



2021
Annual **INCOSE**
international workshop
Virtual Event
January 29 - 31, 2021

Premier Systems Engineering Workshop

Schema, Metamodels, and Ontologies, Oh My!

www.incose.org/iw2021/

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17 July 1969

MILITARY STANDARD
SYSTEM ENGINEERING MANAGEMENT



AFLC-WPAFB-DEC 69 500

ANSI
ANSI Z39-18-1999
APPROVED: JANUARY 1999
REAFFIRMED: SEPTEMBER 2003

**GEIA
STANDARD**

EIA-632
Processes for Engineering and Software Development

EIA-632
(Upgrade and Revision of EIA-602)

JANUARY 1999

GOVERNMENT ELECTRONIC
INFORMATION TECHNOLOGY

GEIA

INTERNATIONAL
STANDARD

**ISO/IEC
26702**

IEEE
Std 1220-2005

INTERNATIONAL
STANDARD

**ISO/IEC
15288**

IEEE
Std 15288-2008

Second edition
2008-02-01

**Systems and software engineering —
System life cycle processes**

*Ingénierie des systèmes et du logiciel — Processus du cycle de vie
du système*

Carnegie Mellon
Software Engineering Institute
Pittsburgh, PA 15213-3890

**CMMI® for Development,
Version 1.2**

CMMI-DEV, V1.2

CMU/SEI-2008-TR-008
ESC-TR-2006-008

Improving processes for better products

CMMI Product Team

August 2006

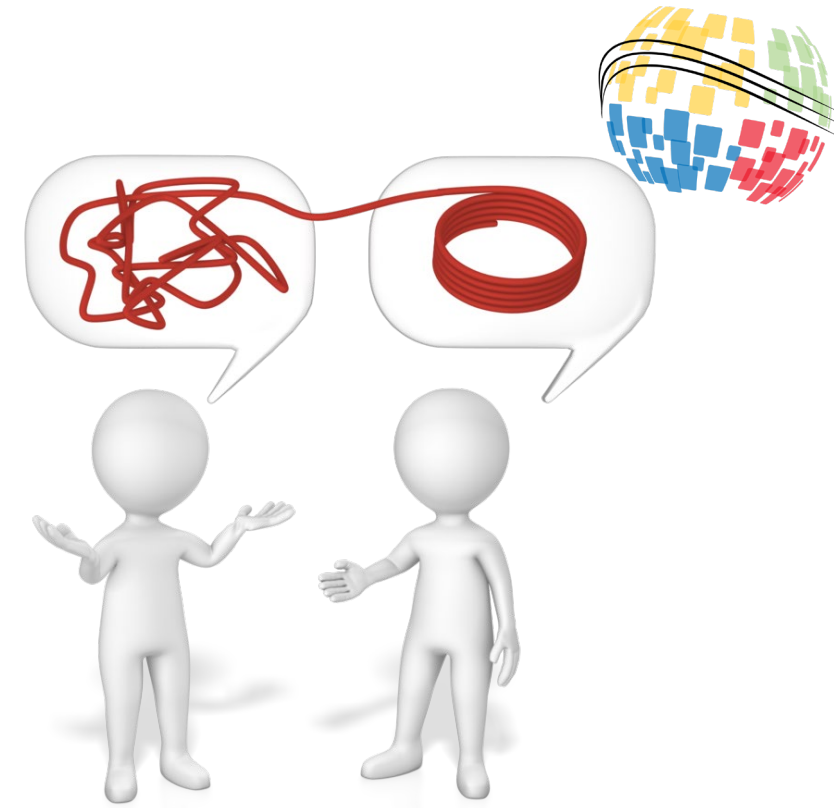


Moving from Ambiguity to Clarity, “One Idea in One Place”

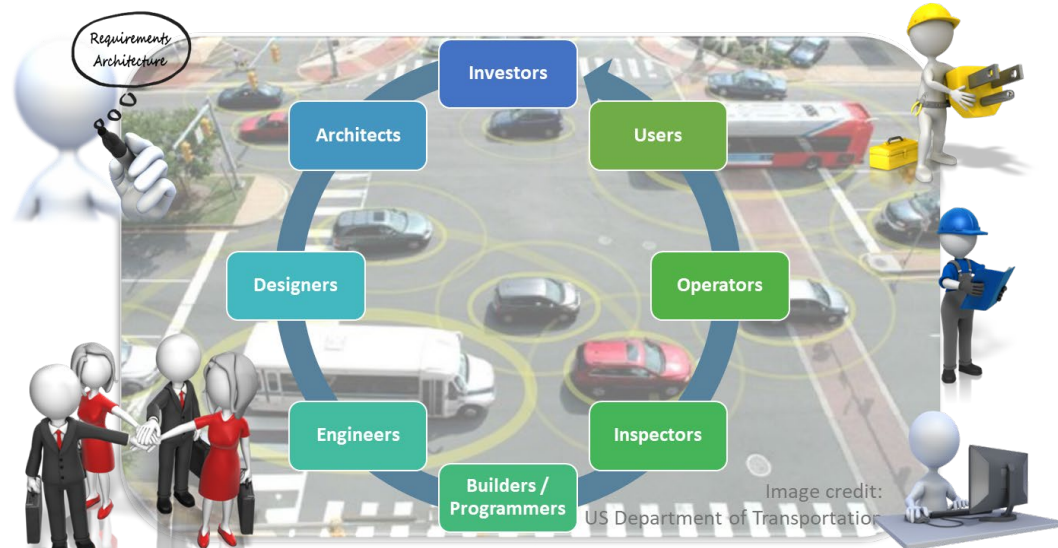


EXPLICIT > IMPLICIT

CLARITY > AMBIGUITY



ACCURACY || PRECISION





Ontology, Metamodel, and Schema

Ontology: a set of concepts and categories in a subject area or domain that shows their properties and the relations between them

Oxford Languages

Metamodel: a model which is intended to give an all-inclusive picture of a process, system, etc., especially by abstracting from more detailed individual models contained within it

Oxford Languages

Schema: the organization of data as a blueprint of how the database is constructed

