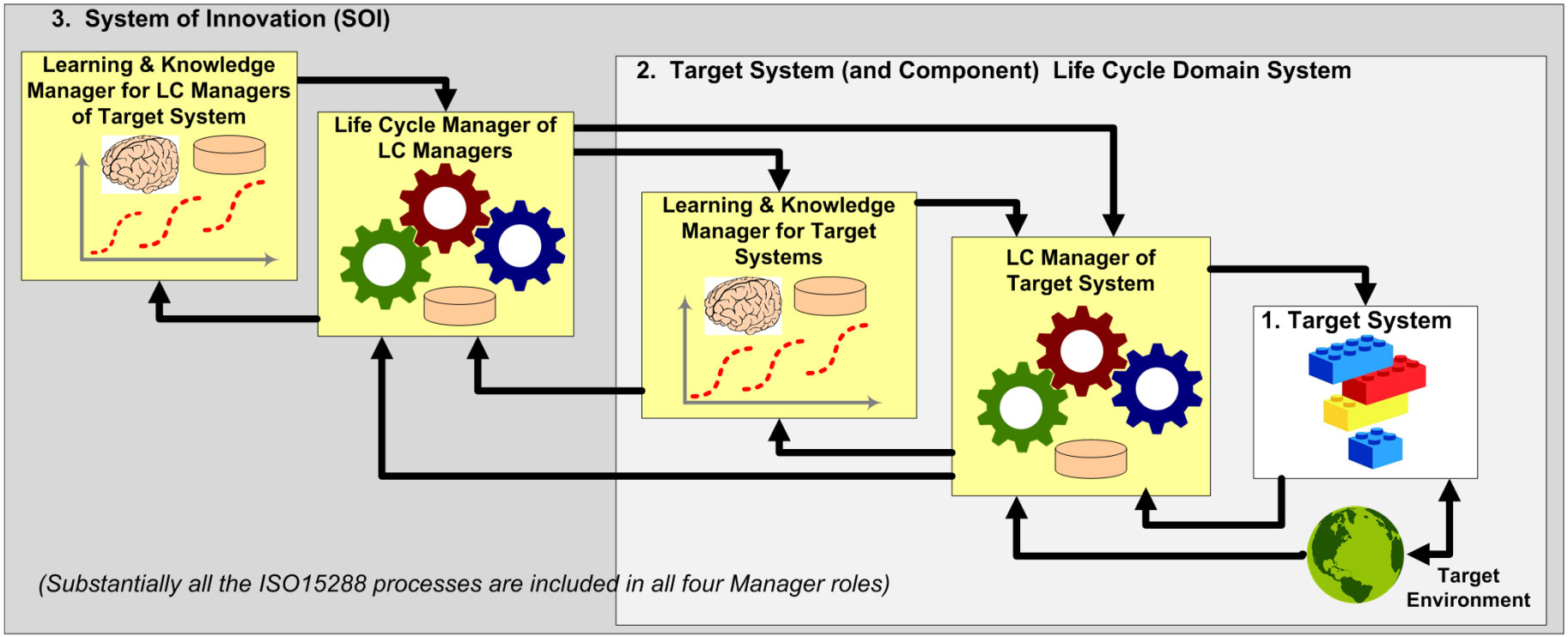
Track 1 (MBSE) Data Collection—Using Model-Based Facilitation



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V1.6.1

Contents

- Purpose and Scope
- Intended Audience
- Assumed Background and Sources
- Construct Relationships, in Brief
- ET 2016 Discussion Data Collection Annotation
- MBSE in Life Cycle Management Processes
- Electrical Power Domain
- General Critical Infrastructure Domain
- Subsequent Planning Discussions

- References and Attachments

Purpose and Scope

- Capture a visual summary of key points from the Energy Tech 2016 session attendees, presenters, and panelists.
- Limited to Track 1 (MBSE in Critical Infrastructure).
- Organized and interrelated by the framework of the INCOSE ASELCM Pattern, including S1/S2/S3 framework specializations for the Electrical Grid in general and Critical Infrastructure in general.
- Used to summarize Track 1 to other Track participants, during ET Nov. 30 concluding and synthesis session.
- Also as a record communicated for follow up in post-conference activities.
- And, to illustrate the potential value of this approach for organizing other related information in the future.
- Only using the top level subsets of the ASELCM Pattern, as an organizing framework or ontology relating subjects of interest--not the underlying detailed ASELCM Model, and not the details found in the session presenter's slides.

Intended Audience

- ET 2016 Attendees
- Also for use by ET 2016 Attendees summarizing covered aspects to other interested parties:
  - INCOSE members across multiple Working Groups (CIPR, Patterns, Agile, Model Life Cycle, others), Teams (MBSE Initiative, MBE Transformation, and Chapters)
  - Members of other CIPR-interested teams, societies (IEEE, InfraGuard, VVI)

Assumed Background and Sources

Awareness of the following subject matter and constructs is helpful:

- Electrical Power or Critical Infrastructure Domains
- System Life Cycle Mgmt. Processes of ISO 15288 / SE Handbook
- Model-Based Systems Engineering (MBSE):
  - Including S*Metamodel
- Pattern-Based Systems Engineering (PBSE) and related S*Patterns:
  - INCOSE Agile SE Life Cycle Management (ASELCM) S*Pattern
  - Embedded Intelligence (System Management) S*Pattern

- Related background information sources:
  - ET2016 Session Presenter Materials (conference proceedings)
  - References section herein

Construct Relationships, in Brief

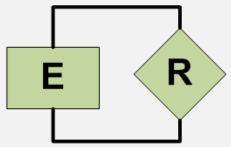
More General

More Specific

Emergence of Patterns from Patterns: S*Pattern Class Hierarchy

Definition of **Relational Modeling Paradigm**

Entity-Relationship Paradigm

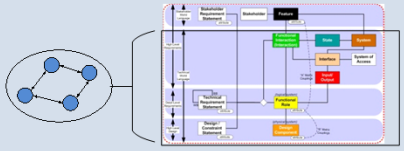


E=Entity
R= Relationship

Structured or unstructured semantic web

Minimal System S*Metamodel: Definition of (Elementary) System, Material Cause

S*Metamodel Core



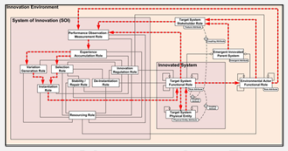
Core S*Metamodel

Smallest model of a system, for engineering or science

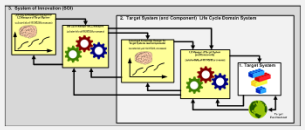
Emergence & Definition of **System of Innovation**, Fitness, Value, Purpose, Stakeholders, Agility, Final Cause, Formal Cause, Efficient Cause, Intelligence, Management, Science, Living Systems

