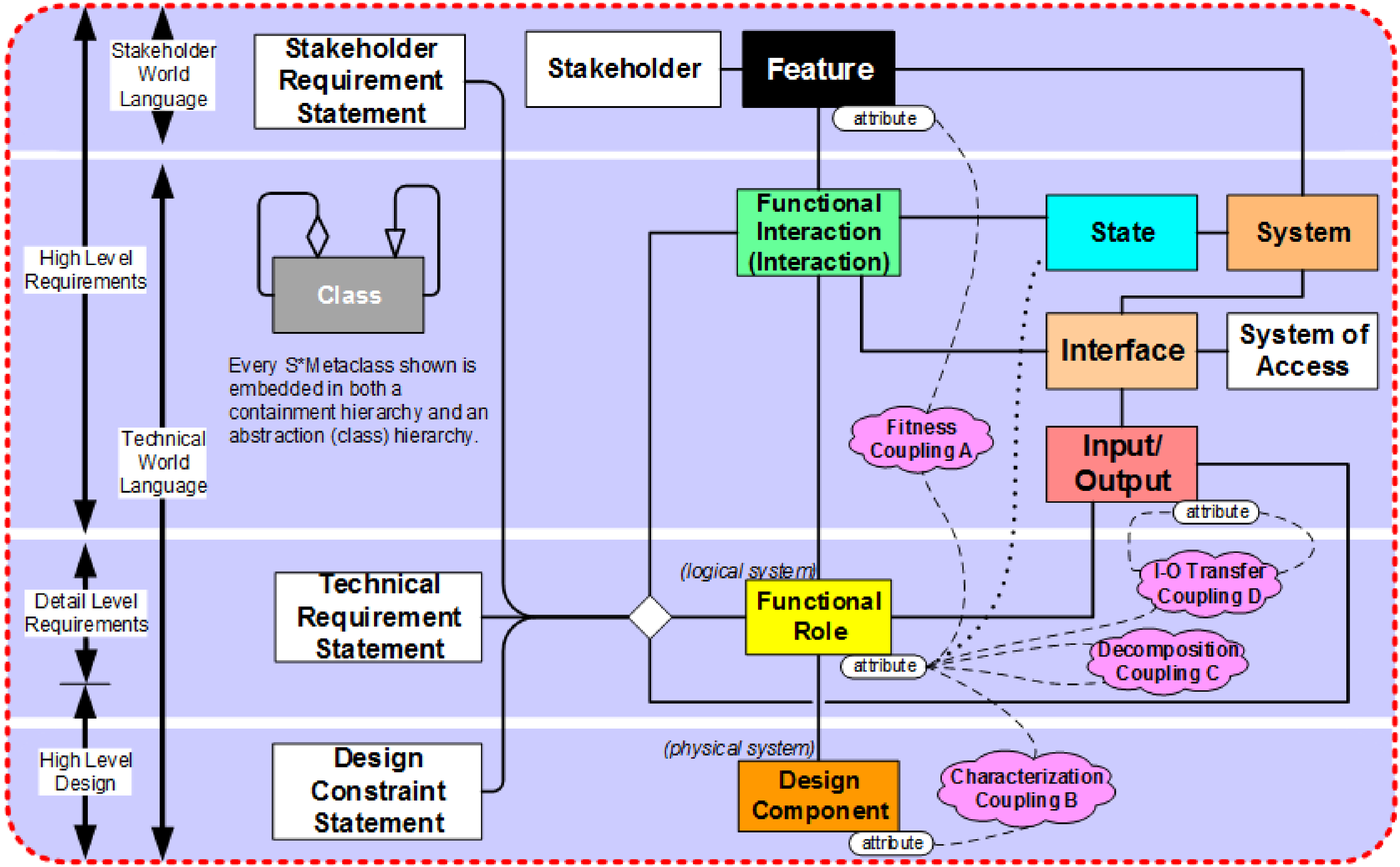
- S*Metamodel: To strengthen the engineering foundations of system level modeling, we use the smallest set of information necessary for the purposes of engineering and science over the life cycle of systems.
- Examples: Fundamentals of Interactions ; how Stakeholder Features express concerns and imply selectable configurations, connected views and viewpoints, trade space and risk space; 04/21 discussion example--protocol conformance.
- Language and tooling agnostic: The S*Metamodel is mapped into SysML or any other modeling language / tooling
- An S*Model is any model, in any language, that satisfies the S* Metamodel



S*Metamodel informal summary pedagogical diagram
(formal S*Metamodel includes additional details.)

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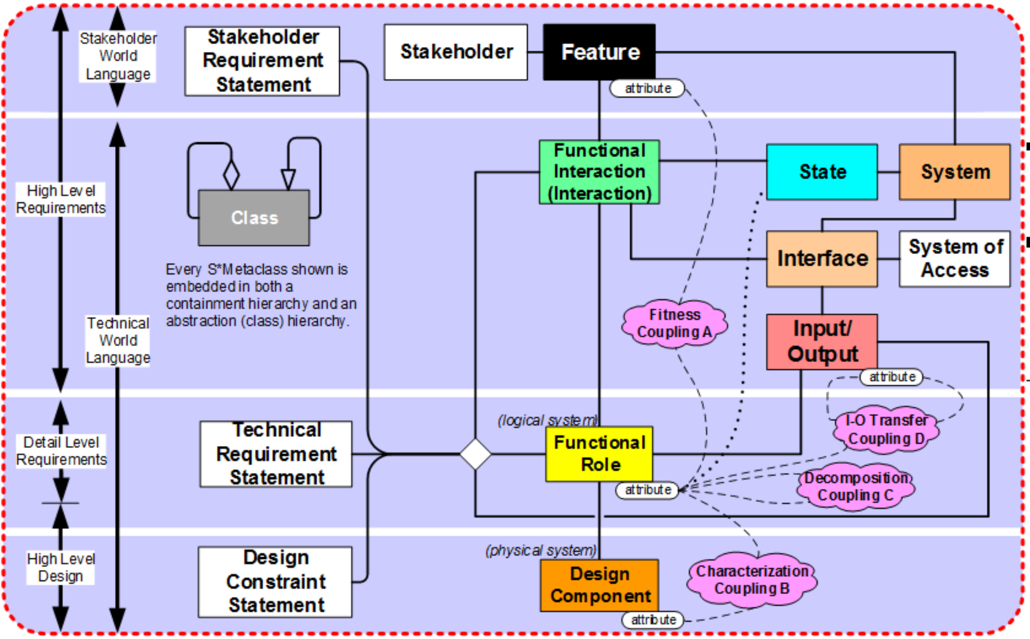

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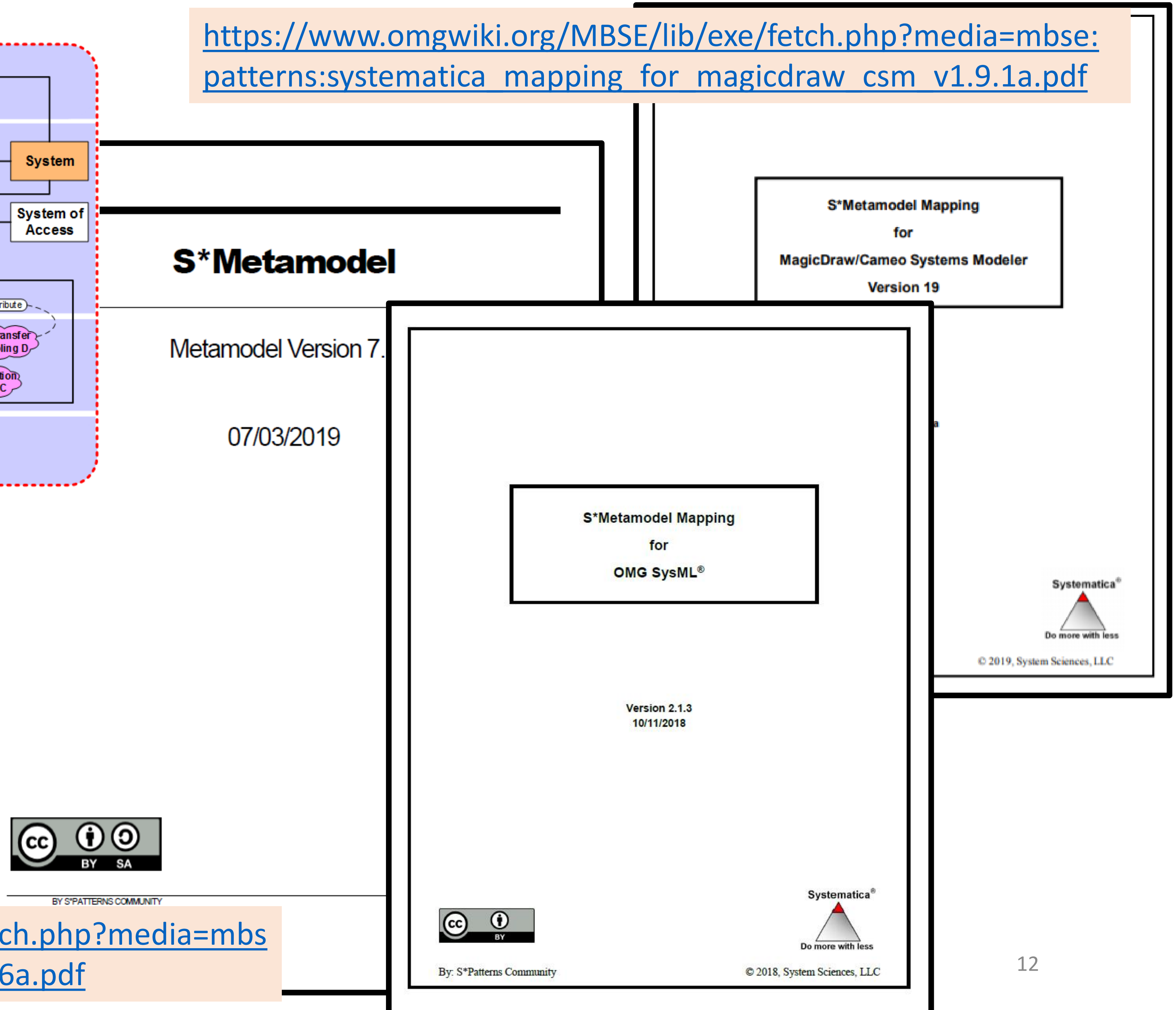
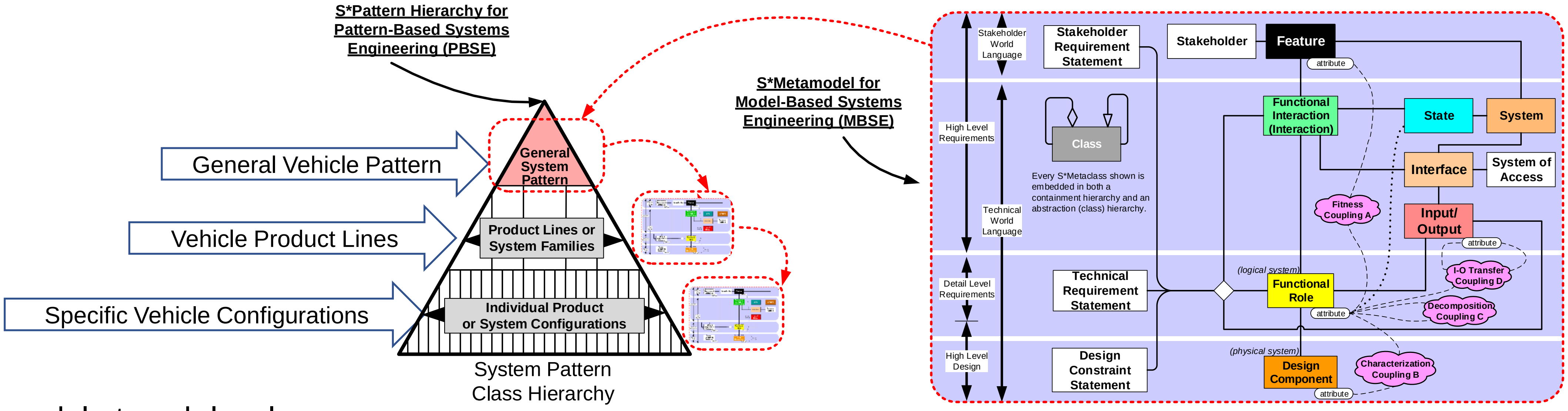


Formal S*Metamodel (100 pages), mappings to individual languages, 3rd party COTS tools.

https://www.omgwiki.org/MBSE/lib/exe/fetch.php?media=mbse:patterns:systematica_5_metamodel_v7.1.6a.pdf