Wikipedia





Setting the Right Context

FOUNDATION

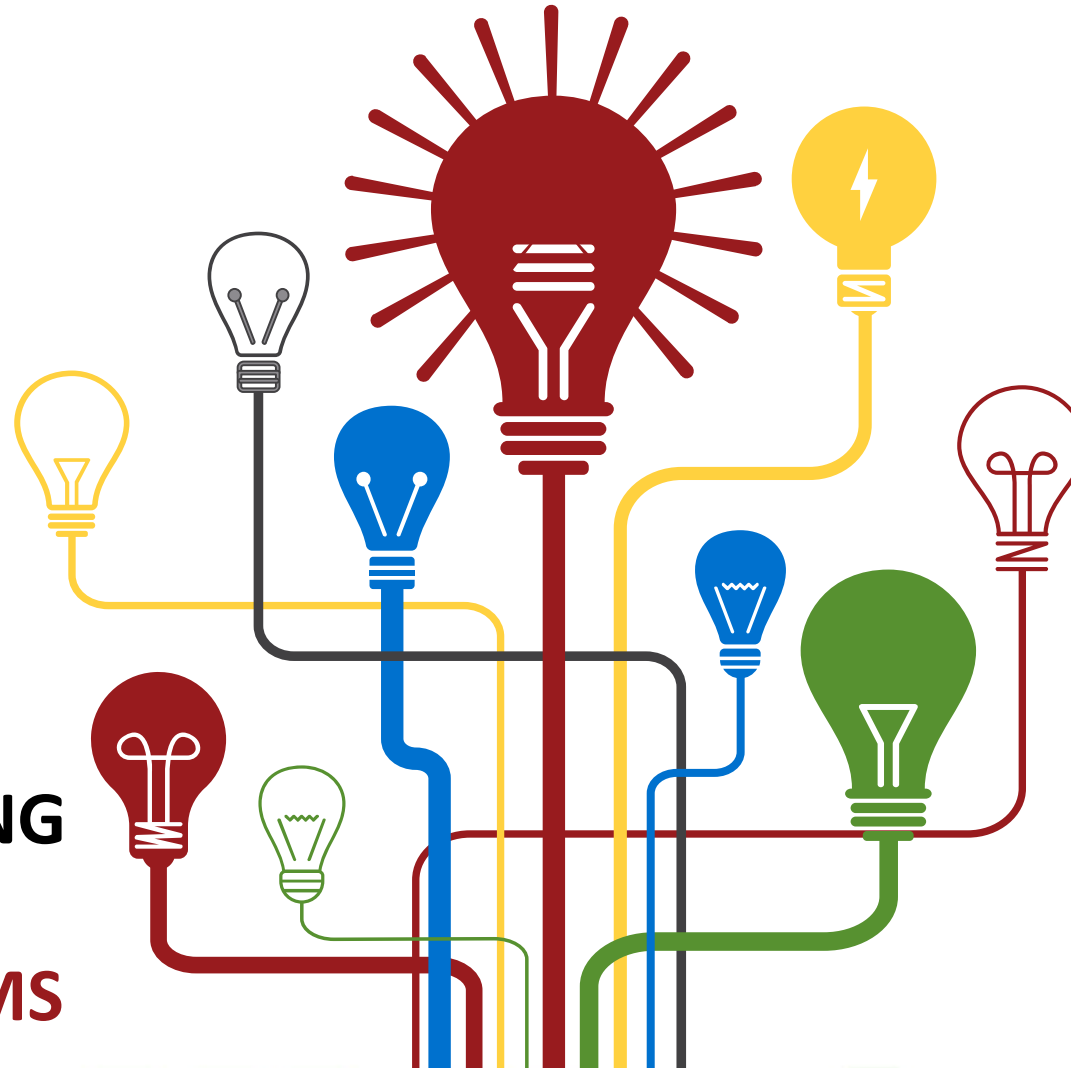
EDUCATION

INTERCHANGE

INTEROPERABILITY

HUMAN

MACHINE



SYSTEMS ENGINEERING

ENGINEERING SYSTEMS



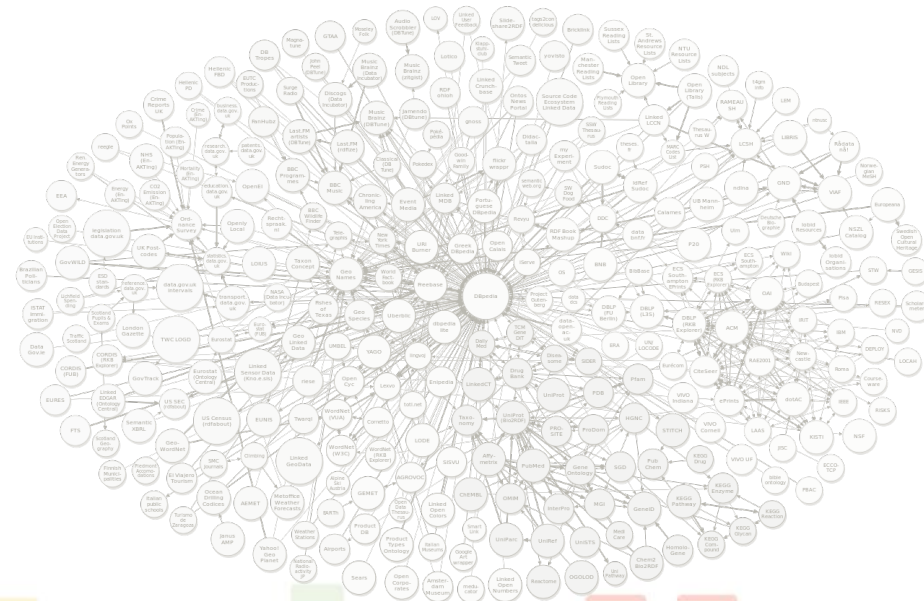


Avoiding the Perils of the Extremes



“For every complex problem, there is an answer that is clear, simple, and wrong”

H.L. Mencken





Towards an Essential Systems Metamodel or Sparse Information Model or Minimal Systems Ontology or ...

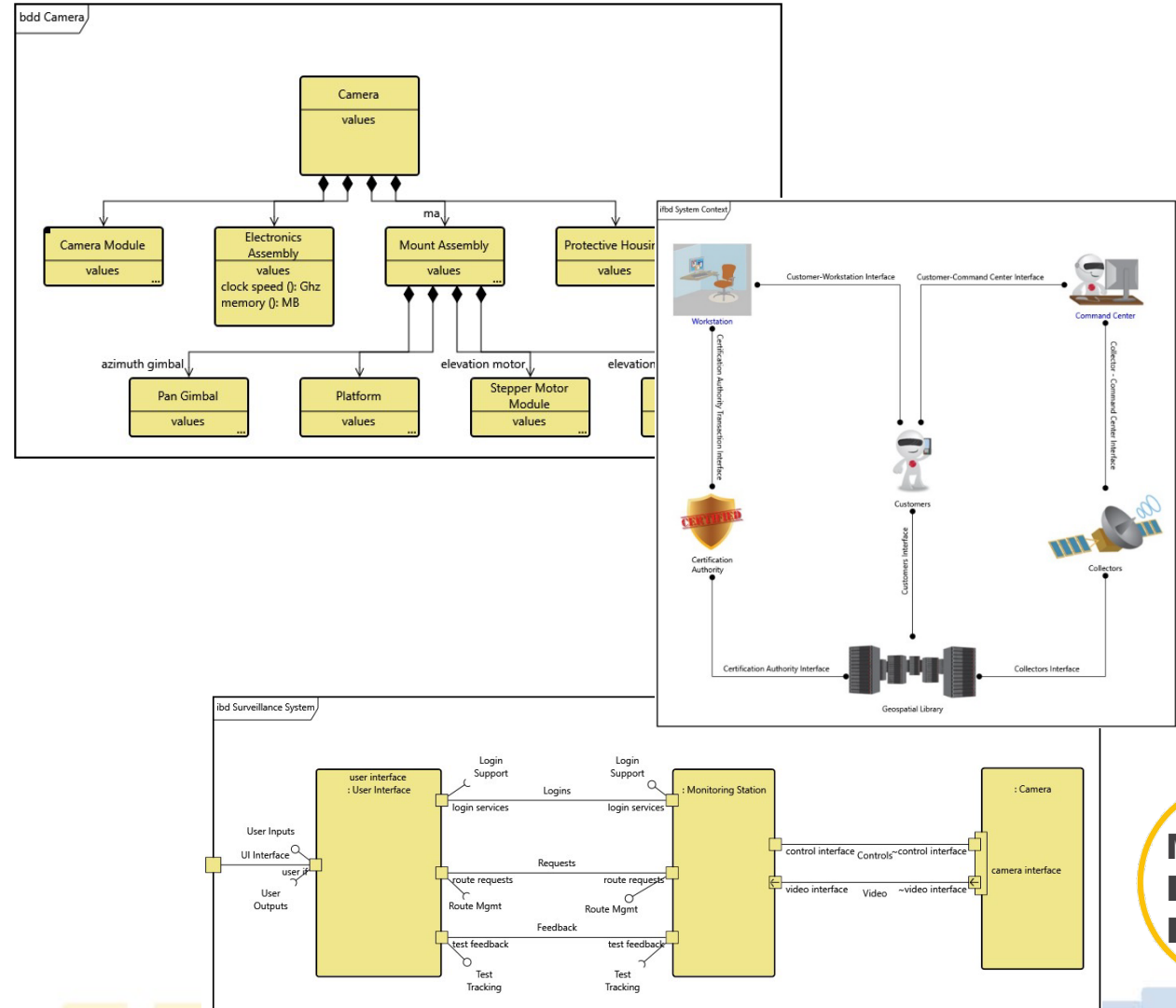
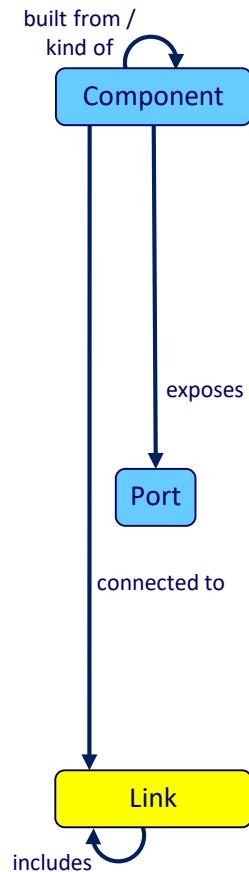