EI Pattern, SOI Pattern, Fitness, Value

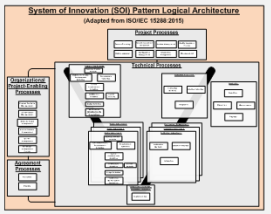
S*Purpose, Fitness, Value



System of Innovation Pattern



Agile Sys Life Cycle Pattern



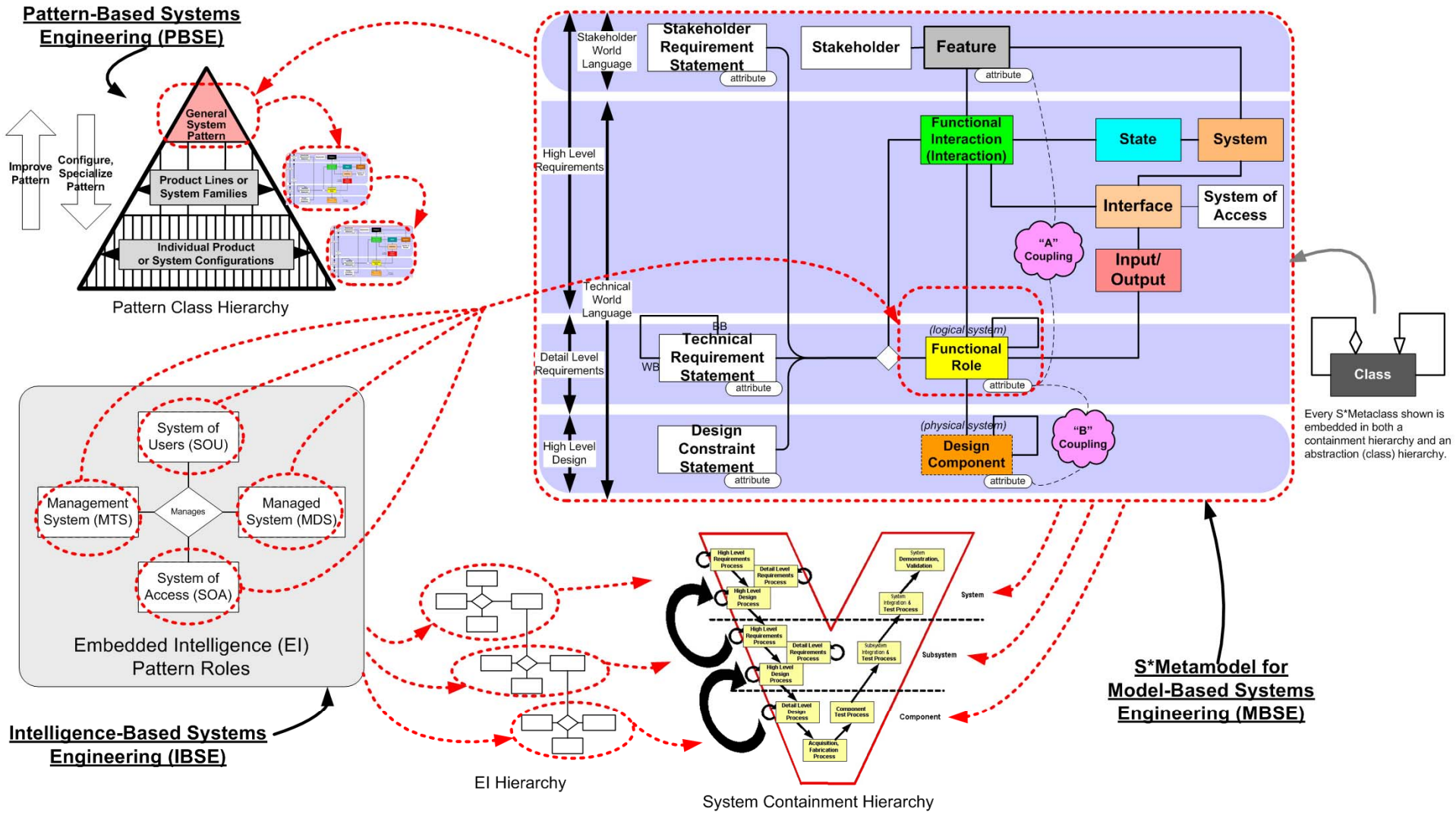
ISO 15288 System Life Cycle Mgmt Pattern

Emergence & Definition of **Domain Specific Systems**

Domain Specific Pattern

- Terrestrial Vehicle Domain Pattern
- Manufacturing System Pattern
- Product Service System Pattern
- Space Tourism Pattern
- Electrical Power Domain Pattern
- Aircraft Flight Control Pattern
- Medical Device Pattern
- Distribution System Pattern
- Socio-Technical Pattern
- Critical Infrastructure Domain Pattern

See also: References section



See also: References section

ICTT System Sciences	S* Metamodel–Summary View, for MBSE, PBSE, and IBSE 04-28-11 V1.5.9 Systematica Release 4.0	Systematica™ Do more with less

ET 2016 Discussion Data Collection Annotation

- What improved agility or MBSE use "results"?
  - In the domain models, marked the highest cases of:

Sticky Dots

Needs for improved future results (even if most difficult)

Opportunities for improved future results (low-hanging fruit)