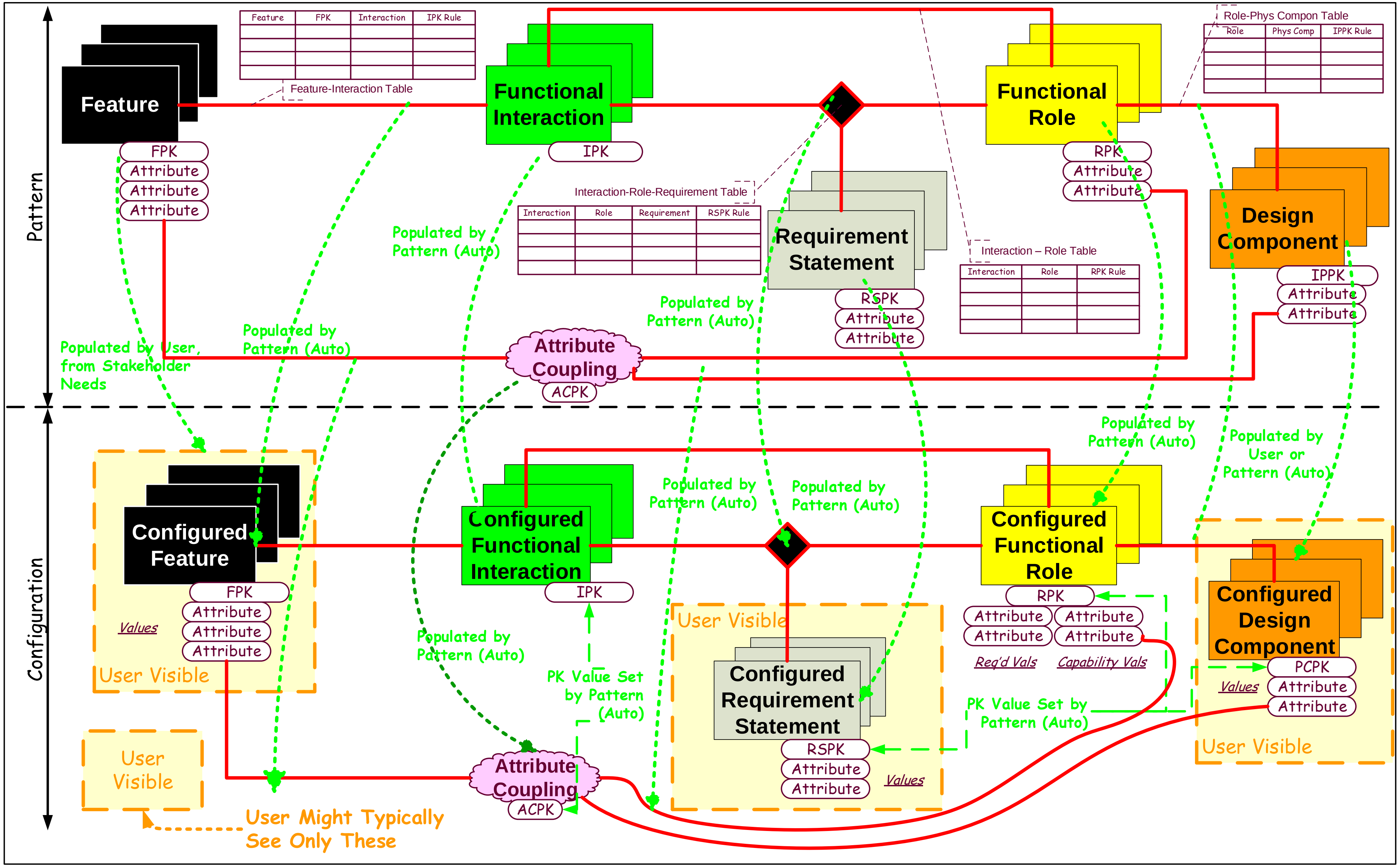
- An **S* Pattern** is a configurable, re-usable S* Model. It is an extension of the ideas of PLE platforms, ontologies, and architectural reference frameworks.
- The Pattern includes not only the physical Platform information, but all the extended system information (e.g., requirements, design, failure modes & risk analysis, design trade-offs & alternatives, decisions, etc.):



Same S*Metamodel at each level

S*Metamodel informal summary pedagogical diagram
(formal S*Metamodel includes additional details.)

Semi-Automatically Configuring Model from Pattern



Over two decades of model-based S*Patterns

Medical Devices Patterns	Construction Equipment Patterns	Commercial Vehicle Patterns	Space Tourism Pattern
Manufacturing Process Patterns	Vision System Patterns	Packaging Systems Patterns	Lawnmower Product Line Pattern
Embedded Intelligence Patterns	Systems of Innovation (SOI) Pattern	Consumer Packaged Goods Patterns (Multiple)	Orbital Satellite Pattern
Product Service System Patterns	Product Distribution System Patterns	Plant Operations & Maintenance System Patterns	Oil Filter Pattern
Life Cycle Management System Patterns	Production Material Handling Patterns	Engine Controls Patterns	Military Radio Systems Pattern
Agile Systems Engineering Life Cycle Pattern	Transmission Systems Pattern	Precision Parts Production, Sales, and Engineering Pattern	Higher Education Experiential Pattern

(See References and links)

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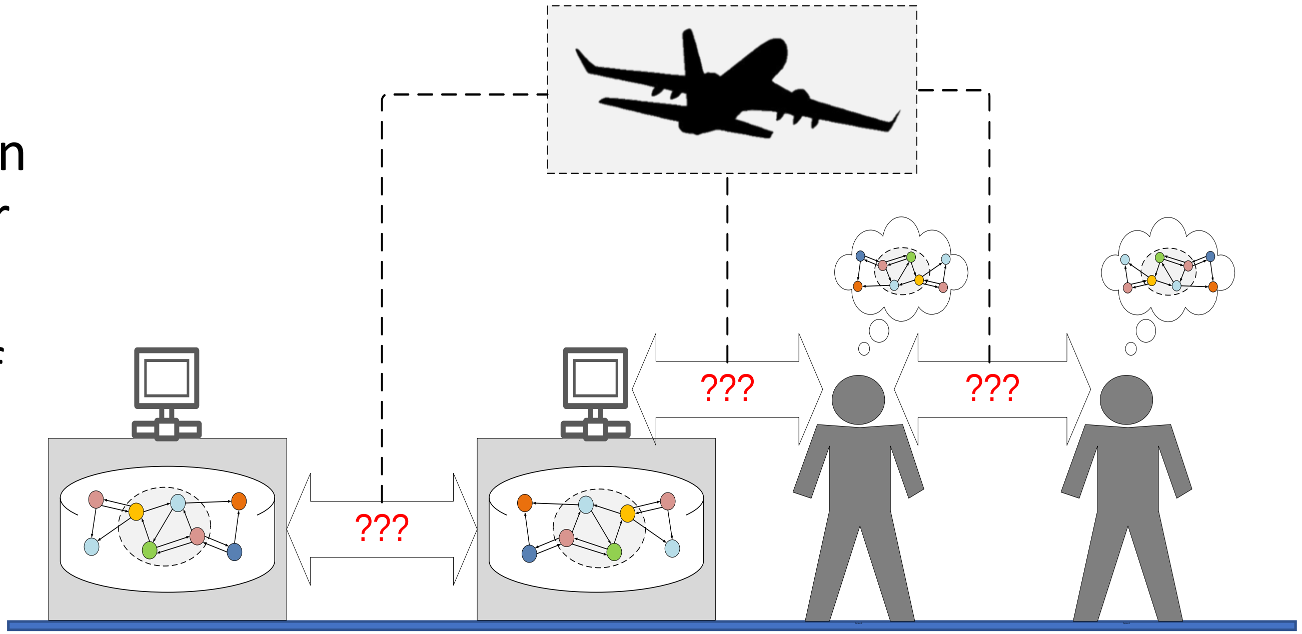
Semantic interoperability, domain-specific frameworks, languages, ontologies

- Common misunderstandings about semantic interoperability of models, frameworks:
  - Having everything “in SysML” does not mean the semantics of different models (and their different authors) are interoperable.
- We only used a profile to narrow the degrees of freedom within SysML—not to step outside it:
  - Like the “idiom” Will referred to on 4/21
  - Helps modelers stay within idiom

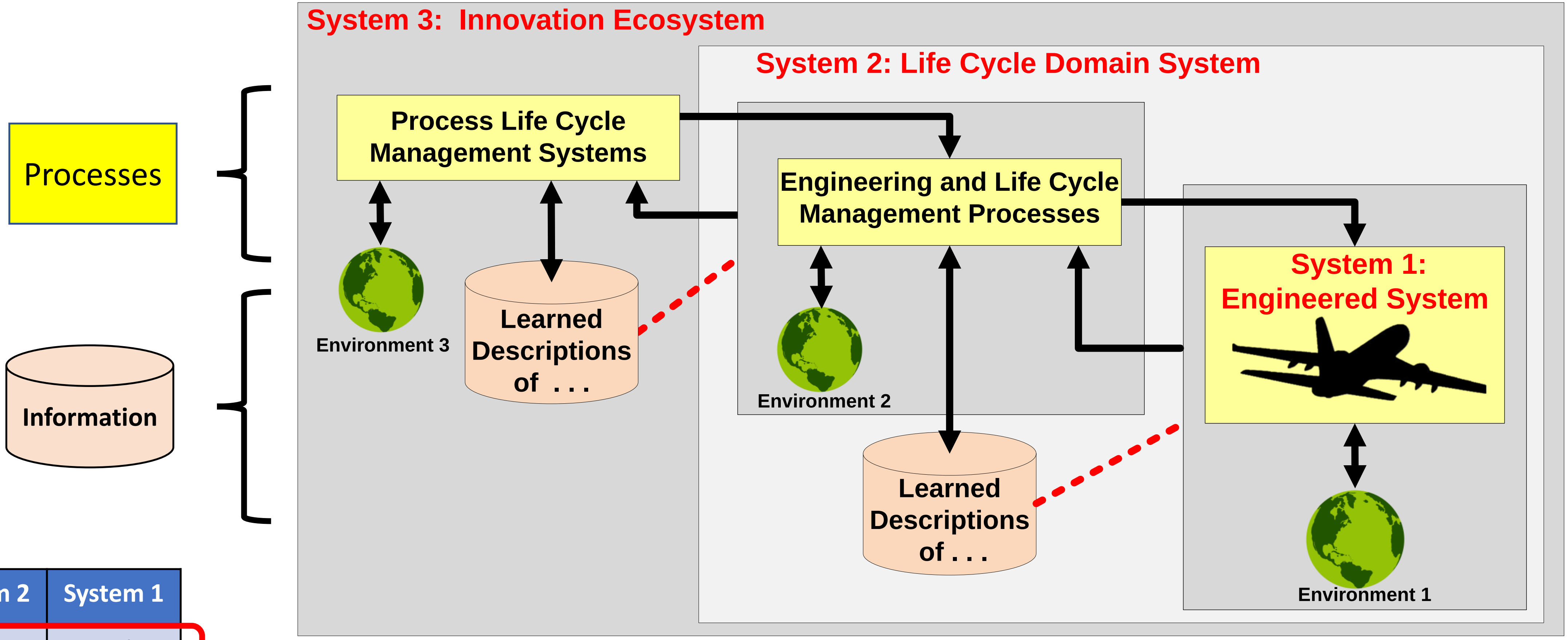


- But whether you follow that path on not, you will face semantic interoperability issues:
  - As you introduce a domain-specific specialization (such as the Mechanical Engineering case mentioned on 4/21), there are effective interoperability issues with other models you’ll want to collaborate with—such as Systems Engineering or other domain disciplines.
  - Some management required.
  - Example: Catalogs mentioned on 4/21 a very good idea—but need to be managed to not be accumulators of over-proliferated names.

Appendix B: Excerpts from INCOSE ASELCM Ecosystem Pattern

- Why of possible MBE interest:
  - Is based on a model-based pattern of limited focal aspects of the model-based enterprise
  - Some did not come up in the first two days of meetings this week, and may be complementary value to ASME MBE.
  - Ideas your model might incorporate, whether you make use of the specific INCOSE SysML model form or not.
- Emphasizes the role of models (and other information forms) in supporting the business processes and goals of the enterprise—being an MBE.
- Shifts the historical balance of emphasis on process versus information, but integrates both.
- Descriptive, not prescriptive reference framework that describes the continuum of any and all innovation ecosystems, from past to future, independent of modeling, methods—useful for describing pathologies.
- Foundational in INCOSE to *INCOSE Vision 2035* (in review) description of the future of SE, so a good way to collaborate with INCOSE about that future.
- Emphasis on learning and improvement, in both developed enterprise products and the capabilities of the enterprise—not just a model of a current or future enterprise, but also of the system for getting it there.
- Introduces key (consistency management) paradigm unifying and simplifying representation of the complex range of development and other processes across life cycle domains.
- Model credibility and exchange emphasis.
- Basis of related work with AIAA on Digital Twins and Digital Threads, and Air Force on Supply Chain Ecosystems
- Highly configurable without remodeling

The ASELCM S*Pattern: Logical Architecture Level 0



Level 0 View, INCOSE ASELCM Pattern

System 3	System 2	System 1
Level 0	Level 0	Level 0
Level 1	Level 1	Level 1
Level 2	Level 2	Level 2
Level 3	Level 3	Level 3
Level 4	Level 4	Level 4