Understanding the Systems Metamodel

Color Code

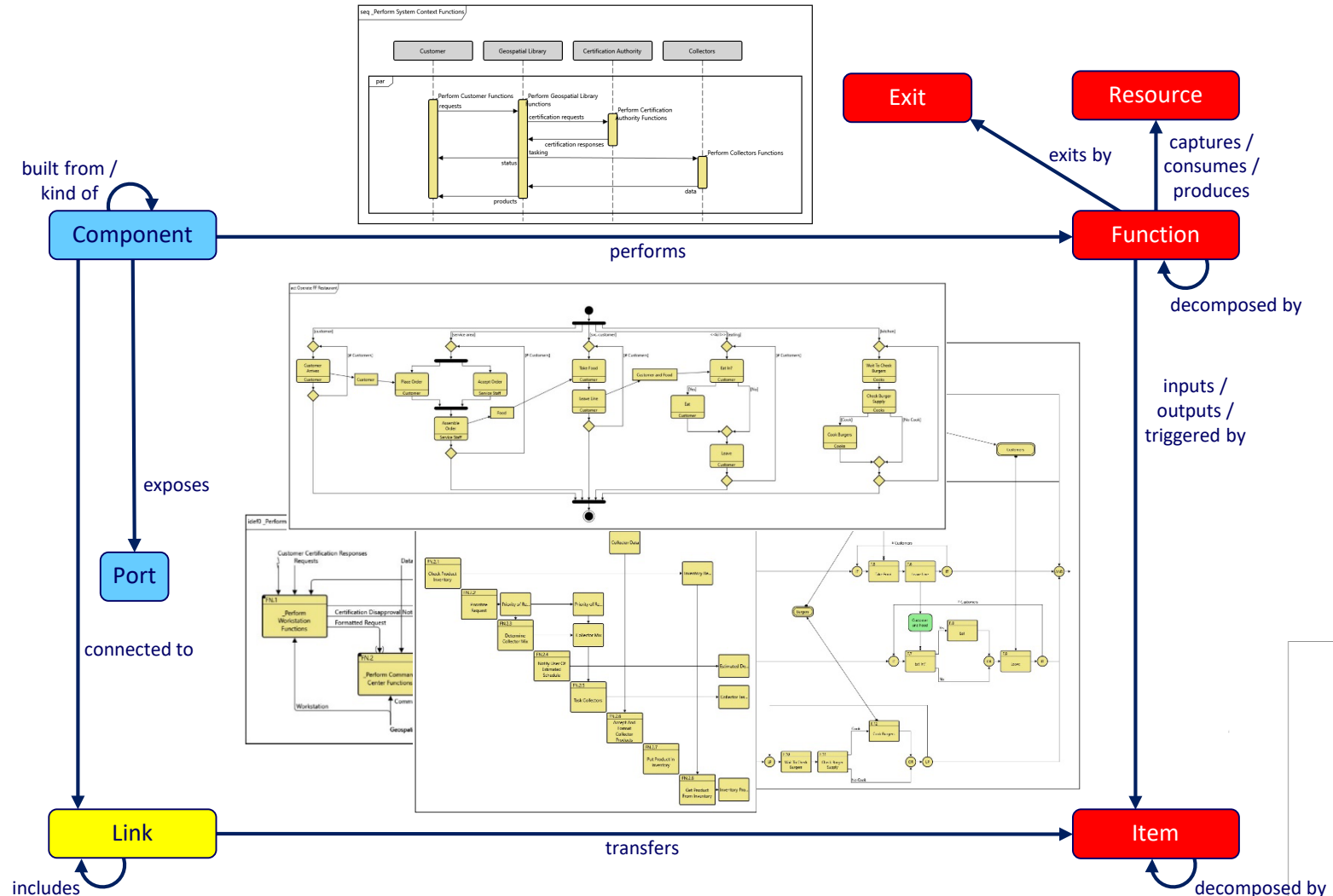
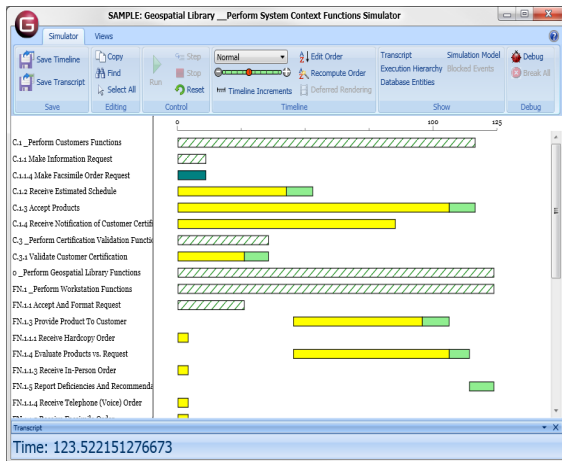
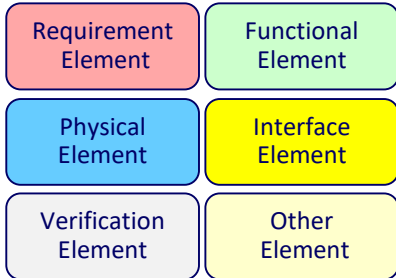
Requirement Element	Functional Element
Physical Element	Interface Element
Verification Element	Other Element