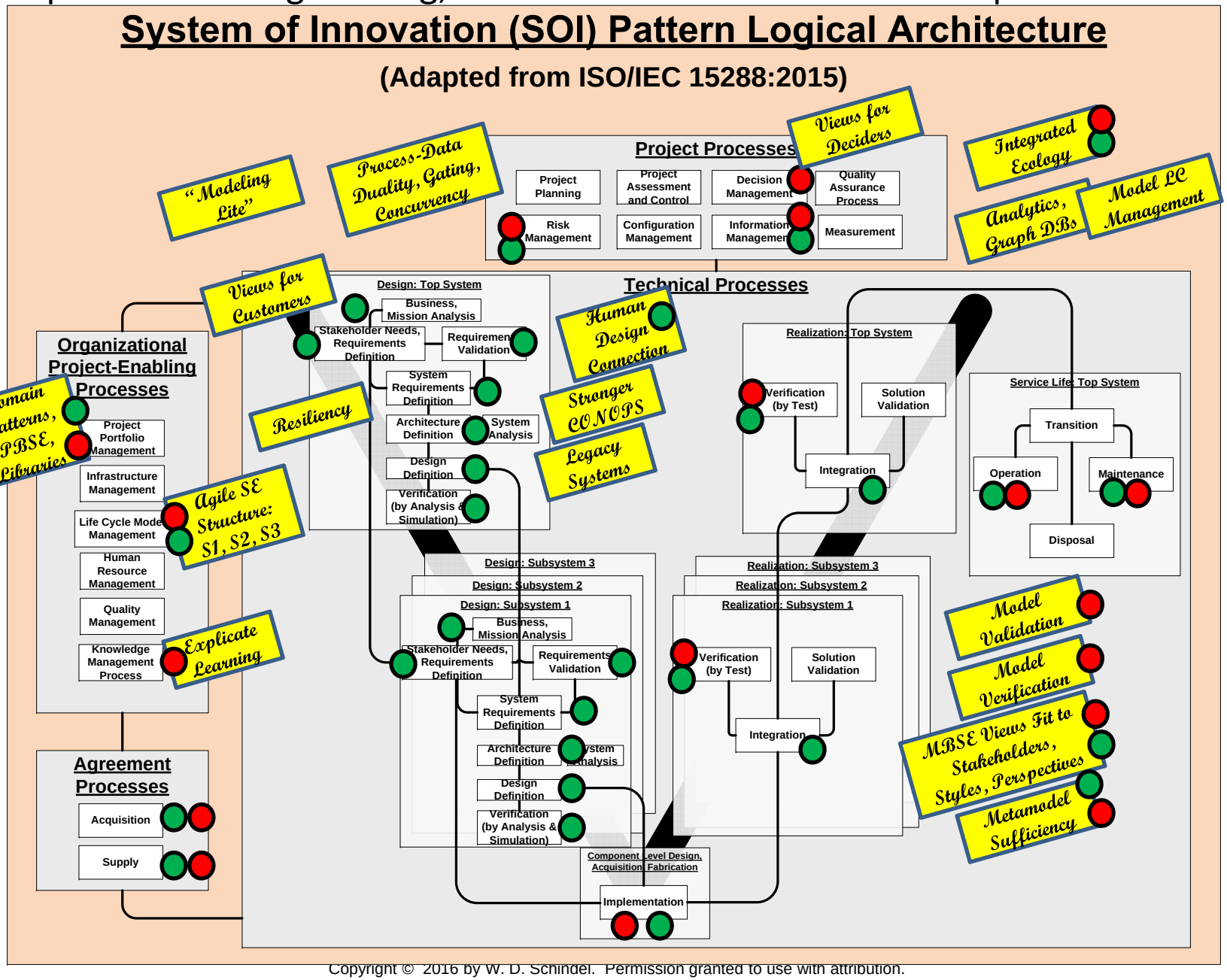
Already accomplished examples of improved results progress (e.g., requirements engineering, simulation, etc.)

In the domain model, identify potential corrections or improvements to the model / framework.

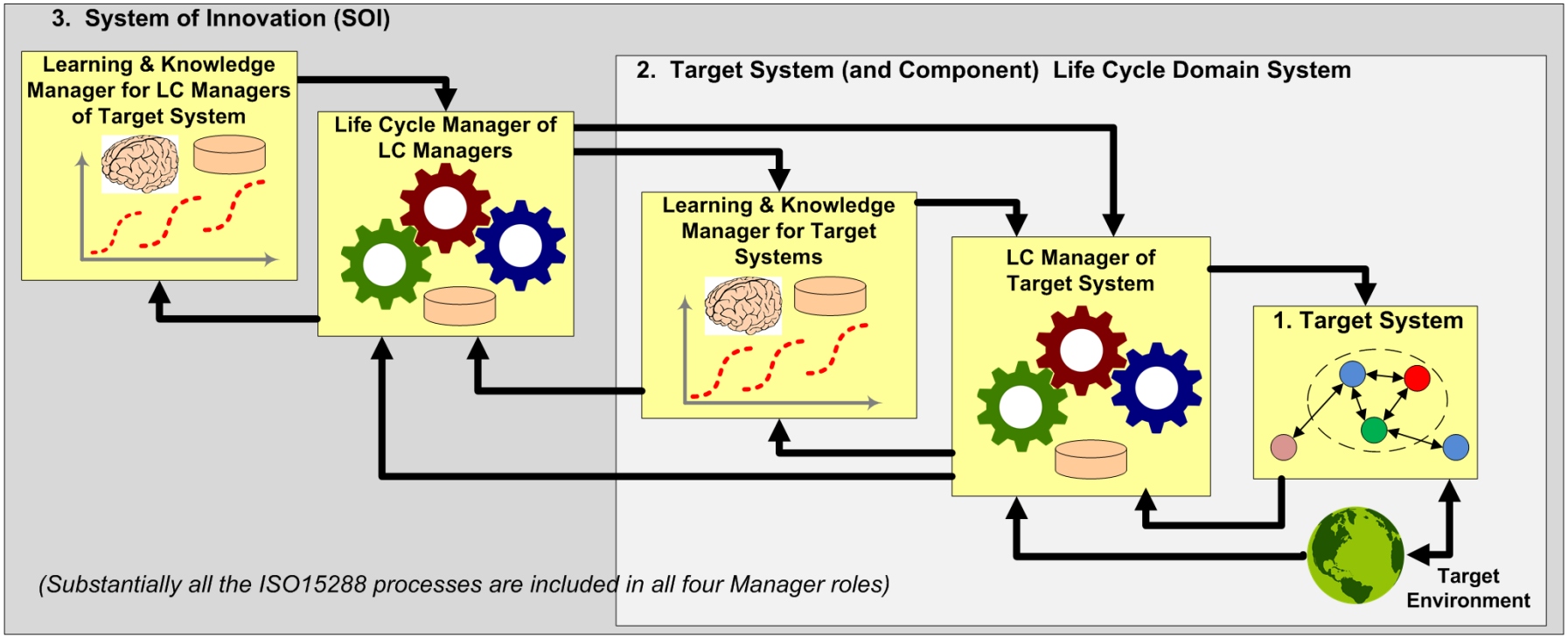
RESULTING ANNOTATIONS FROM ET2016 TRACK 1 ARE ON SLIDES 9, 11, AND 17 OF THIS PACKAGE.