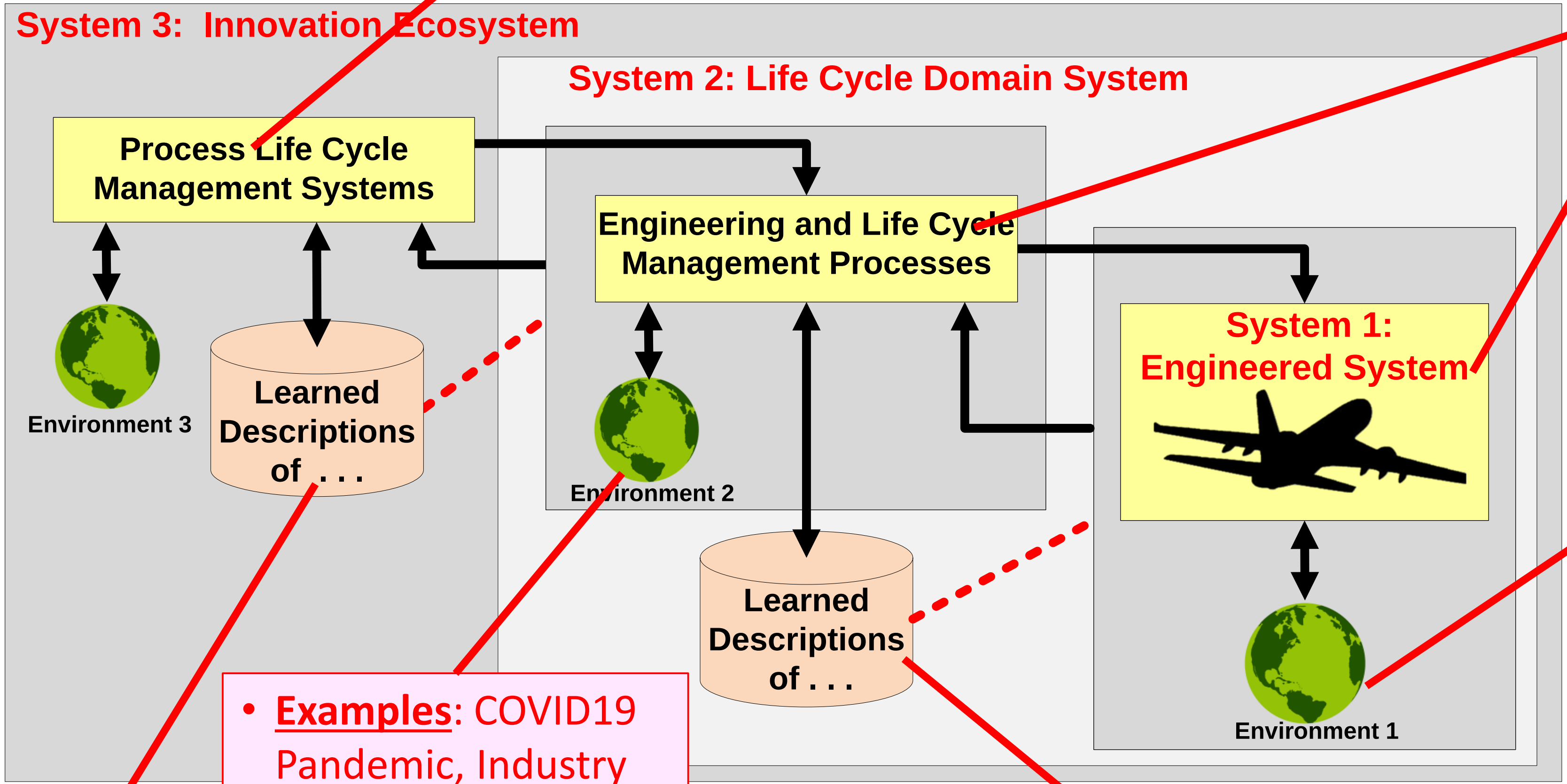
Definition, advancement of engineering, production, support, scientific methods

Engineering, production, support, science

Products that we design, markets, Nature

- **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

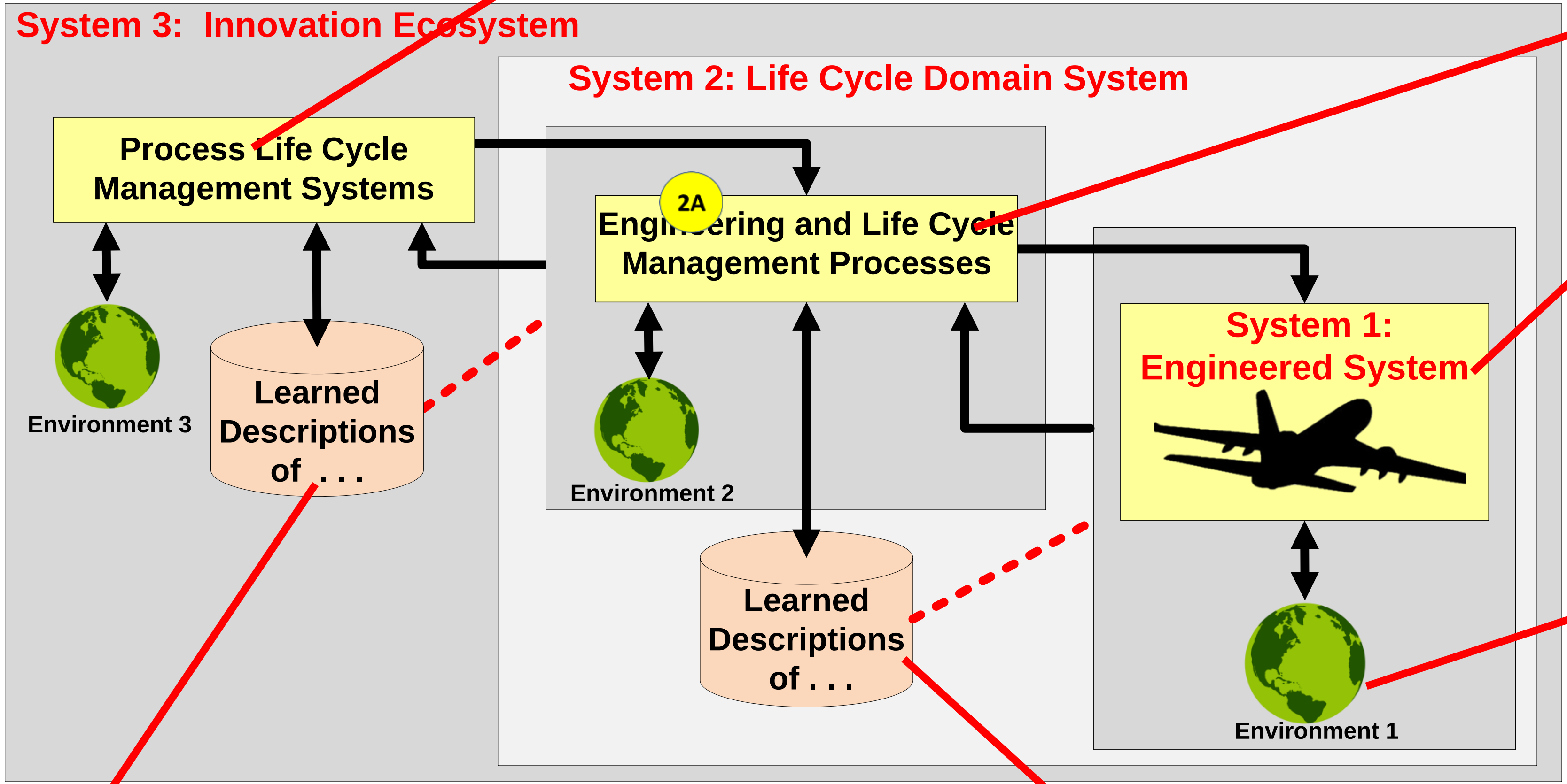
- **Examples**: COVID19 Pandemic, Industry Funding, Job Market

- **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.



Level 0 View, INCOSE ASELCM Pattern

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

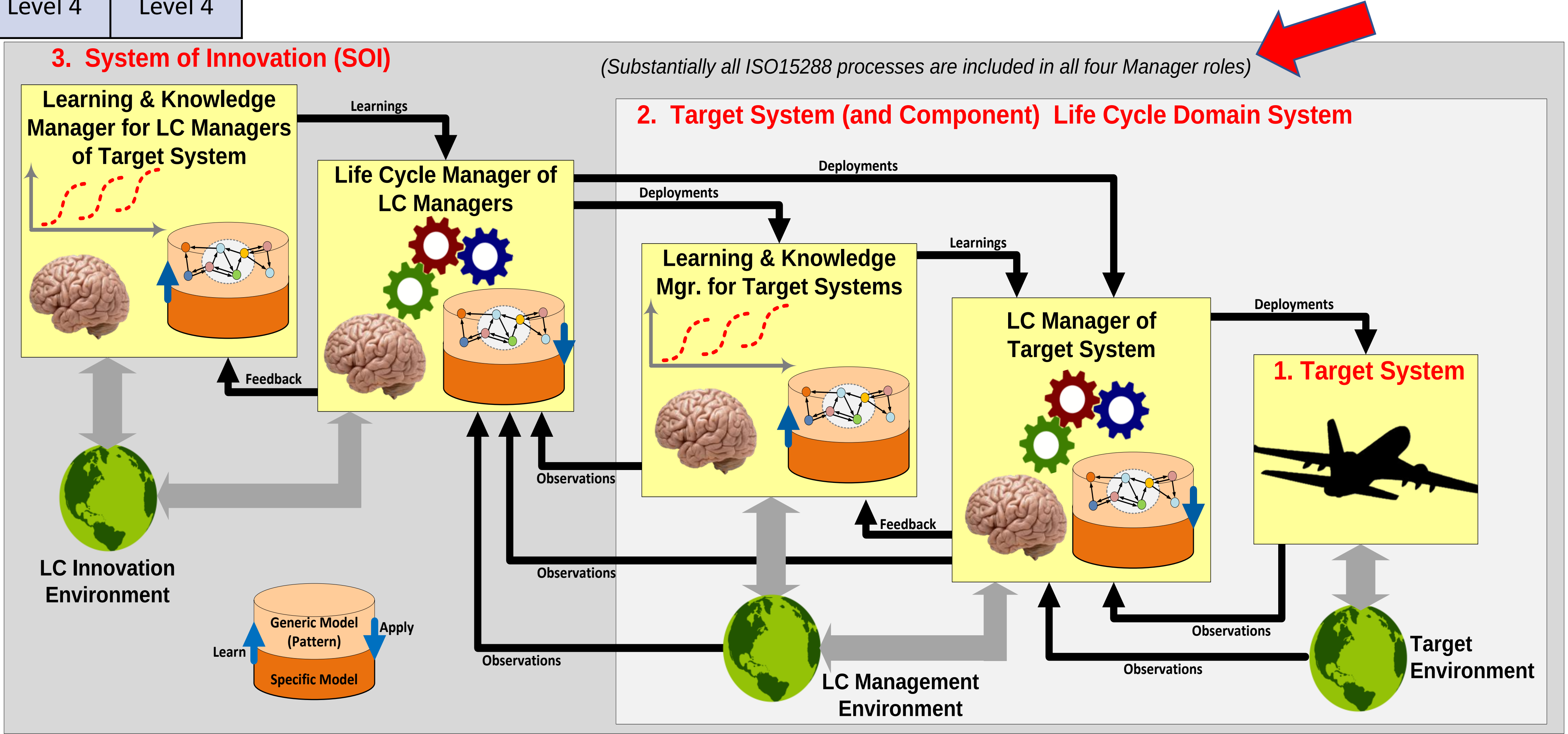
- The environment in which System 1 is operated, sustained, distributed, manufactured, or retired.
- Anything that directly interacts with System 1 during its life cycle.

- 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.

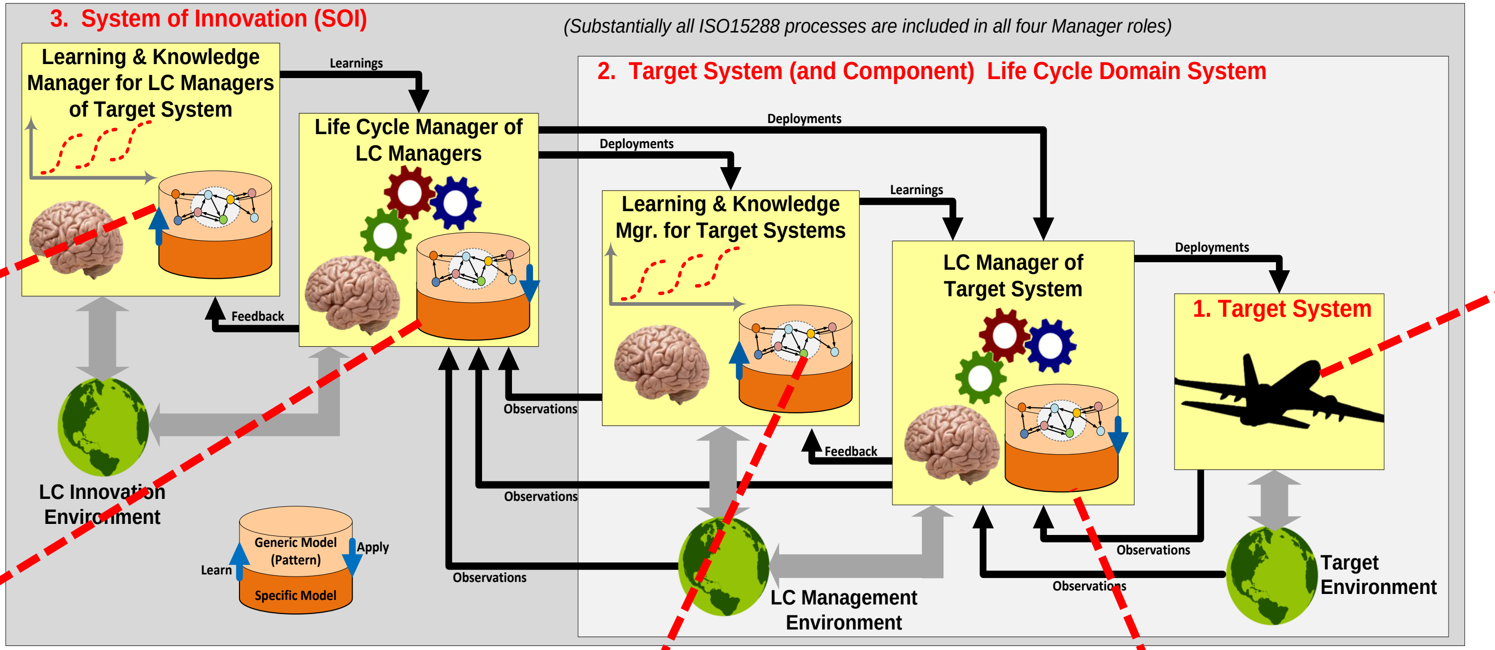
- Accumulated knowledge of System 1 and Environment 1, including explicit models, prose descriptions, implicit and tribal knowledge, captured empirical data or simulations, plans, prints, diagrams, prose, or other descriptions.

System 3	System 2	System 1
Level 0	Level 0	Level 0
Level 1	Level 1	Level 1
Level 2	Level 2	Level 2
Level 3	Level 3	Level 3
Level 4	Level 4	Level 4

ASELCM Pattern, Level 1 (breaks out enterprise learning vs. execution impact of learning)



ASELCM Pattern: Systems 1, 2, and 3



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

System 1: The real engineered system.