Understanding the Systems Metamodel

Color Code

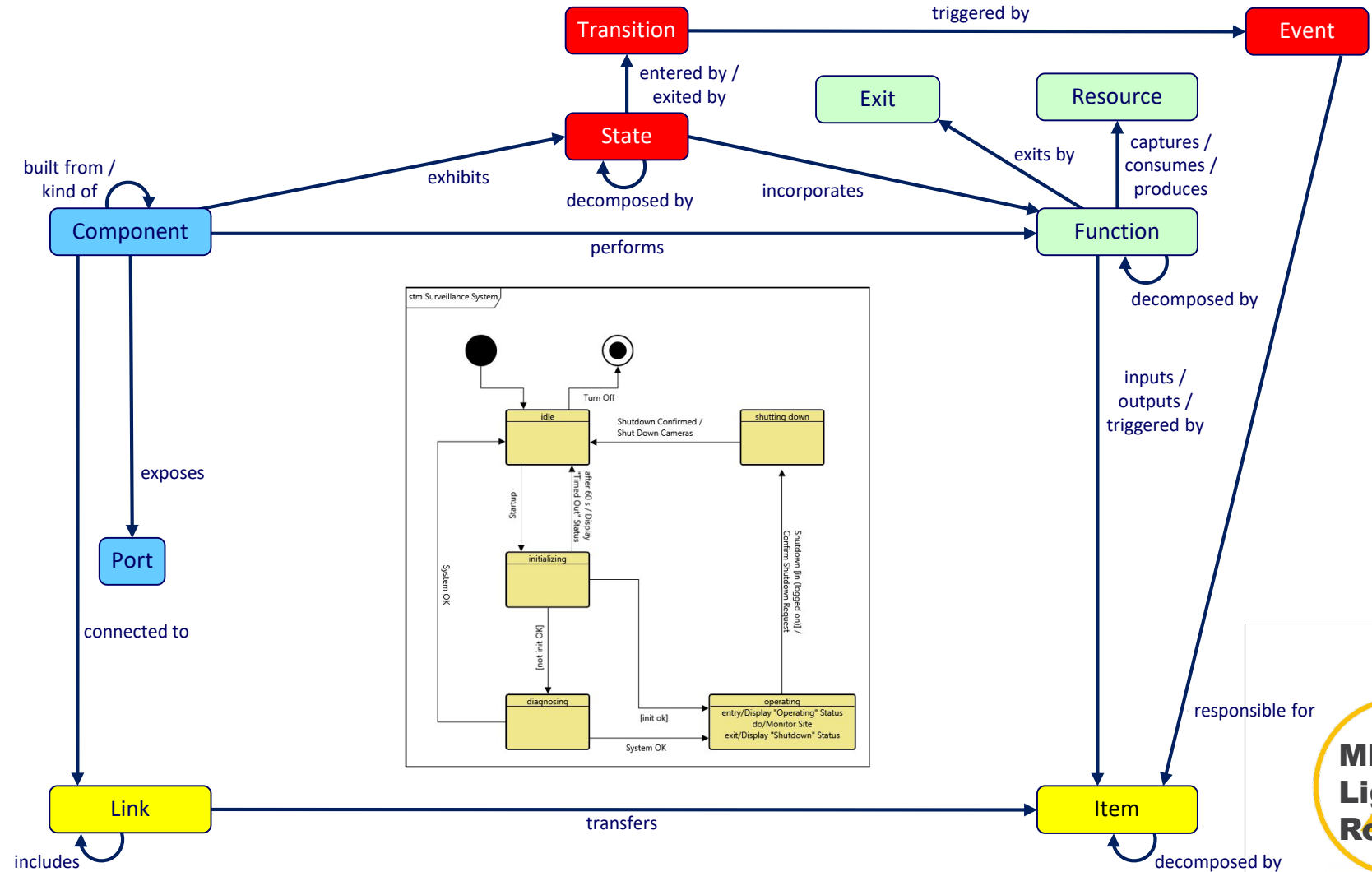




Understanding the Systems Metamodel

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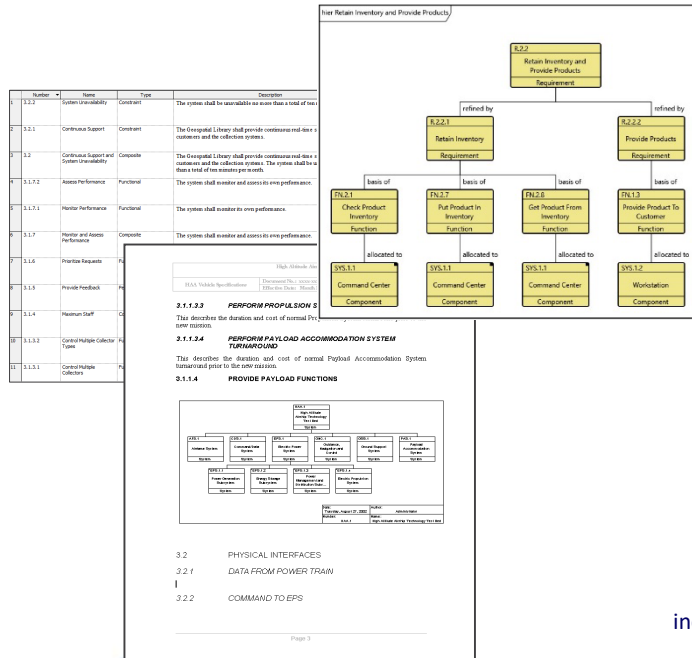
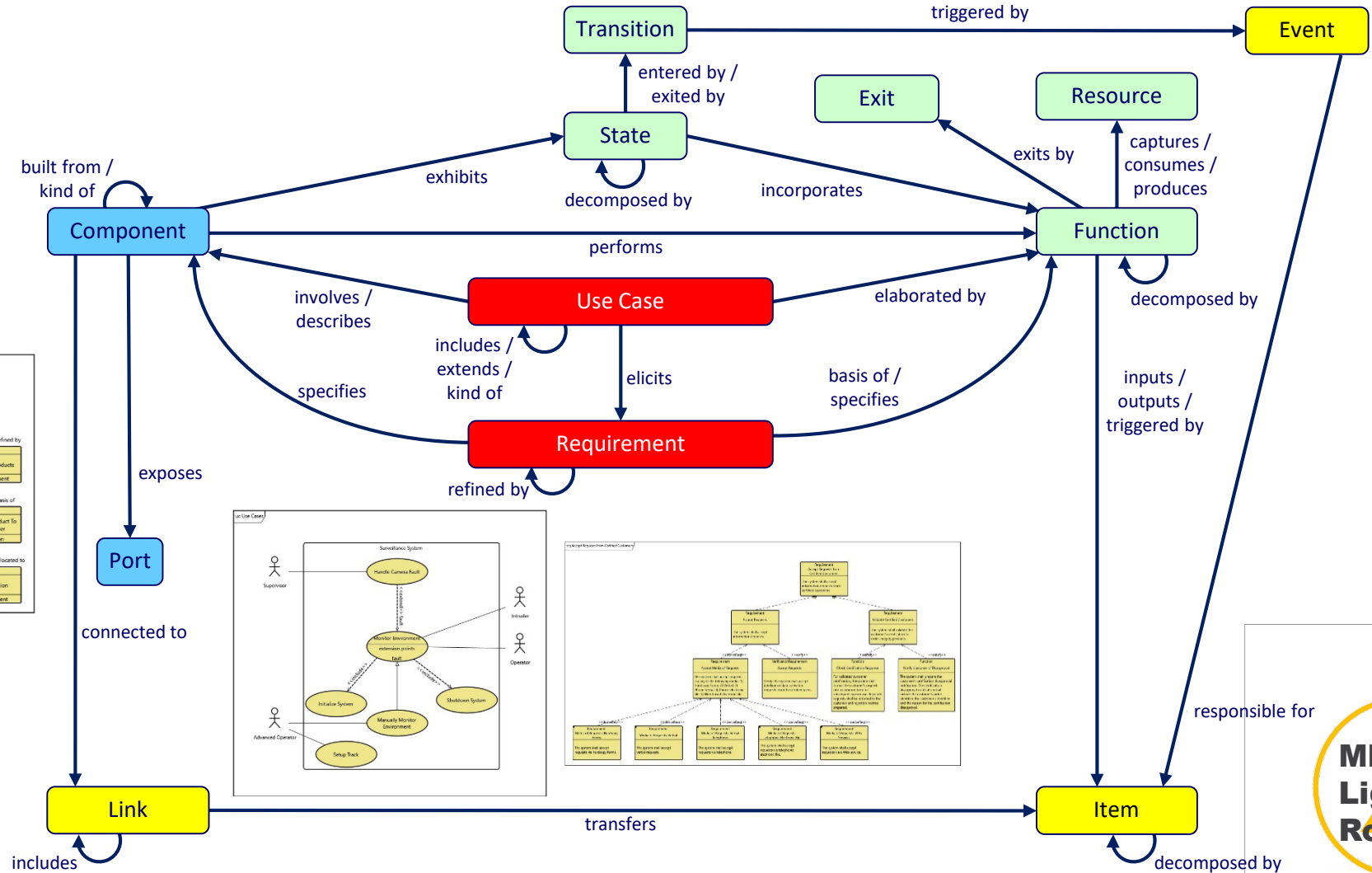
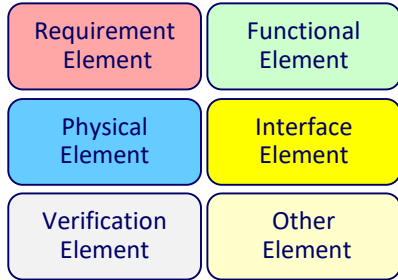
Requirement Element	Functional Element
Physical Element	Interface Element
Verification Element	Other Element