MBSE in Life Cycle Mgmt. Procs: System 2 & 3 Feedback

(not specific to CI engineering; see References for definitions of processes shown)



Logical Architecture of INCOSE Agile Systems Engineering Life Cycle Management (ASELCM) Pattern



For definitions of System 1, 2, and 3, see References

INCOSE Agile System Life Cycle Management Perspective: System 1, 2, 3 Framework

INCOSE Patterns Working Group
Bill Schindel
V1.2.1 11.21.2016

INCOSE MBSE Transformation: Identified MBSE Stakeholders
(from INCOSE transformation strategy)

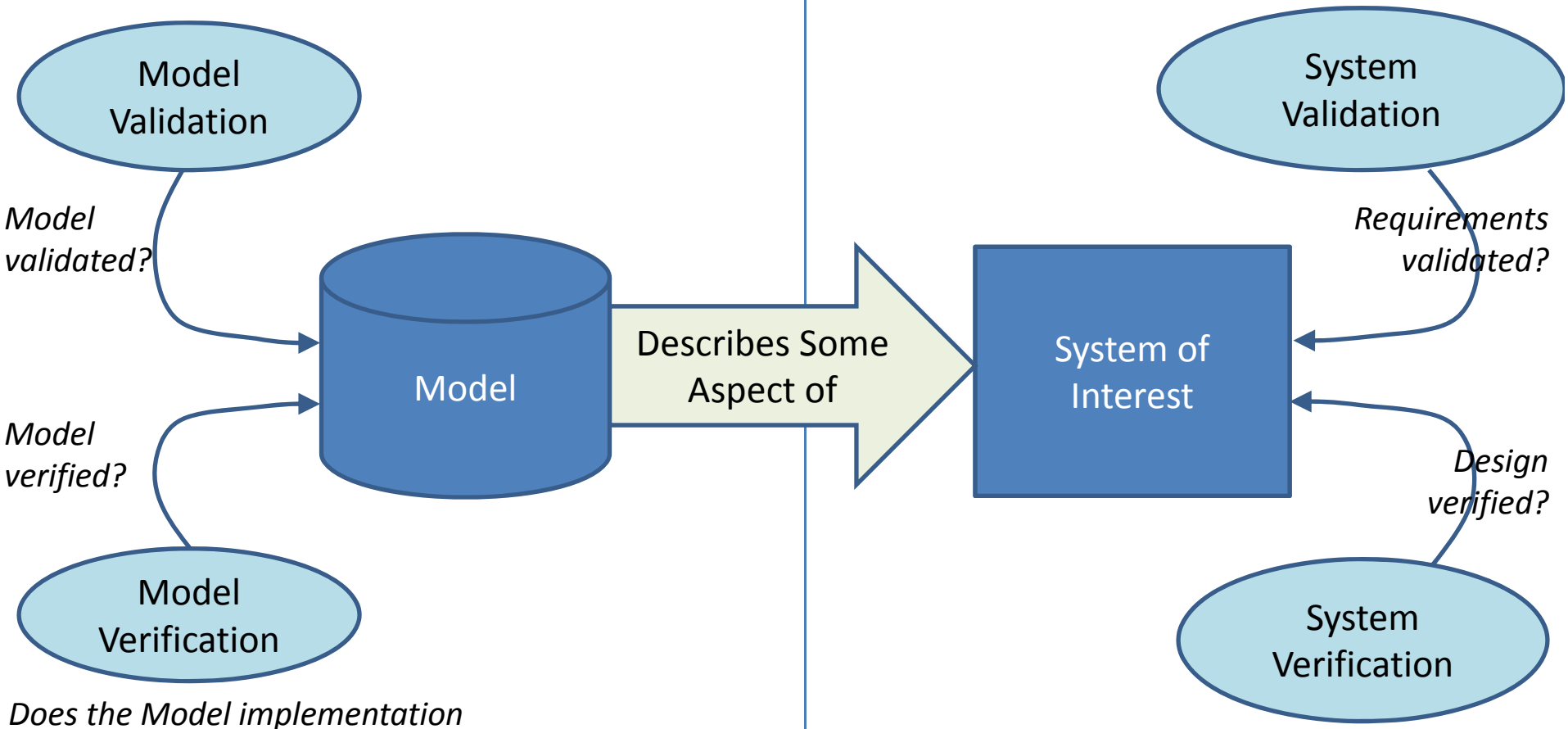
Population <-- Size (Log)	Stakeholders in A Successful MBSE Transformation (showing their related roles and parent organizations)	Industry & Gvmt. Initiatives	Organizations Internalizing MBSE, Including Gvmt Contractors & Commercial	Vendors of MBSE Tooling and Services	Academia and Researchers	Technical Societies, Other Non-Technical Organizations	
Model Consumers (Model Users):							
****	Non-technical stakeholders in various Systems of Interest, who acquire / make decisions about / make use of those systems, and are informed by models of them. This includes mass market consumers, policy makers, business and other leaders, investors, product users, voters in public or private elections or selection decisions, etc.	X	X			X	
**	Technical model users, including designers, project leads, production engineers, system installers, maintainers, and users/operators.	X	X			X	
*	Leaders responsible to building their organization's MBSE capabilities and enabling MBSE on their projects	X	X			X	
Model Creators (including Model Improvers):							
*	Product visionaries, marketers, and other non-technical leaders of thought and organizations	X	X		X	X	
*	System technical specifiers, designers, testers, theoreticians, analysts, scientists	X	X		X	X	
*	Students (in school and otherwise) learning to describe and understand systems				X	X	
*	Educators, teaching the next generation how to create with models	X	X		X		
*	Researchers who advance the practice		X	X	X		
*	Those who translate information originated by others into models	X	X		X	X	
*	Those who manage the life cycle of models	X	X		X	X	
Complex Idea Communicators (Model "Distributors"):							
**	Marketing professionals	X	X	X		X	
**	Educators, especially in complex systems areas of engineering and science, public policy, other domains, and including curriculum developers as well as teachers	X	X	X	X		
**	Leaders of all kinds	X	X	X	X	X	
Model Infrastructure Providers, Including Tooling, Language and Other Standards, Methods:							
*	Suppliers of modeling tools and other information systems and technologies that house or make use of model-based information			X			
*	Methodologists, consultants, others who assist individuals and organizations in being more successful through model-based methods	X	X	X	X		
*	Standards bodies (including those who establish modeling standards as well as others who apply them within other standards)	X				X	
INCOSE and other Engineering Professional Societies							
*	As a deliverer of value to its membership					X	
*	As seen by other technical societies and by potential members					X	
*	As a great organization to be a part of					X	
*	As promoter of advance and practice of systems engineering and MBSE					X	

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

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

Does the Model adequately describe what it is intended to describe?

Do the System Requirements describe what stakeholders need?



Does the Model implementation adequately represent what the Model says?

Does the System Design define a solution meeting the System Requirements?