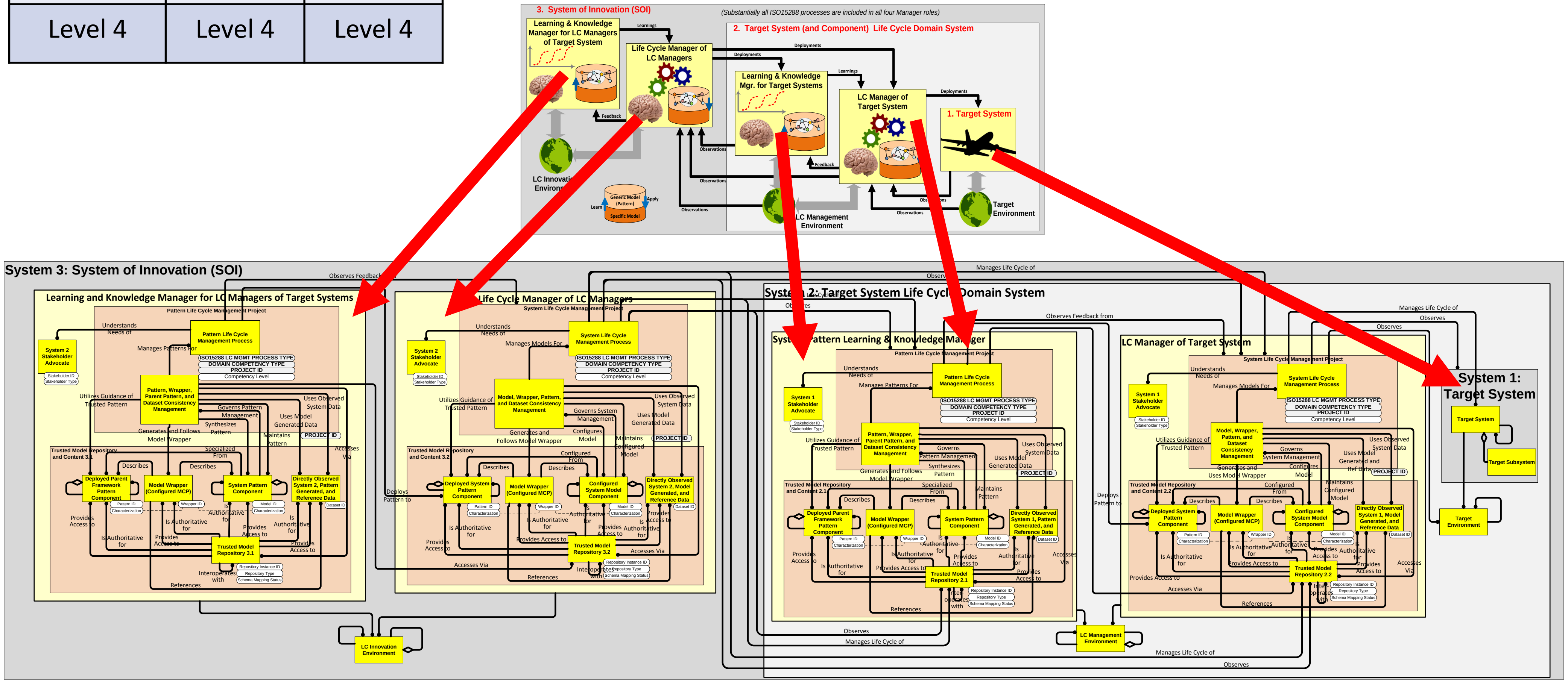
System 3: Configured models of specific System 2 ecosystems (engineers, tools, methods, processes, etc.), ready to deploy in System 2 projects. Driver for organizational change management, improved methods and tools, education.

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.

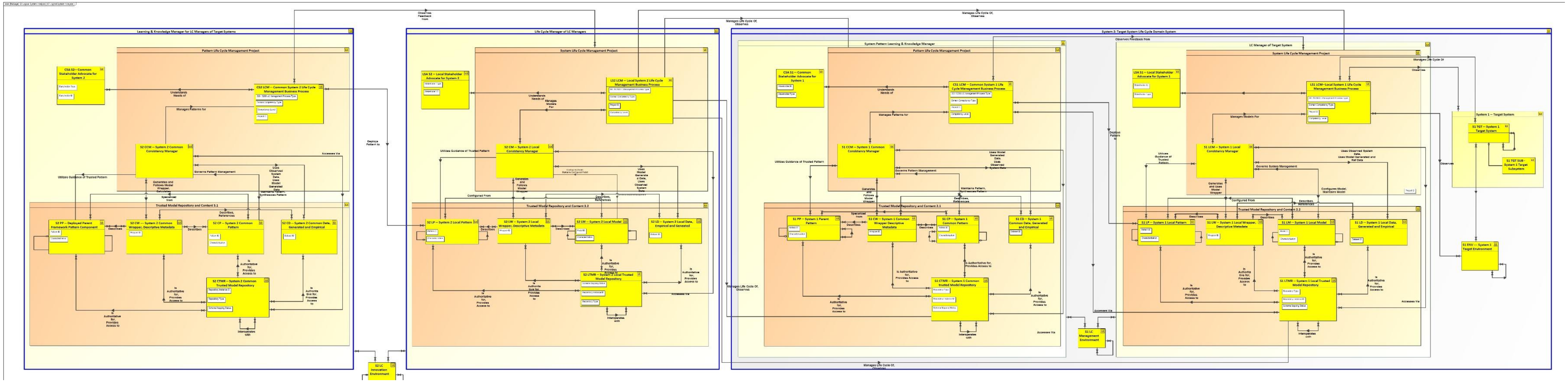
System 3	System 2	System 1
Level 0	Level 0	Level 0
Level 1	Level 1	Level 1
Level 2	Level 2	Level 2
Level 3	Level 3	Level 3
Level 4	Level 4	Level 4

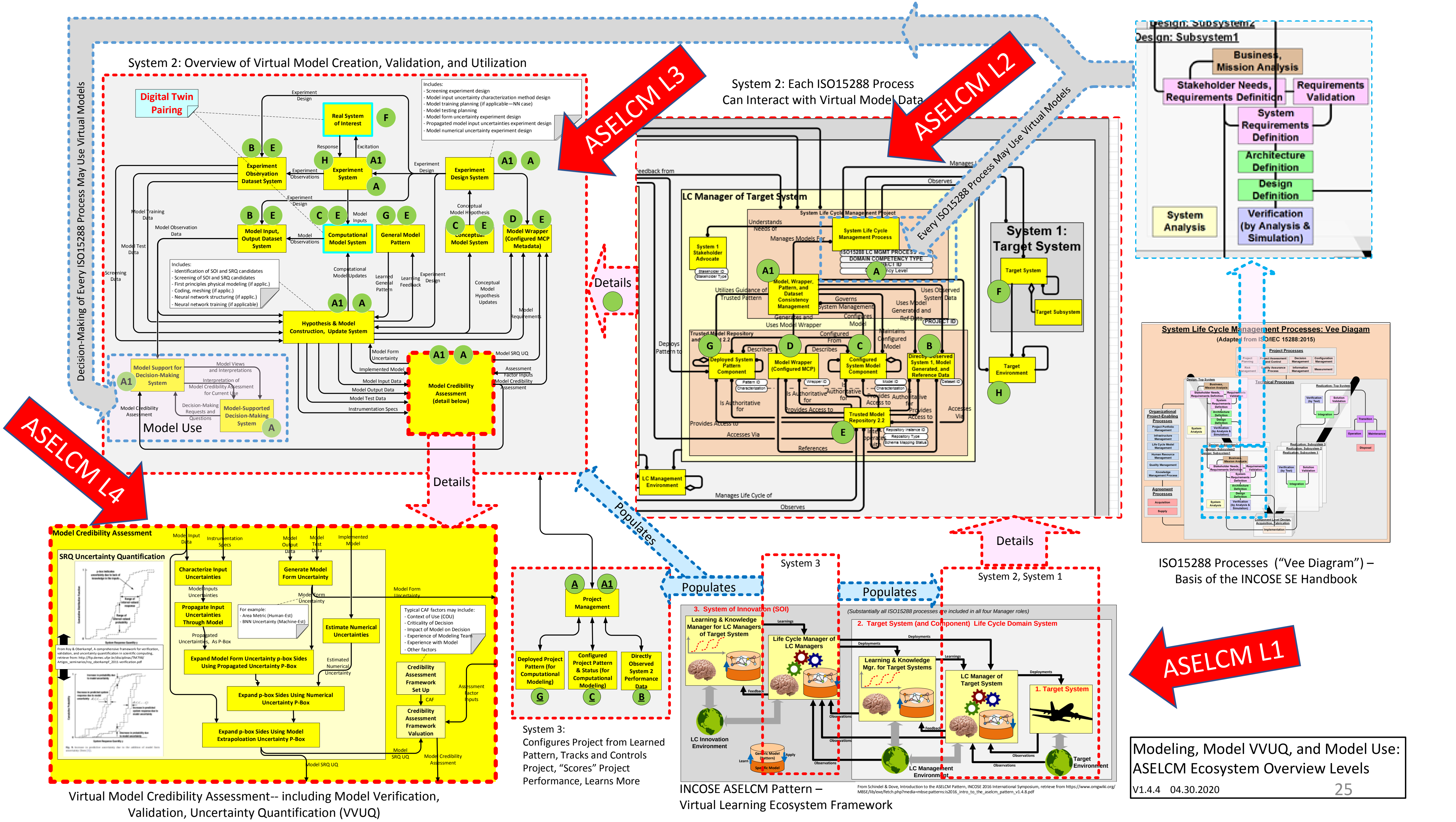


ASELCM
Level 1

ASELCM
Level 2

SysML (Magic Draw Cameo Systems Modeler view of L2)

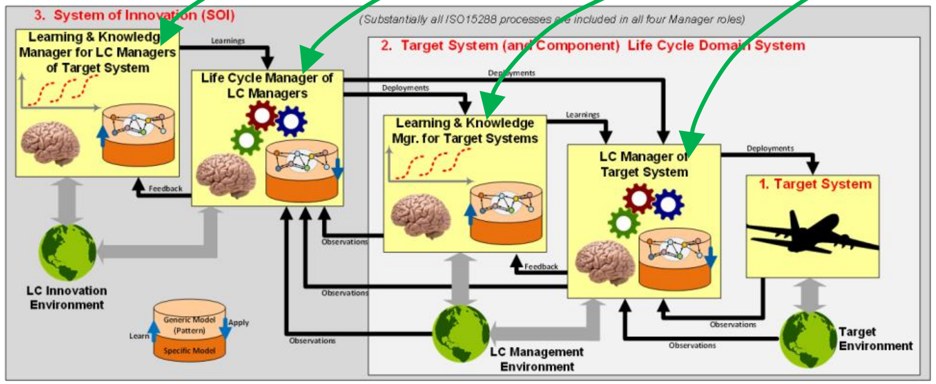


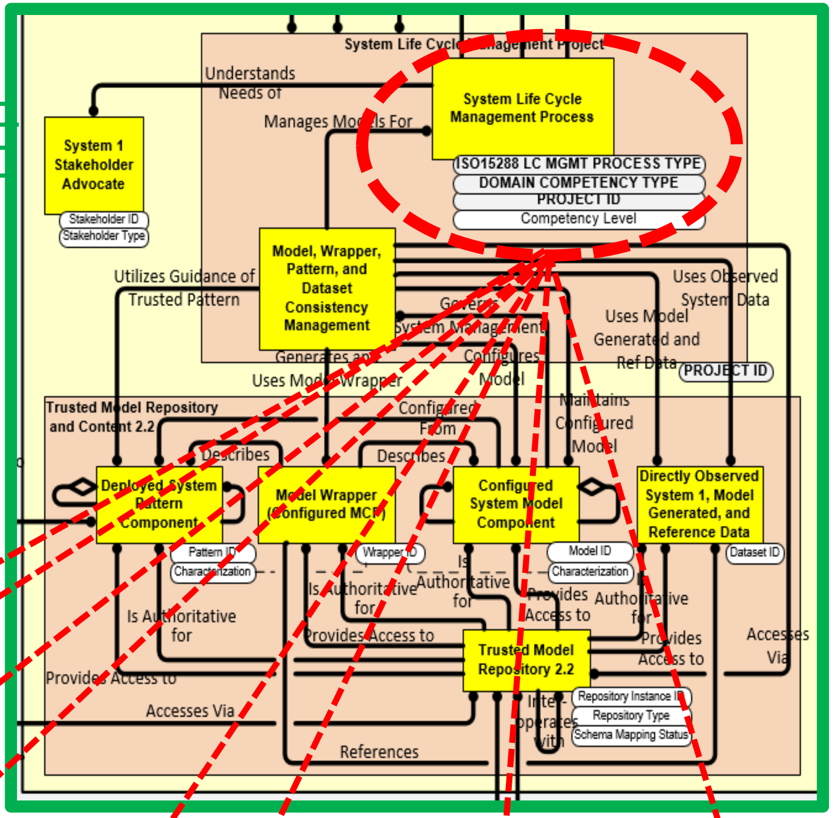


Modeling, Model VVUQ, and Model Use: ASELCM Ecosystem Overview Levels

V1.4.4 04.30.2020

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

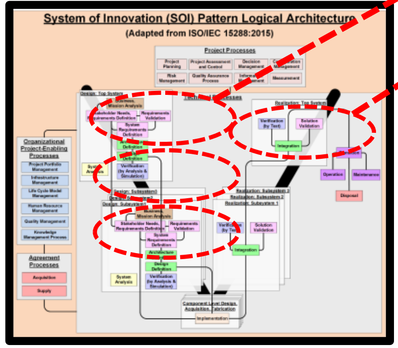




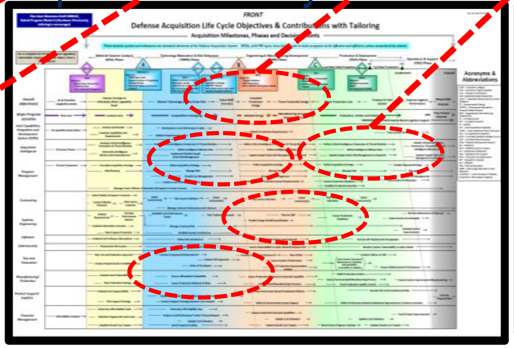
ASELCM Ecosystem Reference Pattern

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

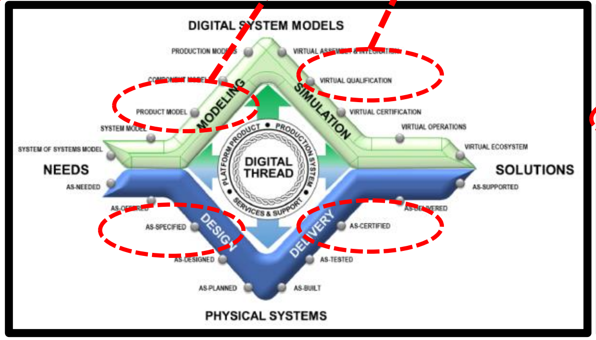
ISO15288 Life Cycle "Vee" Model[1]