Understanding the Systems Metamodel

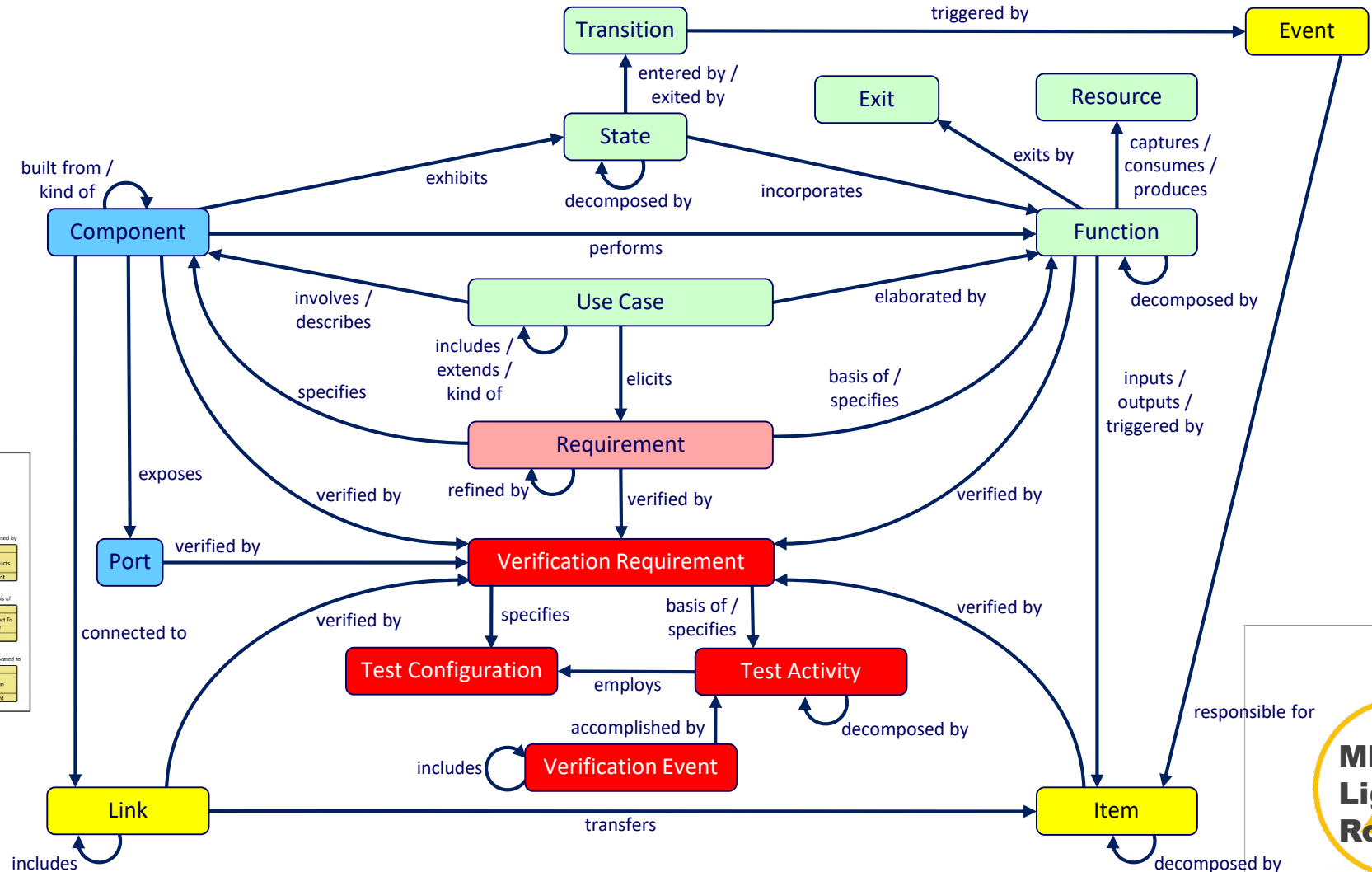
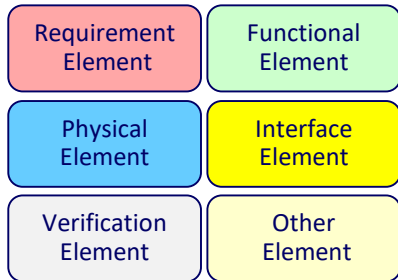
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Understanding the Systems Metamodel

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Appendix B Verification Cross-Reference Matrix

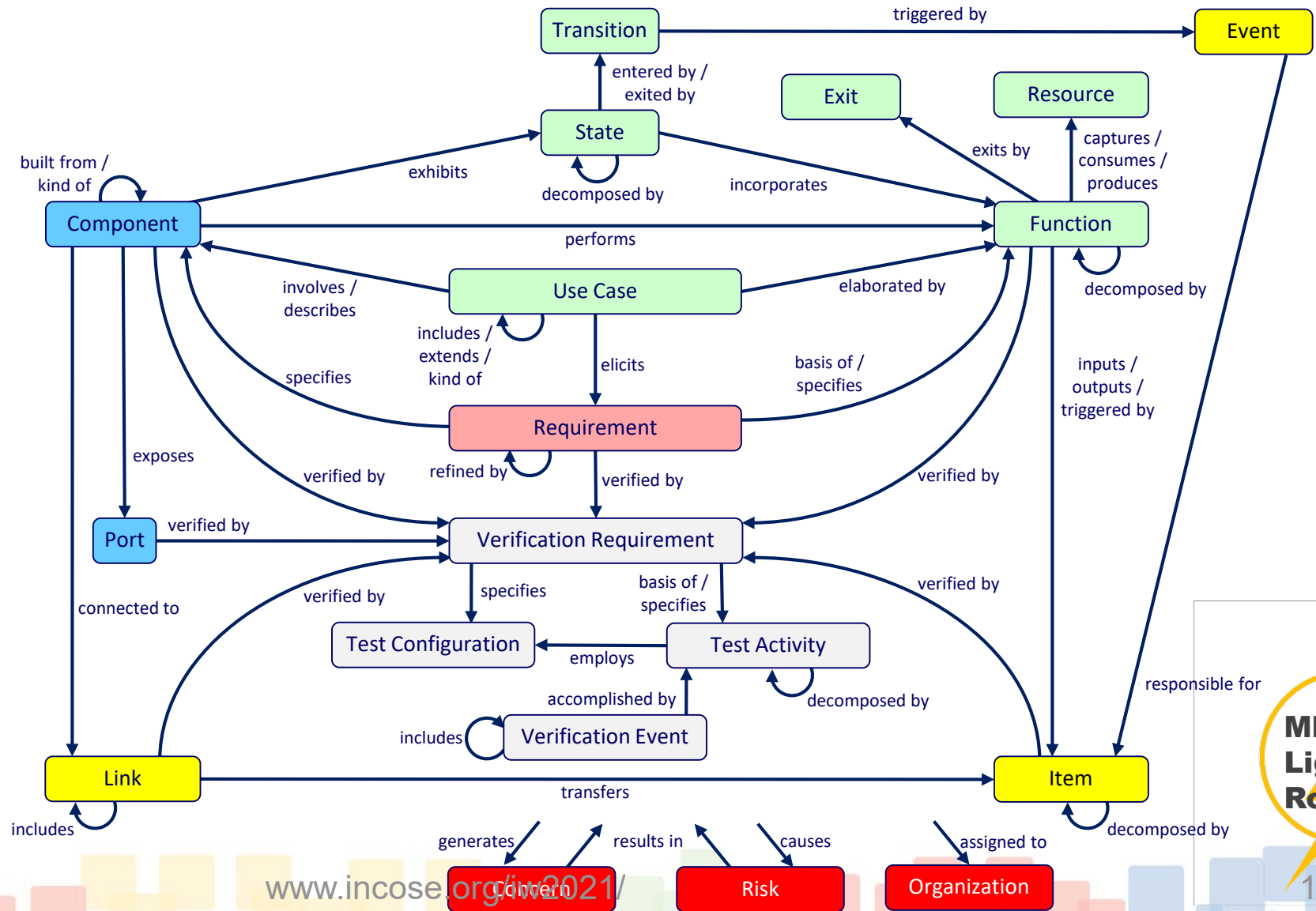
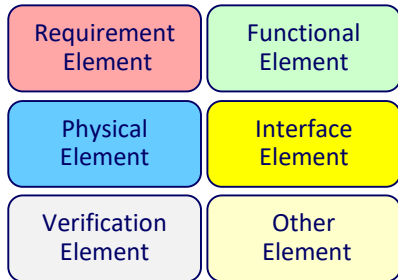
SDS Reqmt Number	SDS Reqmt Title	Verification				
		Inspection	Analysis	Demo	Test	Comments
3.1	SDS DATA DISTRIBUTION AND DEPOSITORY ELEMENT					N/A
3.1.1	Ingest SD3E Data					Use Retain Inventory and Provide Products
3.1.1.1	Product Subscription to IDPS					
3.1.1.2	Ad-hoc Request to IDPS					
3.1.1.3	RDR Ingest from IDPS					
3.1.1.4	Data Delivery Report Ingest					
3.1.1.5	NPESS Data Product and Request Status Ingest					
3.1.1.6	xDR Ordering Request from IDPS					
3.1.1.7	Technology Request (Not Certified Customer)					
3.1.1.8						
3.1.1.9						
3.1.1.11						