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

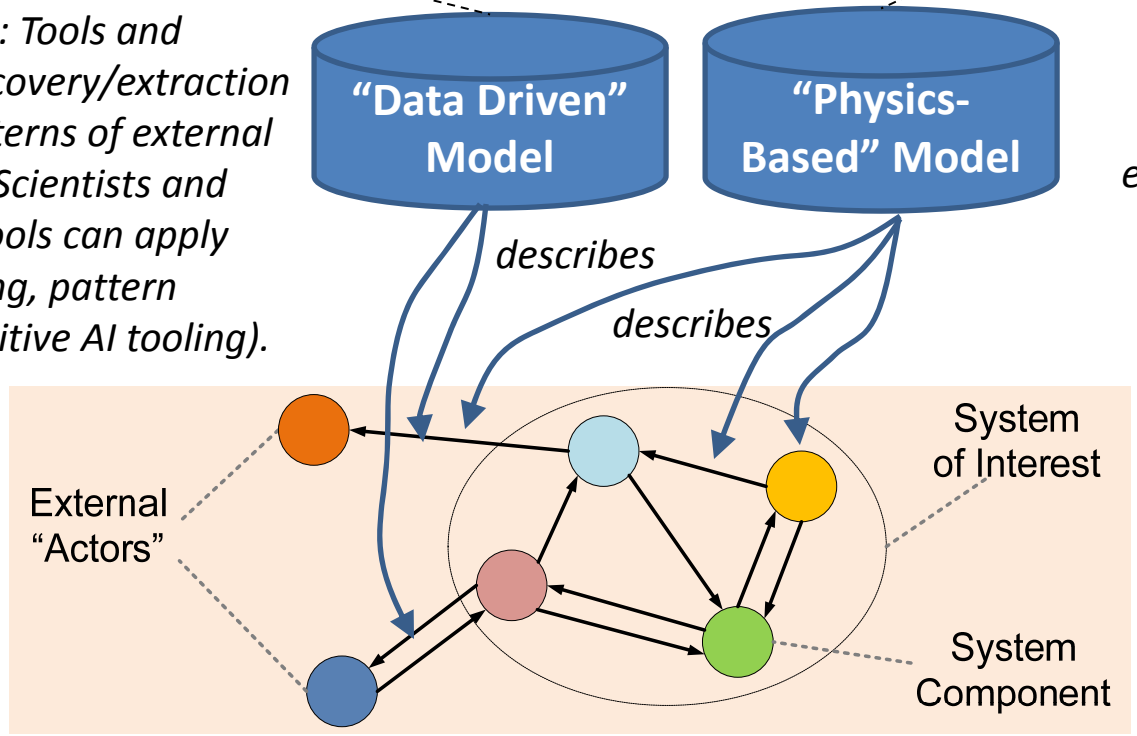
Data Driven Models "Black Box"

What is the behavior of the System of Interest, visible externally to the external actors with which it interacts?

Physics Based "Internal Explanatory" Models

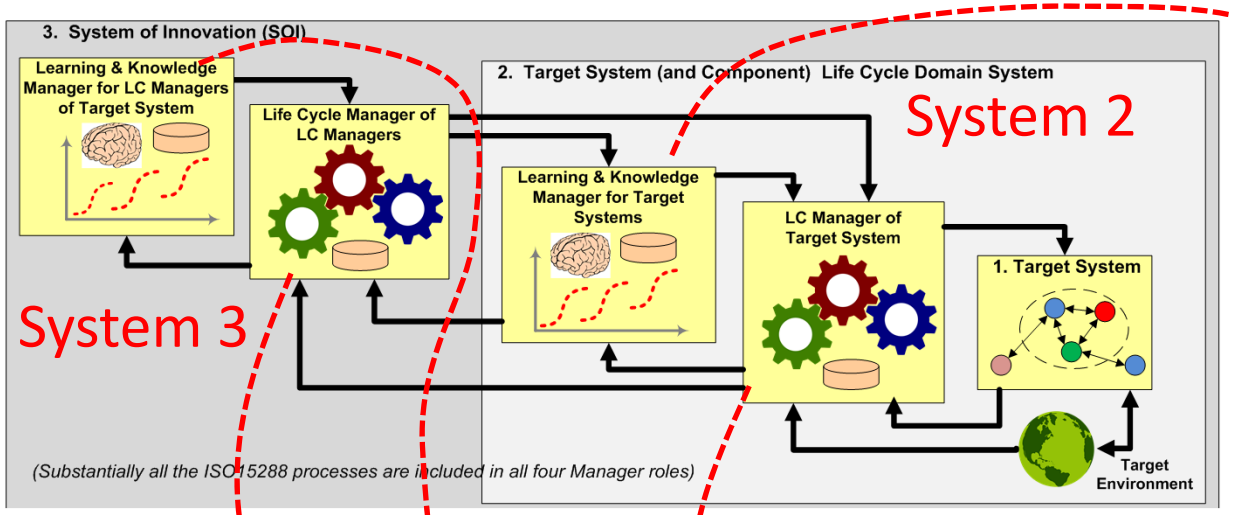
What are the internal interactions of the System of Interest, and how do they combine to cause/explain the behavior that is externally visible as interactions with external actors?

Special interests: Tools and methods for discovery/extraction of recurring patterns of external behavior. Data Scientists and their newer IT tools can apply here (data mining, pattern extraction, cognitive AI tooling).



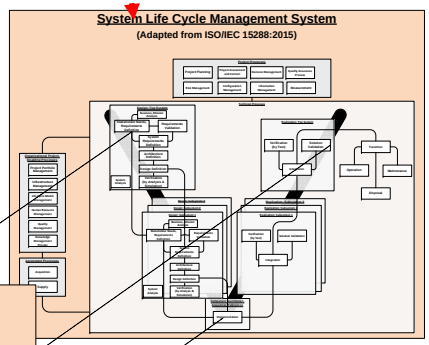
Special interests: The hard sciences physical laws, and how they can be used to explain the externally visible behavior of the System of Interest. Physical Scientists and models from their disciplines can apply here.

When expressed in S*Metamodel framework, the distinction and relationships of these two types of models becomes explicitly clear. It can be seen that this distinction retraces the history of the physical sciences, but with the latest tools. Remember the centuries-earlier studies of the night skies for patterns in the motion of stars and planets, followed later by the explanatory models of Newton and others.



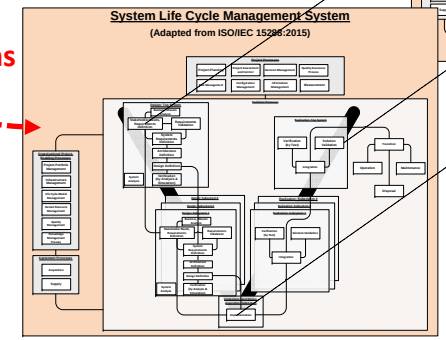
ISO 15288 Processes

Performs most of these ISO processes, to manage what is being learned about S1 space.