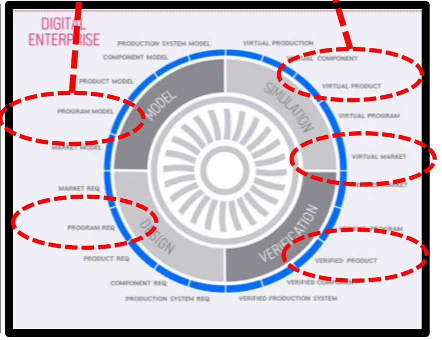
DoD 5000 Defense Acquisition Life Cycle Model[2]



Boeing "Diamond" Model[3]



Rolls-Royce "O" Model[4]

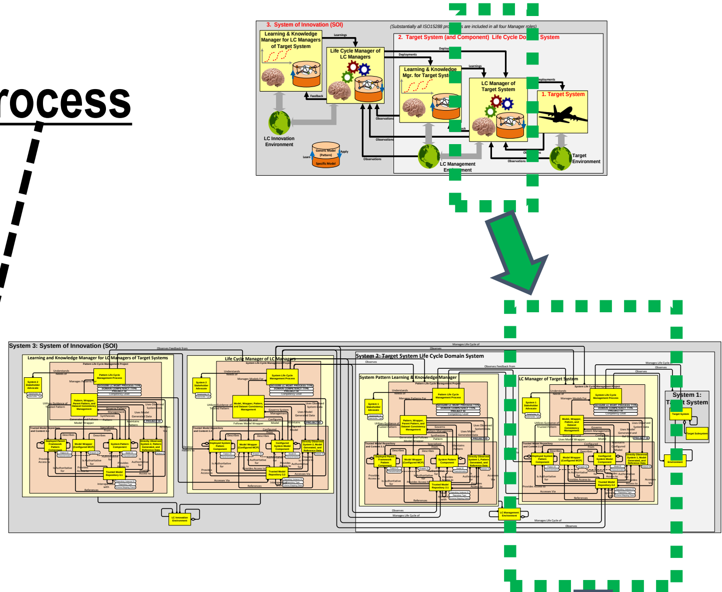


Excerpted or adapted from: (1) ISO15288 and INCOSE SE Handbook; (2) DoD5000 Wall Chart; (3) AIAA Sci Tech, 01.2020, J. Matakeyama; (4) AIAA DEIC Digital Twin Subcommittee, 04.08.19 Donaldson, Flay, French, Matlik, Myer, Pond, Randjelovic

ASELCM Ecosystem Reference Pattern (Level 2)

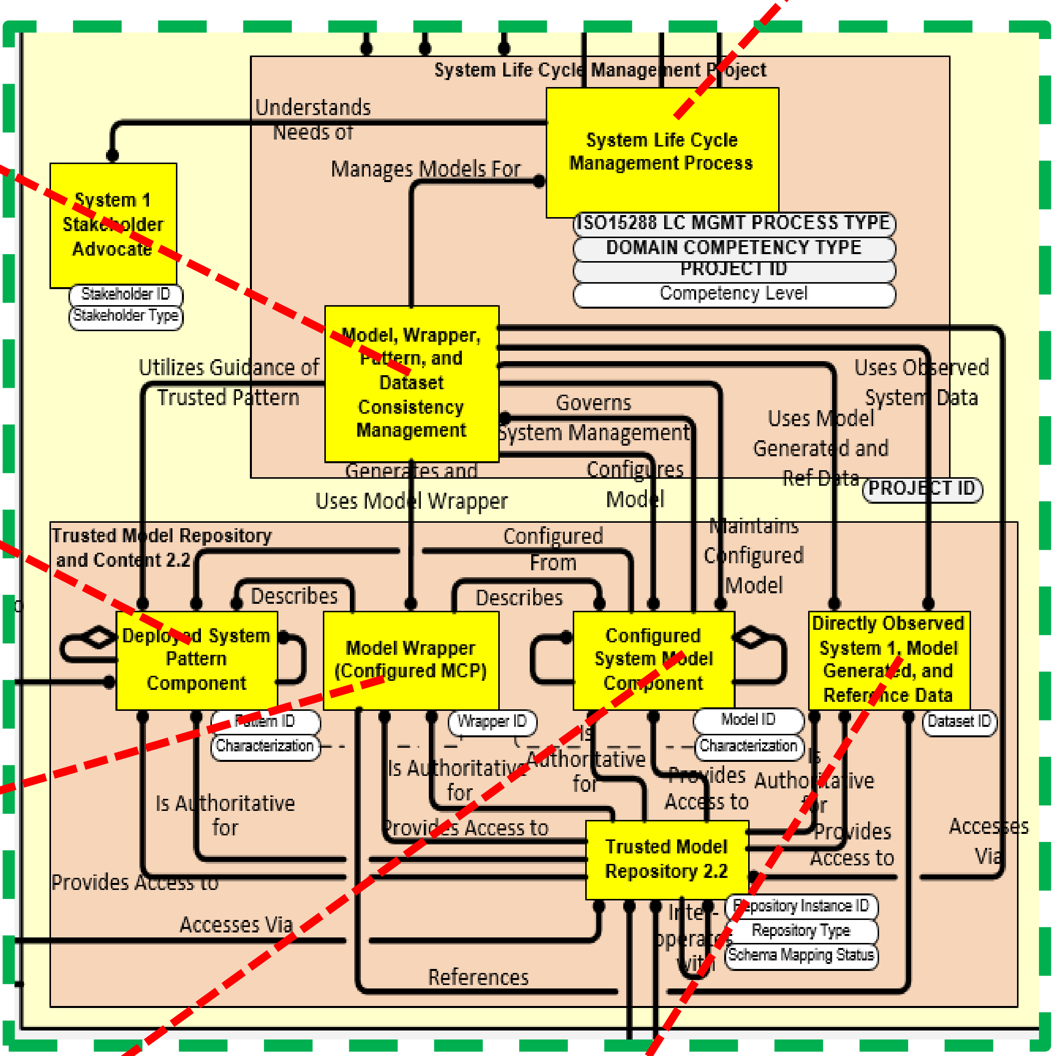
Business Processes: ISO15288 or otherwise

Process



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

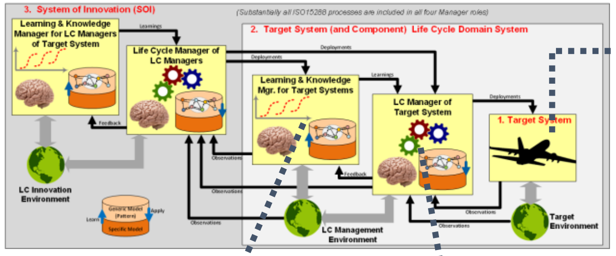


Information

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

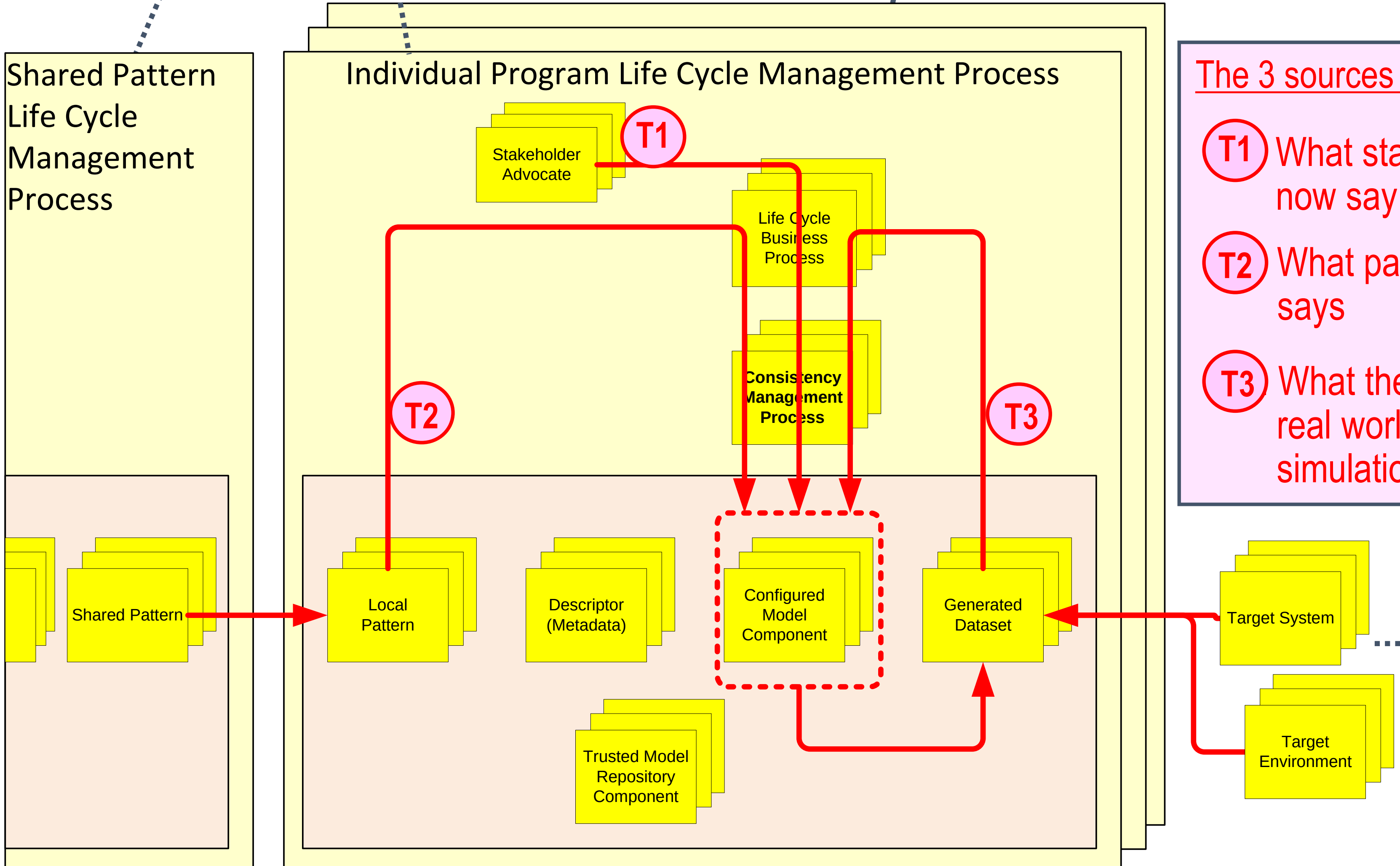
Configured Models: Computational and other (MBSE, etc.) of System 1

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:*



The 3 sources of credibility

T1 What stakeholders now say / want

T2 What past learning says

T3 What the observed real world and its simulation now say

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.
- ASELCM L2 Model focuses on generalized (configurable) role of “consistency management”, concerned with supporting numerous types of consistency implied.

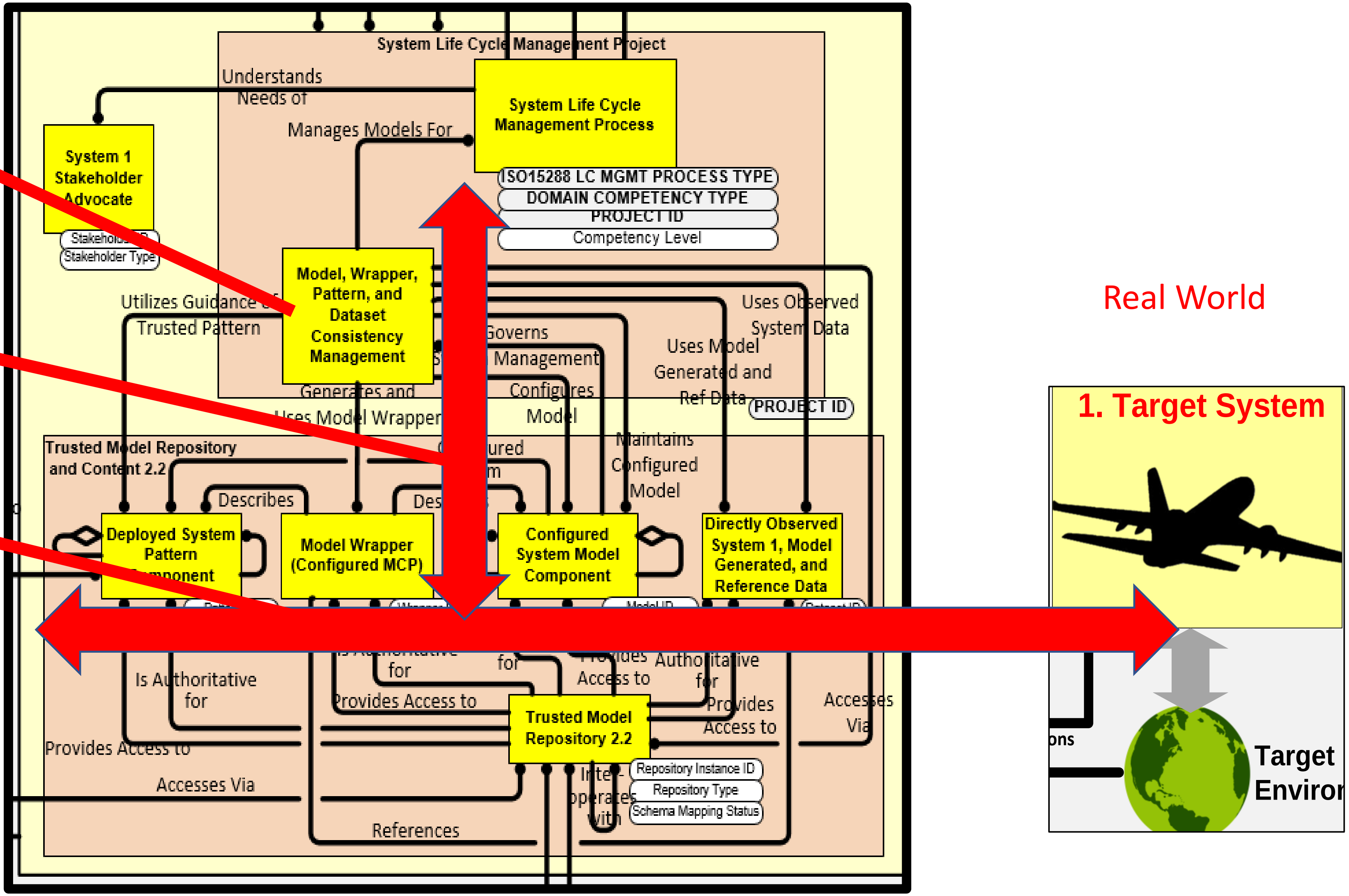
Consistencies across Models, Patterns, Datasets, as well as with external Stakeholders and Real World.