The table is accompanied by a detailed flowchart showing the relationships between various system components and requirements, including elements like 'Retain Inventory and Provide Products', 'Provide Products', 'Customer Product to Customer', and 'Workstation Component'.

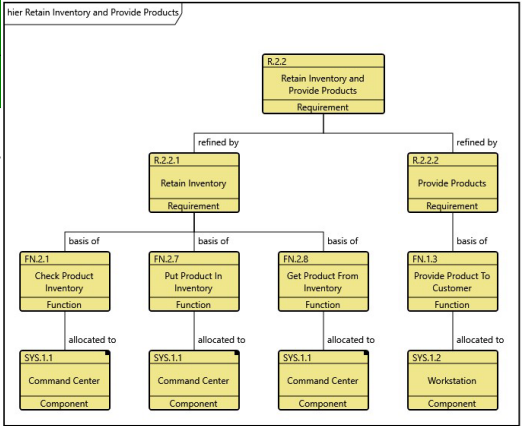


Understanding the Systems Metamodel

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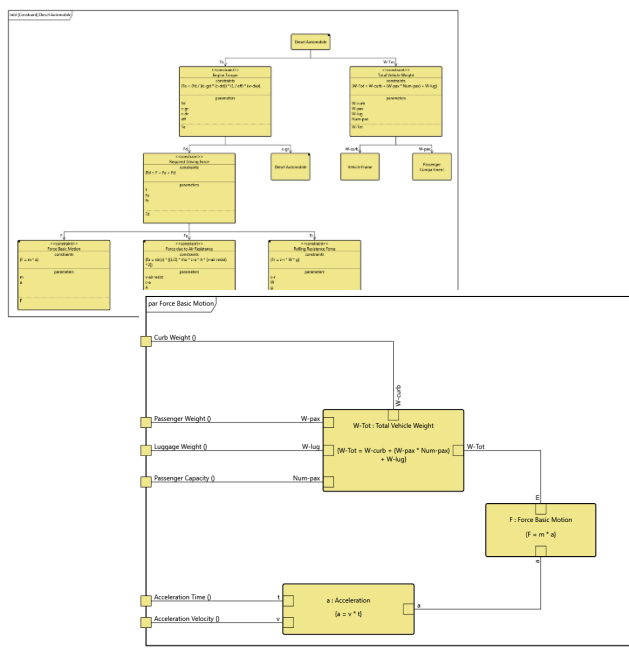
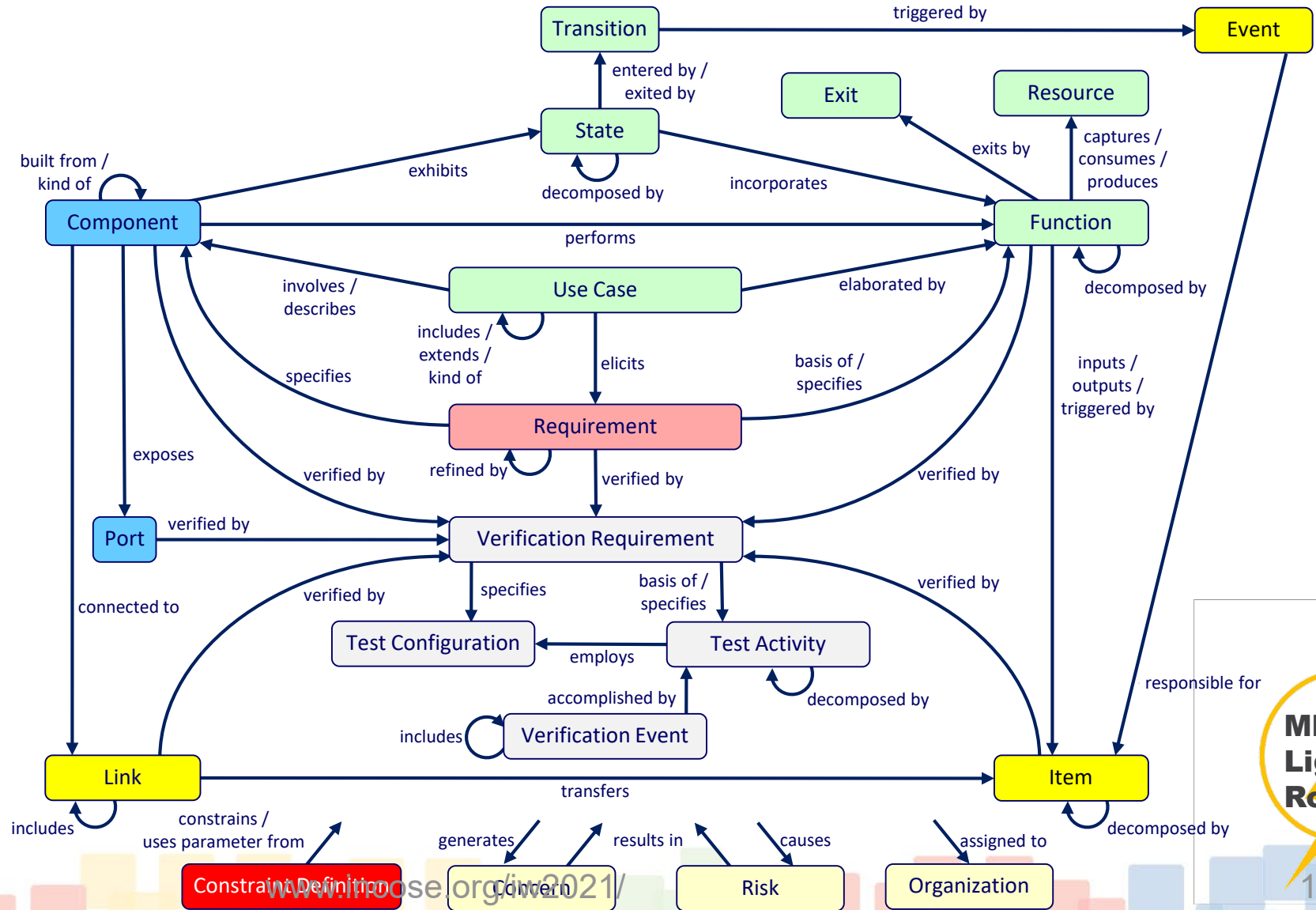
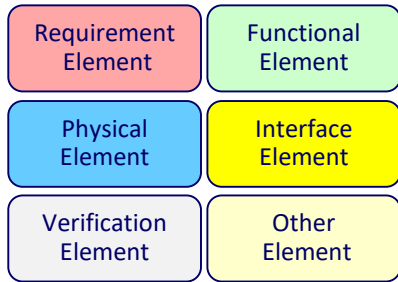
5	0	0	0	0	0
4	0	0	1	0	0
3	0	0	0	0	0
2	0	0	0	0	0
1	0	0	0	0	0