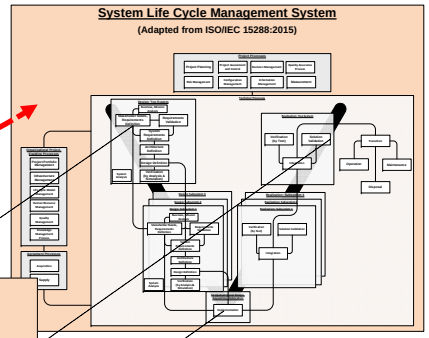


Manages Target System Family Patterns

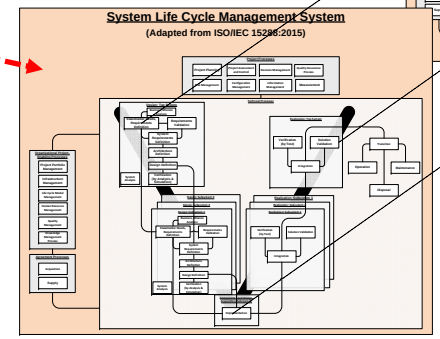
Performs most of these ISO processes, to manage S1 instances , using S1 patterns



Manages LC Management System Family Patterns



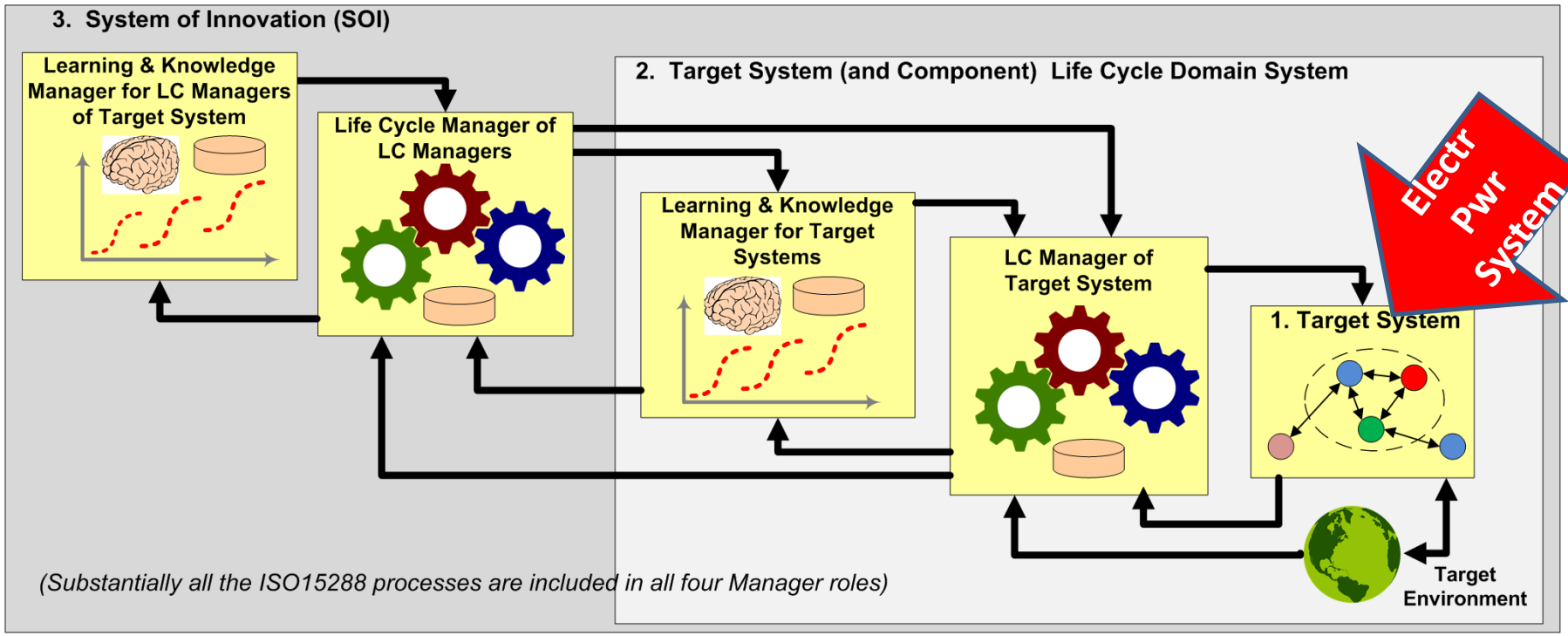
Performs most of these ISO processes, to manage S2 instances , using S2 patterns



Performs most of these ISO processes, to manage what is being learned about S2 space

Systems Engineering and other ISO15288 System Life Cycle Management Processes appear Four Times in the ASELCM Pattern.

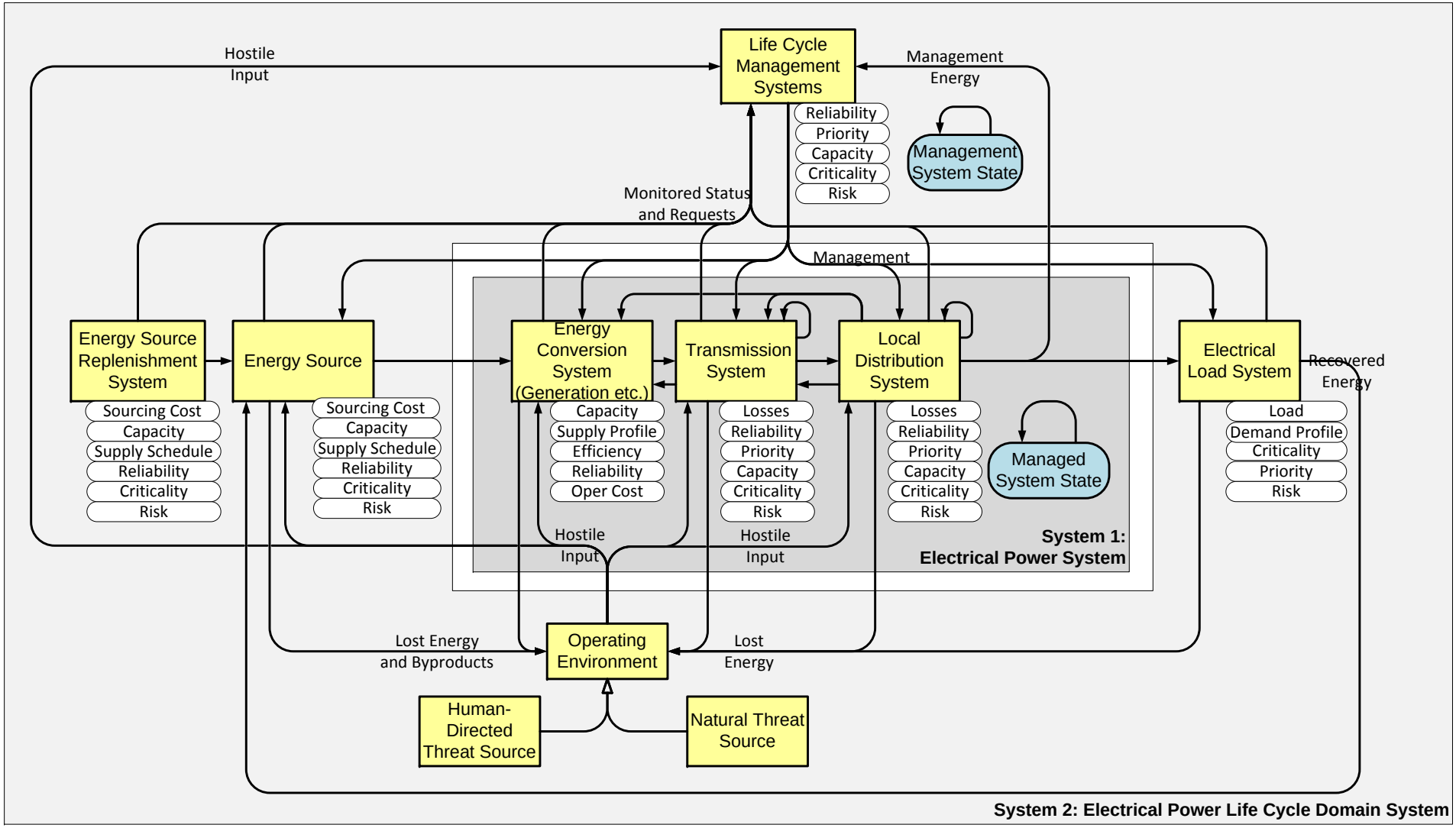
Example Application: Electrical Power Domain