Consistency Management Role

Vertical consistencies of information with Business Processes & Stakeholders

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

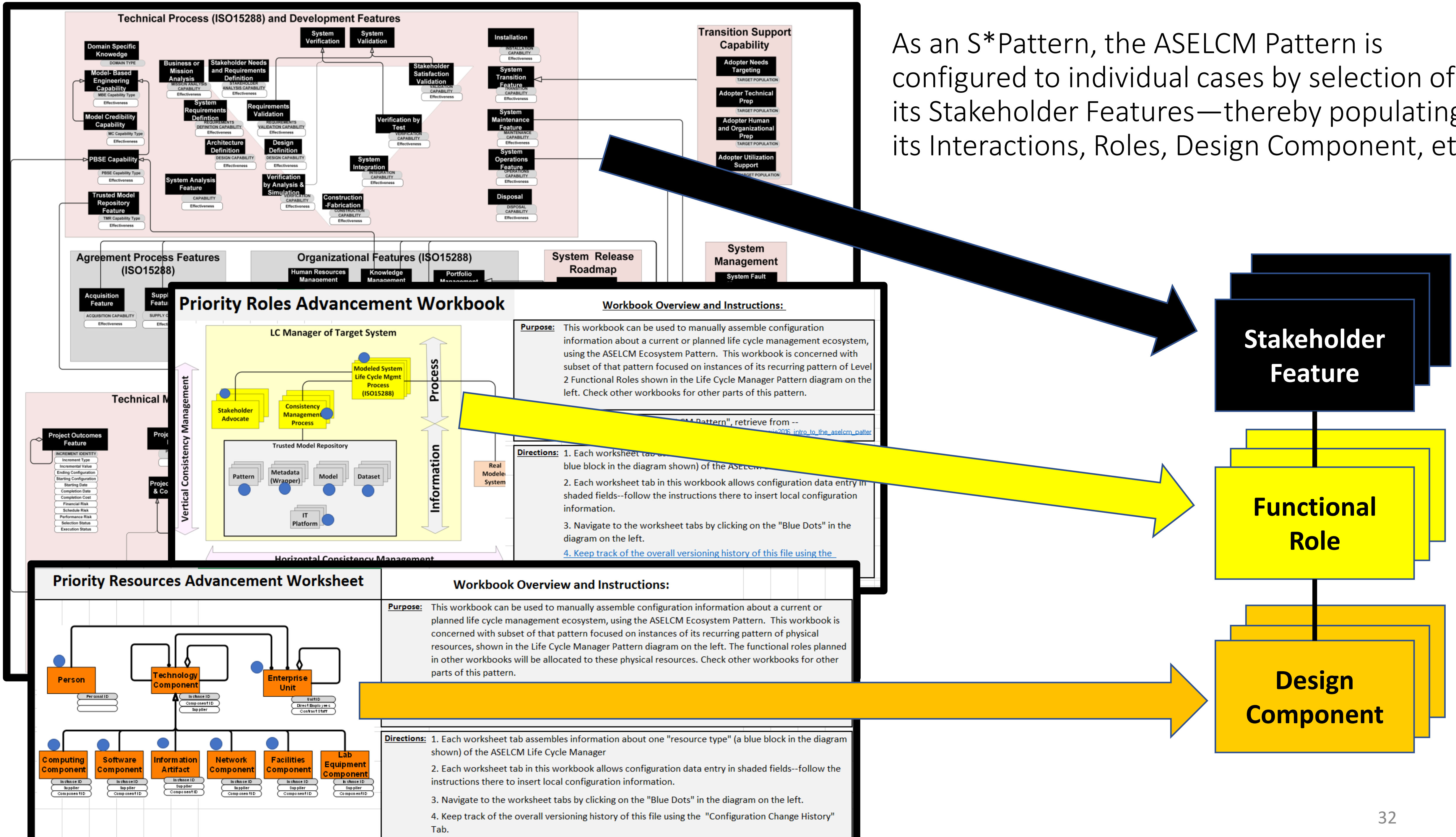
Real World

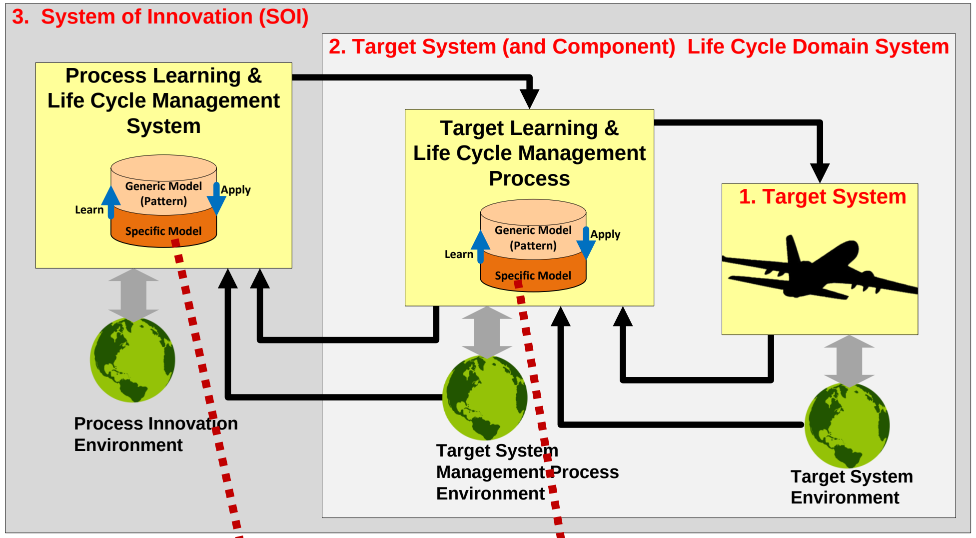


Consistency Management as a Central Paradigm for Digital Engineering

- 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.

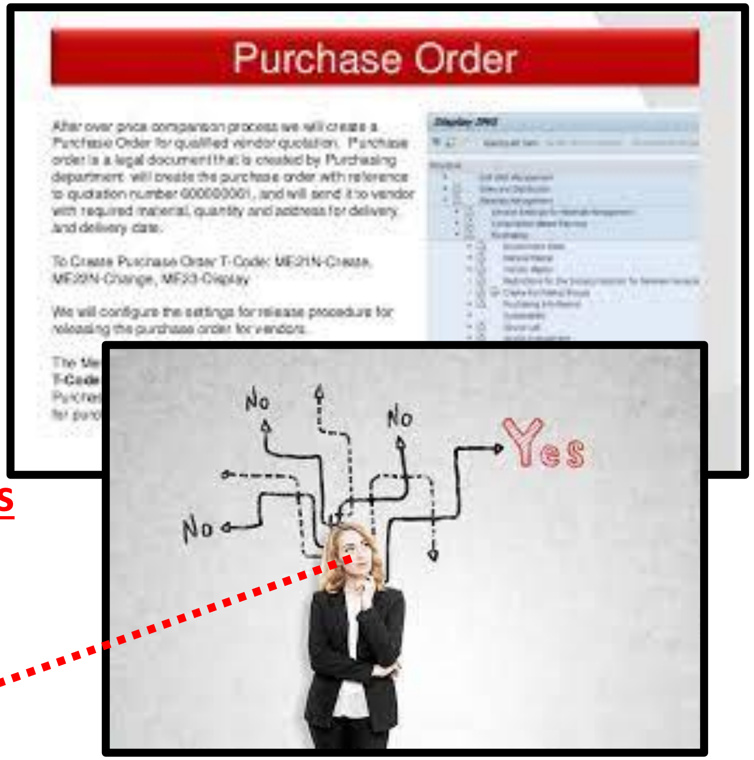
As an S*Pattern, the ASELCM Pattern is configured to individual cases by selection of its Stakeholder Features—thereby populating its Interactions, Roles, Design Component, etc.



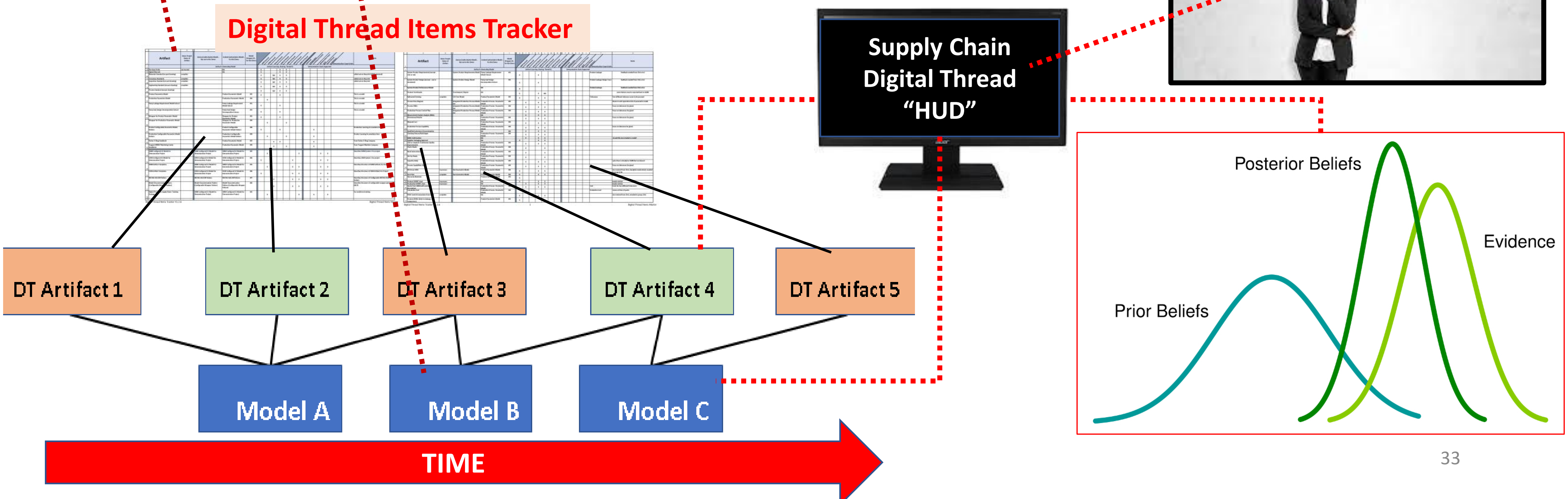


Level 0 View, INCOSE ASELCM Pattern

Overview in Digital Thread Setting



Innovation Ecosystem
Supply Chain Operations

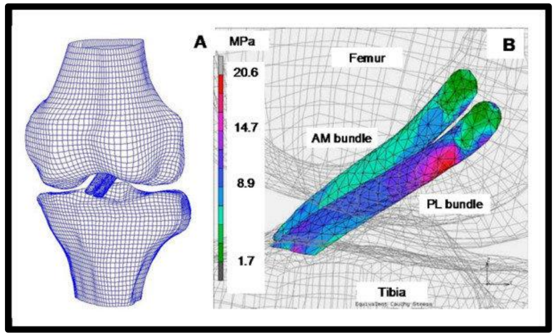


Appendix C: Excerpts from INCOSE Model Characterization Pattern

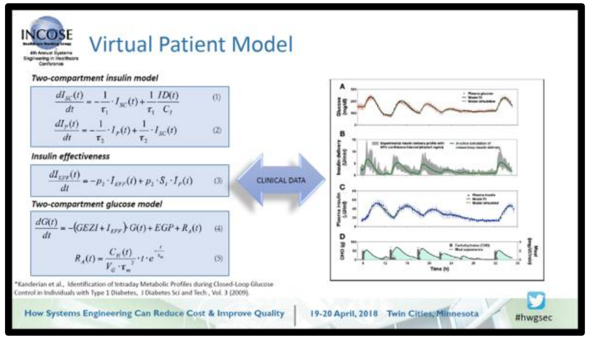
- Why of possible MBE interest:
  - A universal, configurable model “wrapper” of metadata needed for the curation and use of models of all types.
  - Addresses a universal need across the Model-Based Enterprise
  - Currently written into the ASME VV50 standard draft
  - Coordinated with narrower metadata efforts across multiple other organizations