Understanding the Systems Metamodel

Color Code





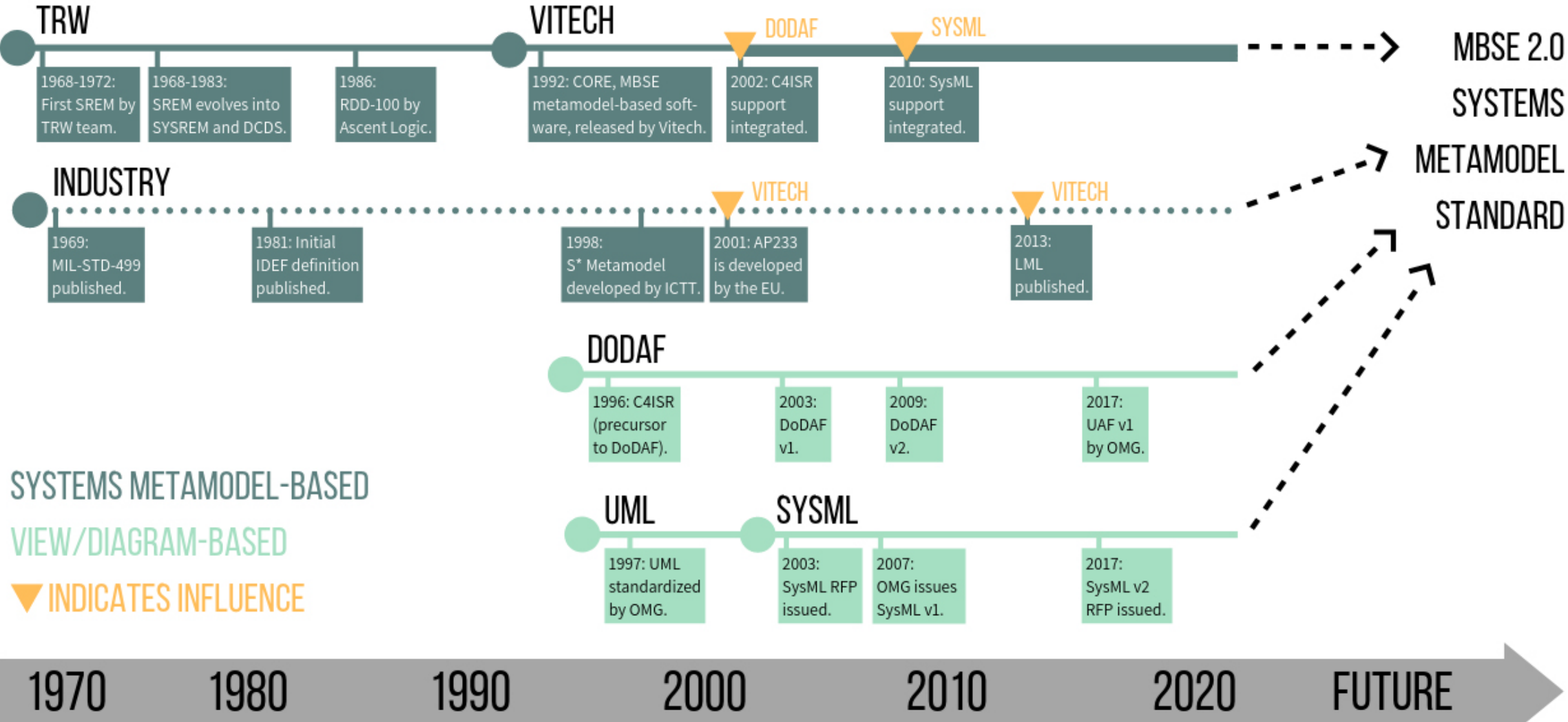
Developing a Better Metamodel

- Define your scope (engineering > modeling)
- Focus on the language of the domain
- Leverage both domain and language experts (but few heads are better than many)
- Manage the size (100 >> 1000 >> 10000)
- Emphasize interrelationships alongside concepts
- Begin with a proven base