INCOSE Agile System Life Cycle Management Perspective: System 1, 2, 3 Framework

INCOSE Patterns Working Group
Bill Schindel
V1.2.1 11.21.2016

Electrical Power Domain : System 1, System 2



INCOSE Agile System Life Cycle Management Perspective: System 1 & 2 Summary, for Electrical Power Domain

INCOSE Patterns Working Group
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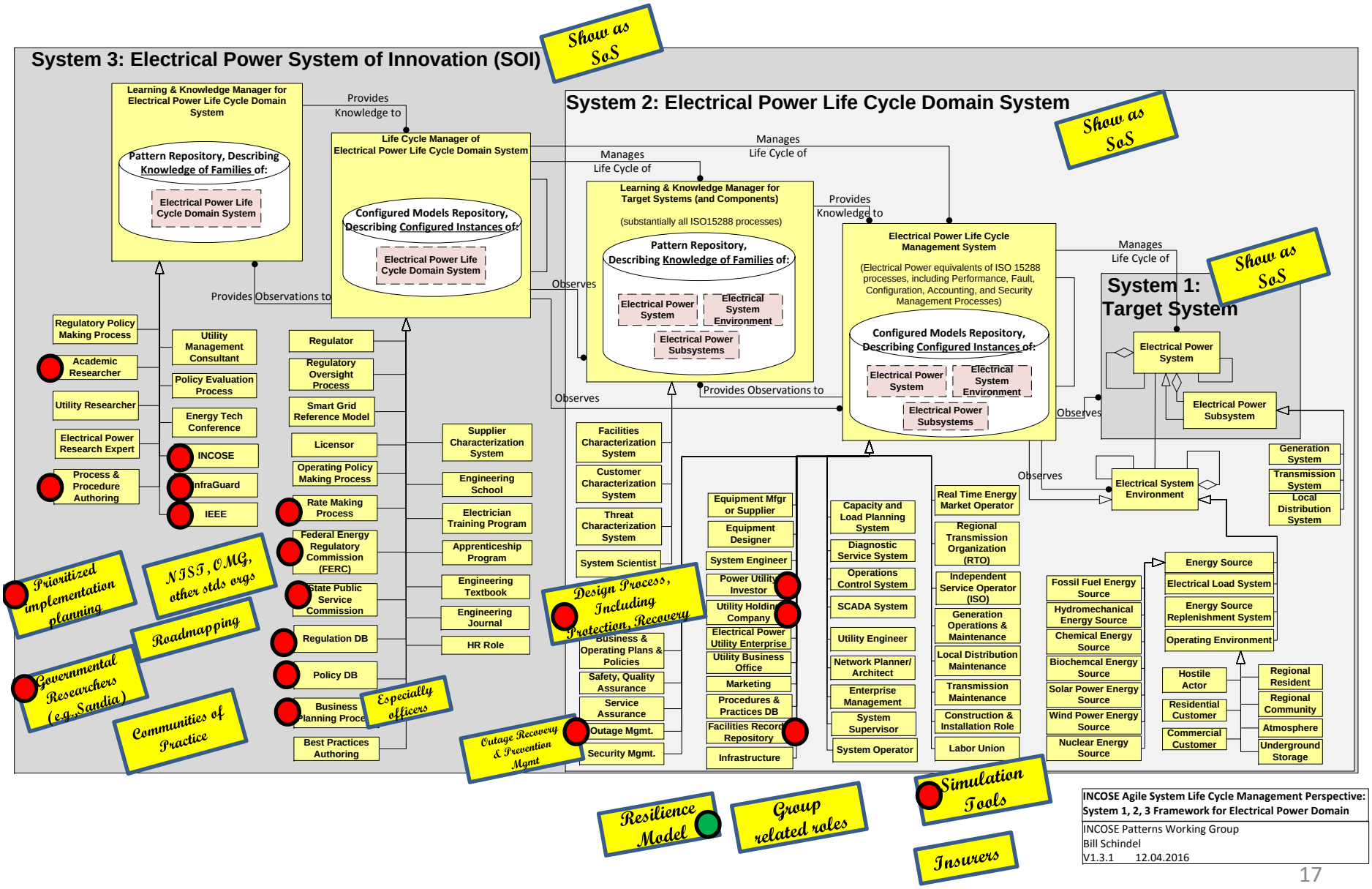
V1.3.2 12.04.2016