Diverse Virtual Models of All Types

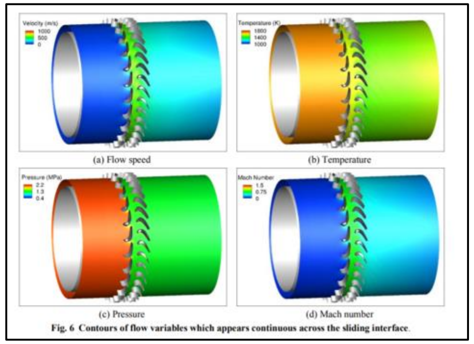
FEA Model



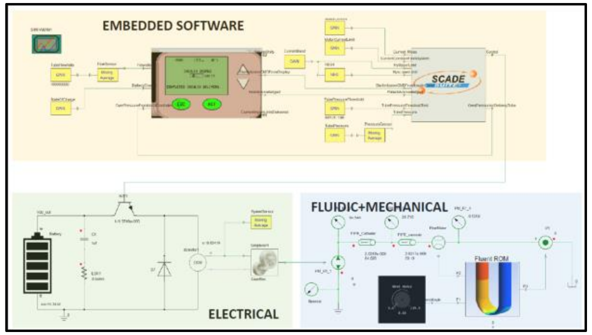
ODE Model

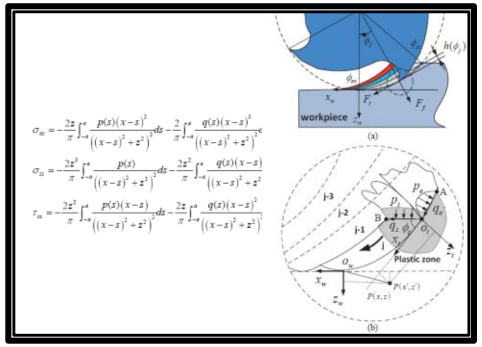


CFD Model

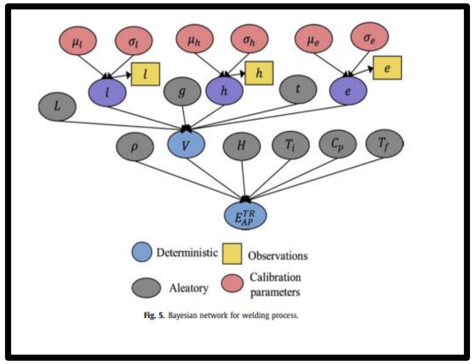


Multi-Domain System Model

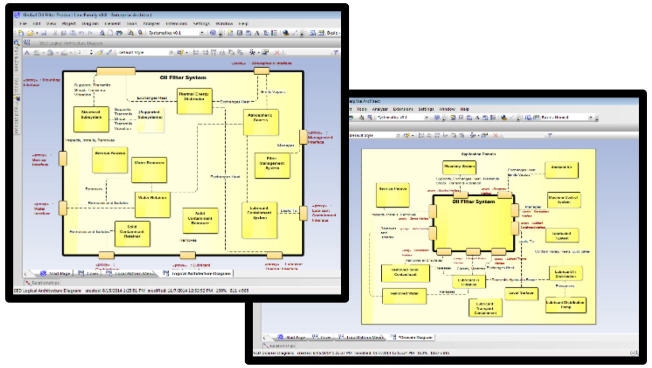




Physics-Based PDE Model



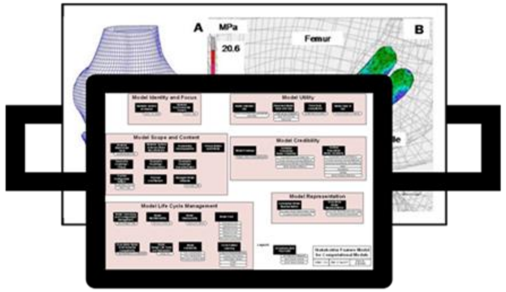
Data-Driven Bayesian Network Model



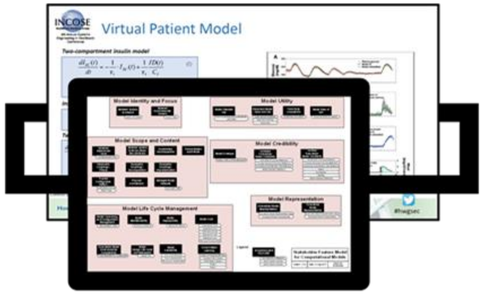
MBSE Model

The Model Characterization Pattern (MCP)

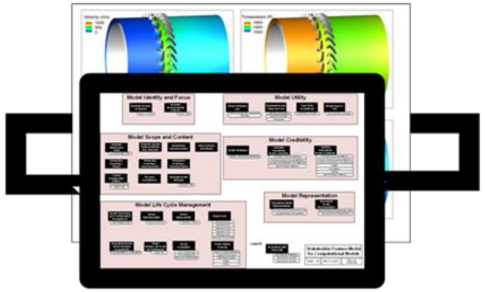
FEA Model



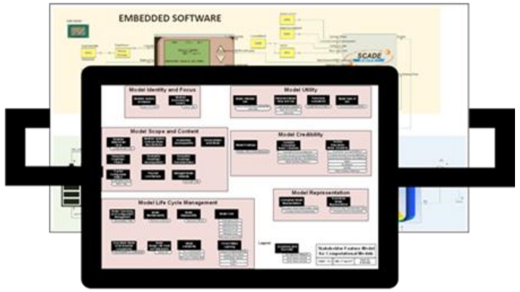
ODE Model

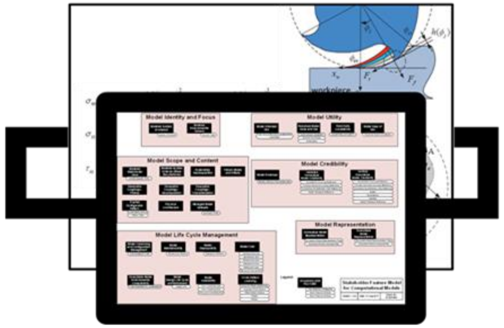


CFD Model

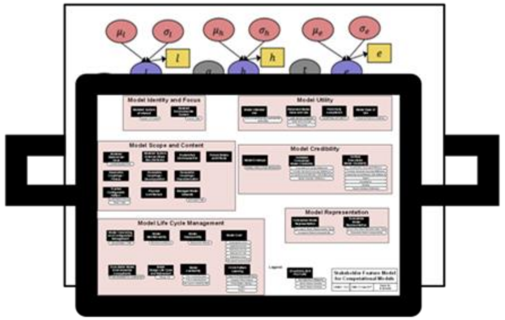


Multi-Domain System Model

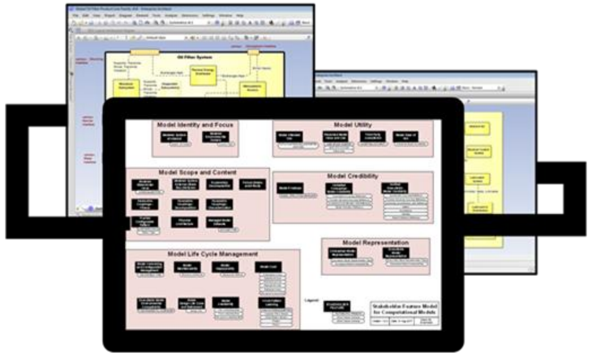




Physics-Based PDE Model



Data-Driven Bayesian Network Model



MBSE Model

A Universal Characterization & Labeling S*Pattern for All Virtual Models

V 1.9.12

Challenges for Model Stakeholders

1. ***Scaling up*** *to the population of people and volume of models and model transactions to be addressed in a world in which these will grow by orders of magnitude, overwhelming what might not otherwise be addressed by a more limited population of deeply expert model authors, model users, or model dependents--a world in which models are also being exchanged more extensively across supply chains beyond their originators.*
2. ***Managing models over their entire life cycle****, particularly for long-life models, including users and maintainers far from the model originator in both space (global supply chains) and time (decades).*
3. ***Increasing use of what has already been learned*** *(especially by others) about specific modeled product and system domains in past model cycles, so that what the same work and costly lesson discovery path is not repeatedly traveled at a cost in time, effort, and risk of model impact on human lives and other assets.*
4. ***Packaging general principles as actionable assets*** *moving from already described general advice, principles, and broad guidance of text books, classes, and standards, to wider and more accessible impact by packaging as structured actionable assets (data structures, tooling, actionable learning, etc.) delivering value without requiring as deep conscious expertise in detailed practice (e.g., packaging analysis of uncertainty propagation using configurable domain specific patterns, or enabling standards that are themselves models directly downloaded and immediately used in projects, shortening adoption cycles).*
5. ***Preparing for a more building-block world****, akin to the 1960's transformation from discrete electronics to integrated circuits, but in this case for model IP. Lifting all boats by enabling more contribution of multiple players to a world of integrated systems of models, without compromise to trust.*
6. ***Unifying external metadata "wrapper" (label) across all models*** *that will continue to be more and more diverse in their internal structure, theory, tooling, domain specifics, methodologies, styles, physics vs. data origins, and other aspects, to reduce the growth rate of challenge facing regulators and other judges of the credibility of these diverse models, appearing in a growing flood.*

What you can do with the MCP in Model Connected Projects and Enterprises

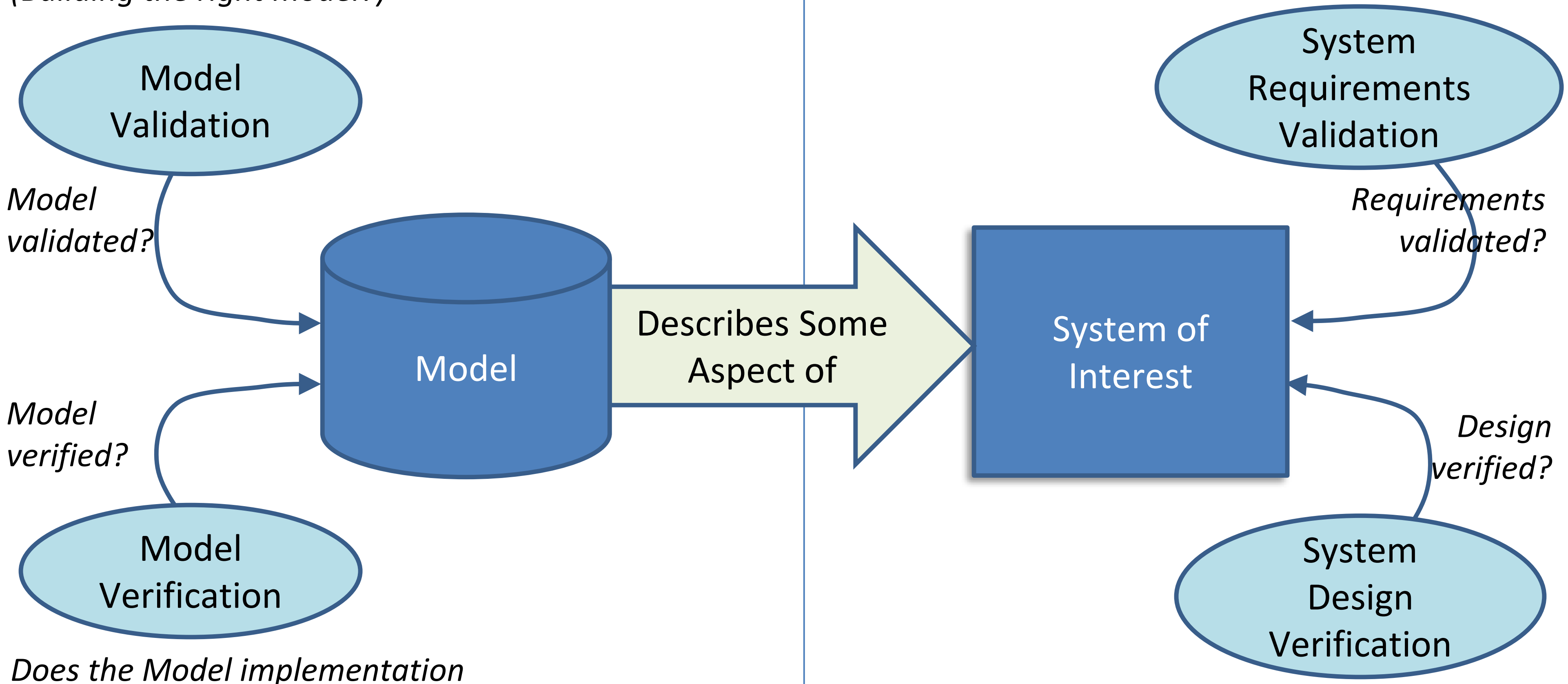
1. Rapidly generate very systematic model requirements for new or existing models, for use in model development, verification, validation, and life cycle management.
2. More effectively plan new or improved models, and know when you need them, versus making use of existing model assets.
3. Lower the experience threshold needed to plan and manage models, including model VVUQ.
4. More effectively manage large collections of diverse models and related information.
5. Improve access to collections of models by exposing their characteristics to users more effectively.
6. More effectively share models across supply chains and regulatory domains.
7. Lower the cost and time necessary to obtain trusted/credible models in regulated or other domains.
8. Use or manage models that were generated by others; increase the range of others who can effectively use models that you generate; reduce the likelihood of model misuse.
9. Improve the accumulation and effective use of model-based enterprise knowledge.
10. Improve the integration of model-related work across specific engineering disciplines and overall systems engineering.
11. Increase ability to manage the integration of multiple computational models (e.g., using FMI), including their integrated VVUQ.

V&V of *Models*, Per Emerging ASME Model V&V Standards

Does the underlying Model adequately describe what it is intended to describe? (Building the right model?)

V&V of *Systems*, Per ISO 15288 & INCOSE Handbook

Do the System Requirements describe what stakeholders need? (Planning the right system?)



Does the Model implementation adequately represent what the underlying Model described? (Implementing the model right?)

Does the System Design define a solution meeting the System Requirements? (Implementing the system right?)

Don't forget: A model (on the left) <u>may</u> be used for system verification or validation (on the right!)

Model Feature Groups: Configurable for Specific Models

Model Identity and Focus

Identifies the main subject or focus of the model.

Model Scope and Content

Describes the scope of content of the model.

Model Utility

Describes the intended use, user, utility, and value of the model.

Model Credibility

Describes the credibility of the model.

Model Life Cycle Management

Describes the related model life cycle management capabilities.

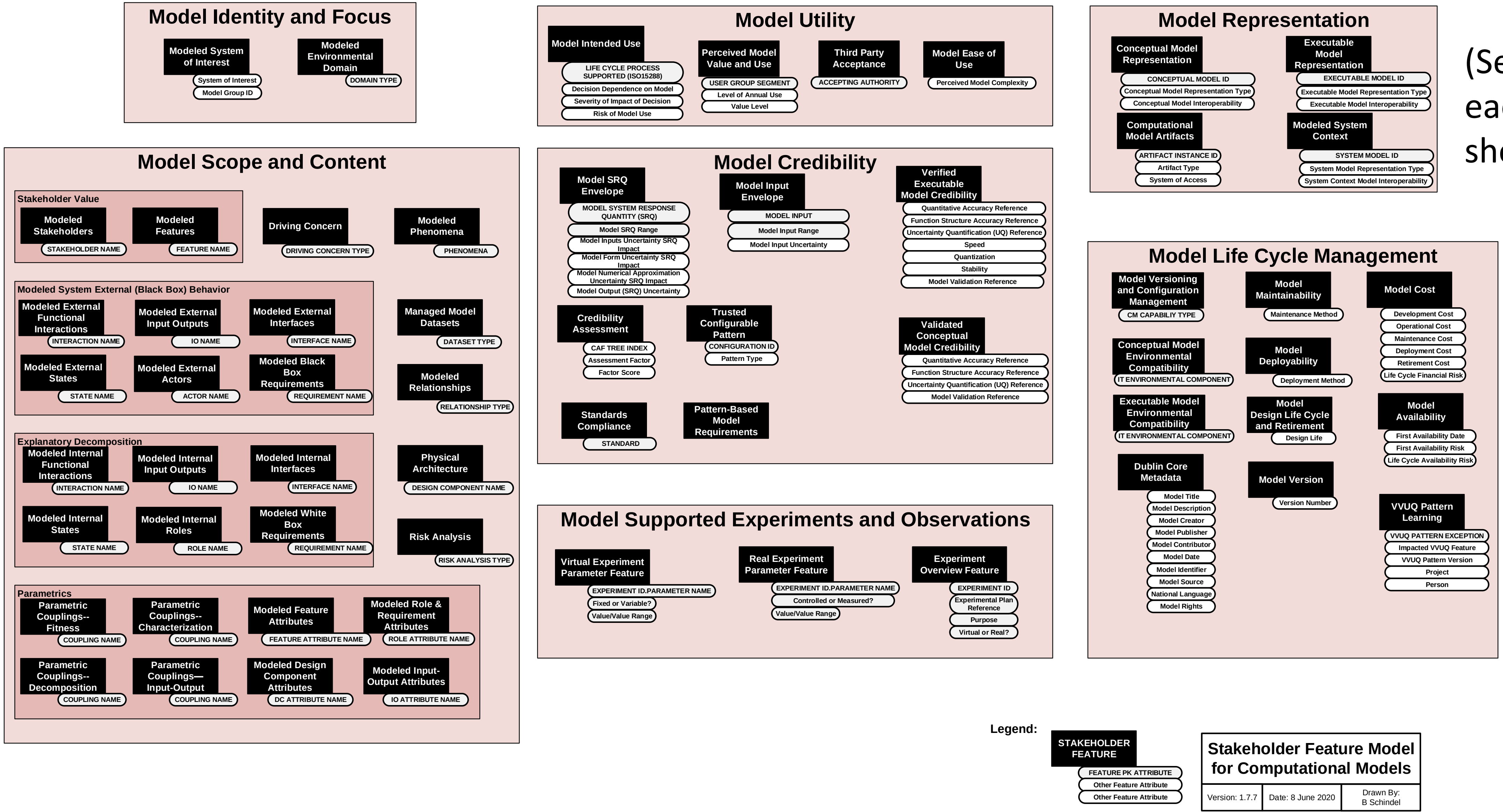
Model Representation

Describes the representation used by the model, along with related artifacts.

Model Supported Experiments and Observations

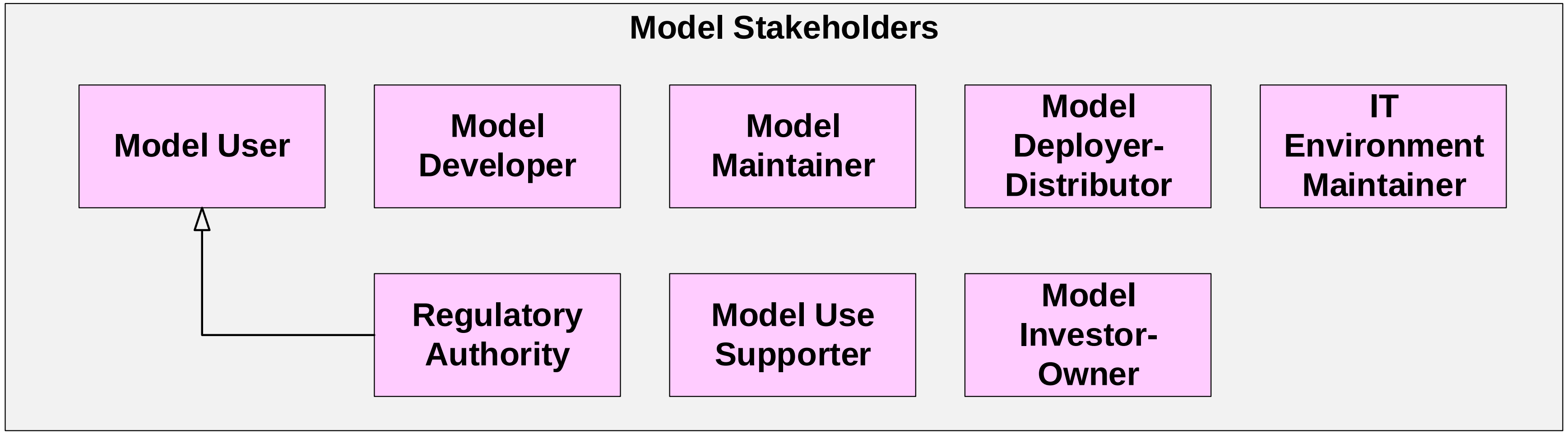
Describes the experimentation and observation related to creating and supported by the model, but does not cover the ability to perform those experiments

Configurable MCP Feature Groups for Models (Computational Model's Stakeholder Requirements)



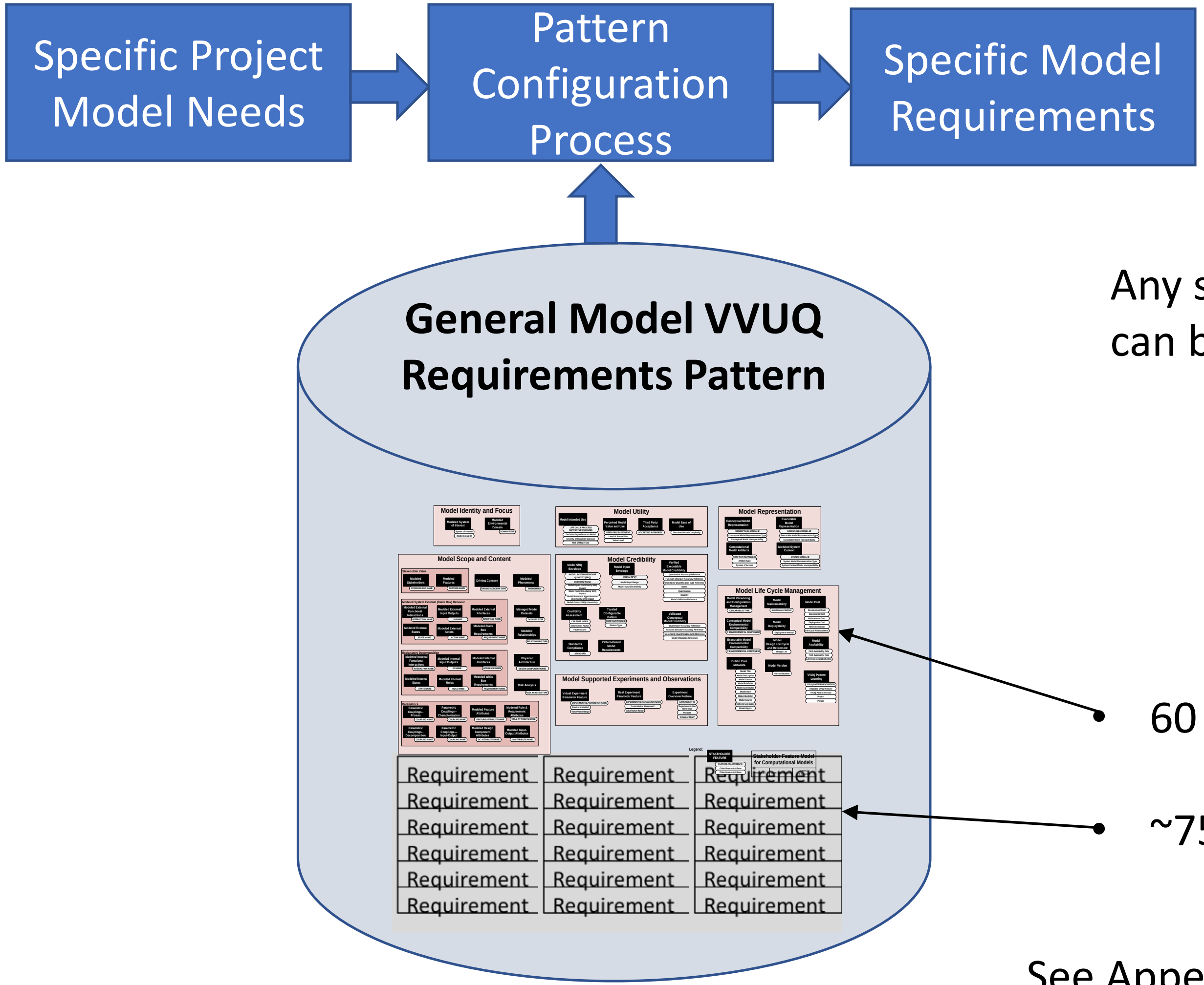
(See definitions of each Feature shown.)

Stakeholders for Models



Model Stakeholder Type	Definition
Model User	A person, group, or organization that directly uses a model for its agreed upon purpose. May include technical specialists, non-technical decision-makers, customers, supply chain members, regulatory authorities, or others.
Model Developer	A person who initially creates a model, from conceptualization through implementation, validation, and verification, including any related model documentation. Such a person may or may not be the same as one who subsequently maintains the model.
Model Maintainer	A person who maintains and updates a model after its initial development. In effect, the model maintainer is a model developer after the initial release of a model.
Model Deployer-Distributor	A person or organization that distributes and deploys a model into its intended usage environment, including transport and installation, through readiness for use.
Model Use Supporter	A person who supports or assists a Model User in applying a model for its intended use. This may include answering questions, providing advice, addressing problems, or other forms of support.
Regulatory Authority	An organization that is responsible for generating or enforcing regulations governing a domain.
Model Investor-Owner	A person or organization that invests in a model, whether through development, purchase, licenses, or otherwise, expecting a benefit from that investment.
IT Environment Maintainer	A person or organization that maintains the IT environment utilized by a computational model.

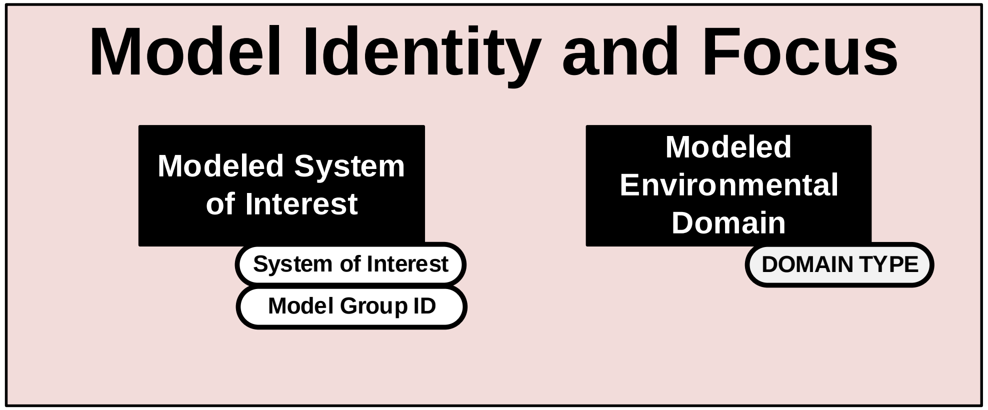
Configurable MCP Technical Requirements for Models



Any system modeling tool enabled with the S*Metamodel can be used for this process.

- 60 Model Stakeholder Requirements
- ~75 Model Technical Requirements

See Appendix II for each of the Technical Requirements)



In ASME V&V50 subcommittee work, the Modeled System of Interest above typically focuses on a <u>manufacturing</u> process (including material in process), usually relating it to some <u>manufactured product</u>.

Features	Feature Attribute	Attribute Definition	Possible Value(s)
Model Identity and Focus: Identifies the main subject or focus of the model			
Modeled System of Interest			
Identifies the type of system this model describes.	System of Interest	Name of system of interest, or class of systems of interest	
	Model Group ID	Identifies the Model Group, if any, to which the model belongs.	
Modeled Environmental Domain			
Identifies the type of external environmental domain(s) that this model includes.	Domain Type(s)	Name(s) of modeled domains (manufacturing, distribution, use, etc.)	

References—with download links

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