Electrical Power Domain : System 2, System 3



INCOSE Agile System Life Cycle Management Perspective: System 1, 2, 3 Framework for Electrical Power Domain
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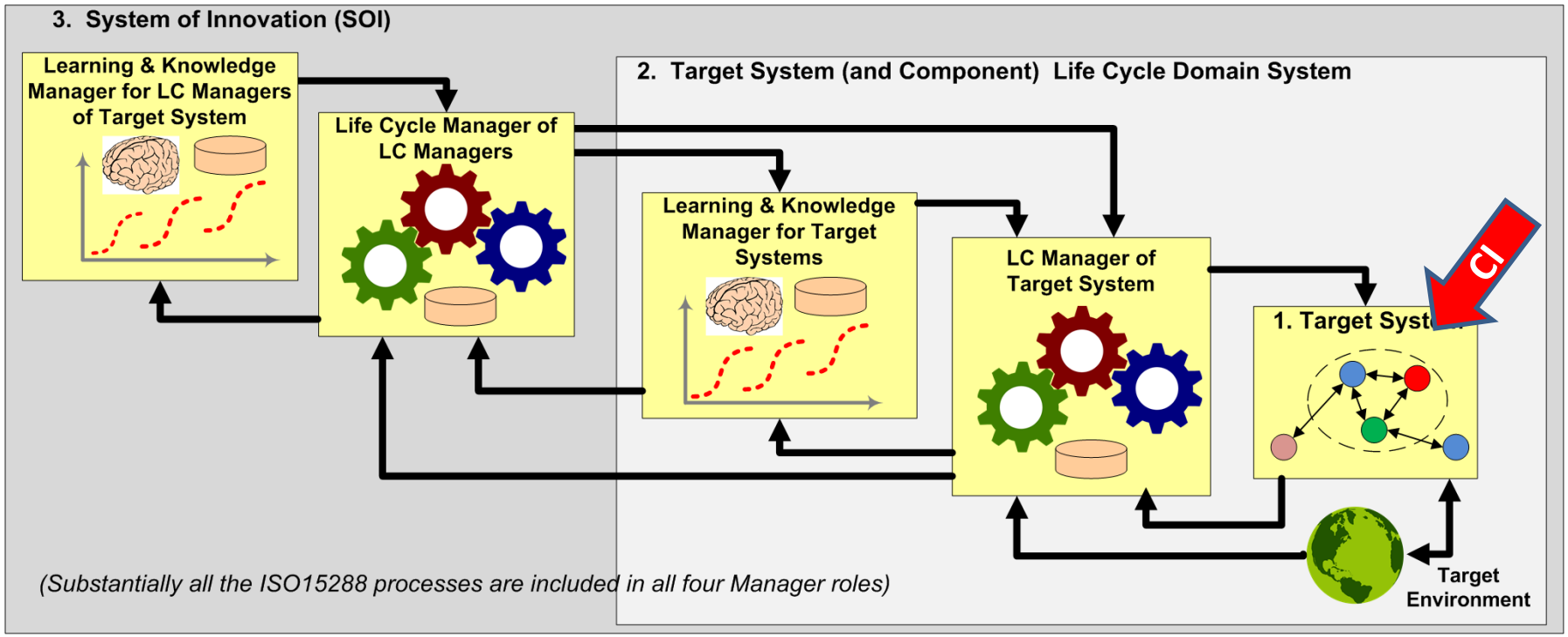
More General Example Application: Critical Infrastructure (CI) Systems Domain



INCOSE Agile System Life Cycle Management Perspective: System 1, 2, 3 Framework

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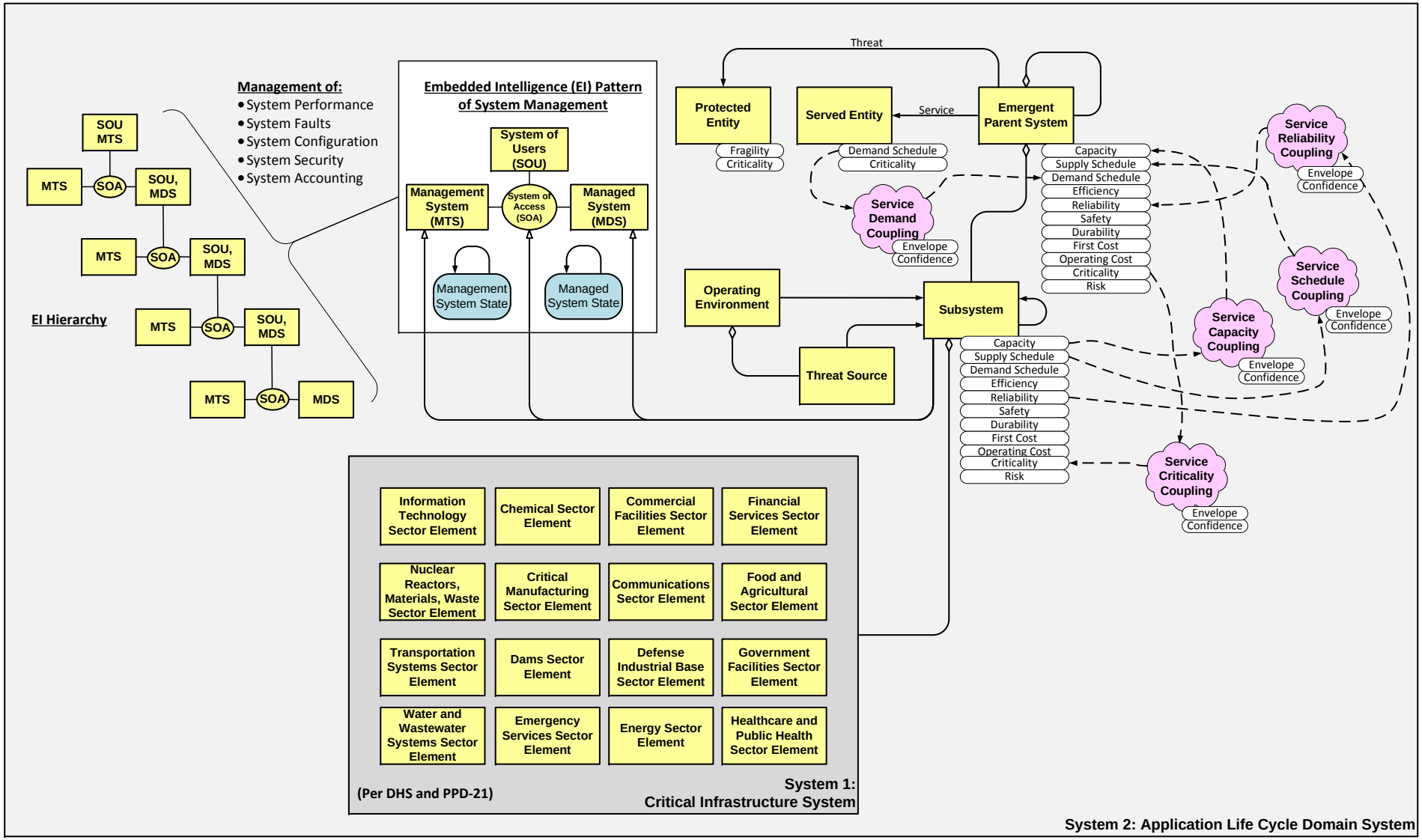
CI Systems Domain : System 1, System 2



INCOSE Agile System Life Cycle Management Perspective: System 1 & 2 Summary, for Critical Infrastructure Domain
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Subsequent Planning Discussions

- This framework was applied during the ET2016 Conference primarily to capture, organize, relate, and summarize the issues discussed there in Track 1 (MBSE).
- In the subsequent Track 1, 2, 3, 4, 5 synthesis discussion at ET2016, it was agreed to discuss in the future the further application of this framework to the interests of CIPR.

References and Attachments

1. Bill Schindel and Rick Dove, "Introduction to the Agile Systems Engineering MBSE Pattern", in *Proc. of the INCOSE 2016 International Symposium*, 2016.
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