DEVELOPMENT OF THE SYSTEMS METAMODEL

50 YEARS OF ADVANCEMENT

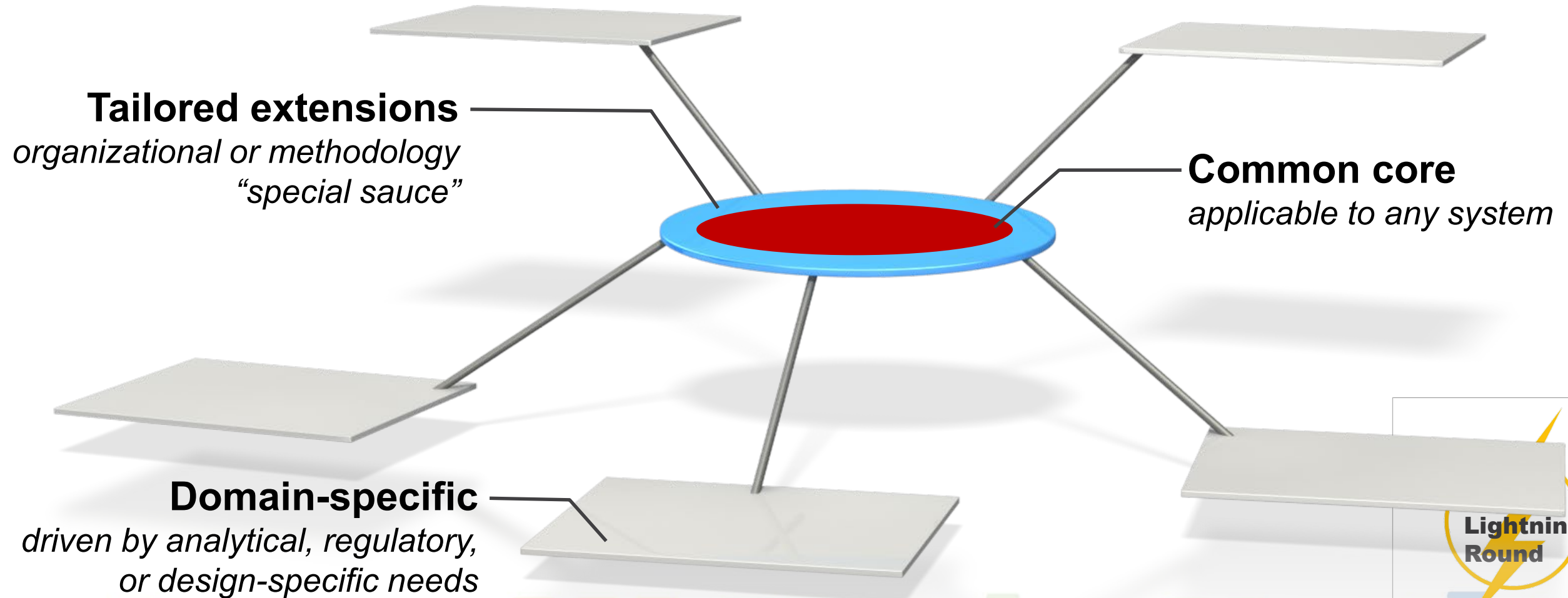


SYSTEMS METAMODEL-BASED
VIEW/DIAGRAM-BASED

▼ INDICATES INFLUENCE

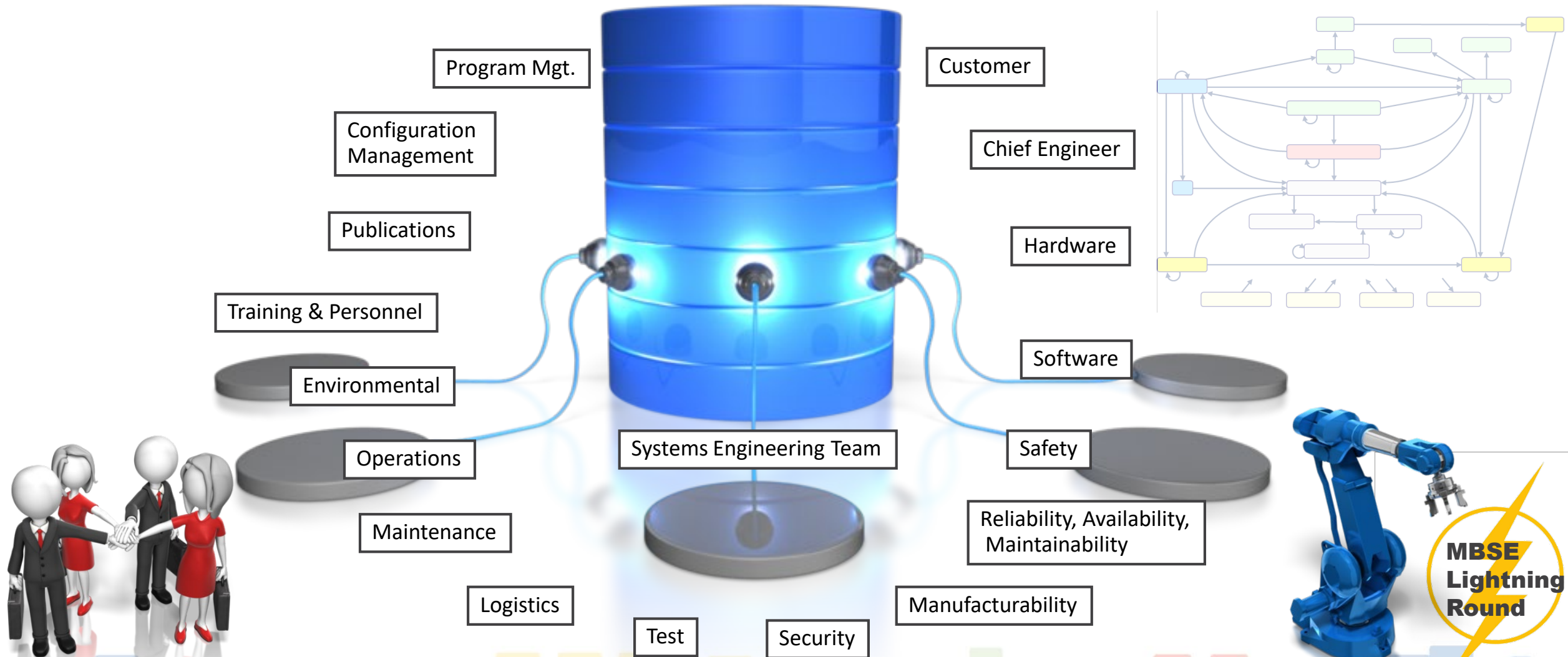


Leveraging and Connecting Core, Tailored, and Domain-Specific



Aligning across the Engineering Enterprise

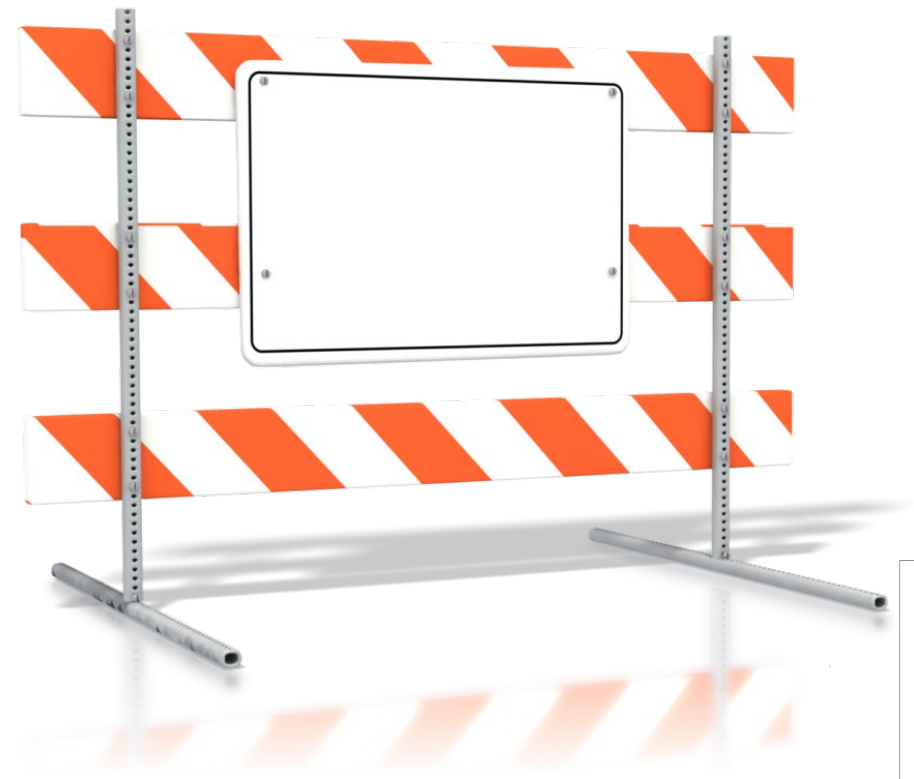
Right Data, Right Place, Right Time, Right Presentation





Recognizing Roadblocks and Risks

- Overestimating current implementation
- Underestimating relationships
- Notation vs concept
- Amateur experts
- Emphasizing tools and artifacts
- Standards (proliferation)
- Reinventing the wheel
- Pursuit of perfection
- Attention Deficit Disorder
- Define and use



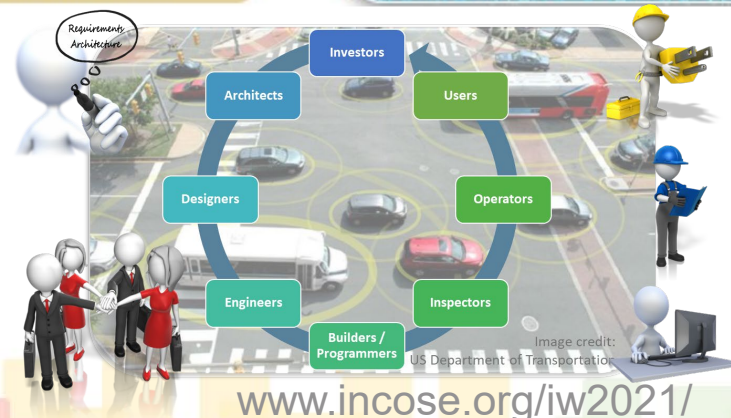
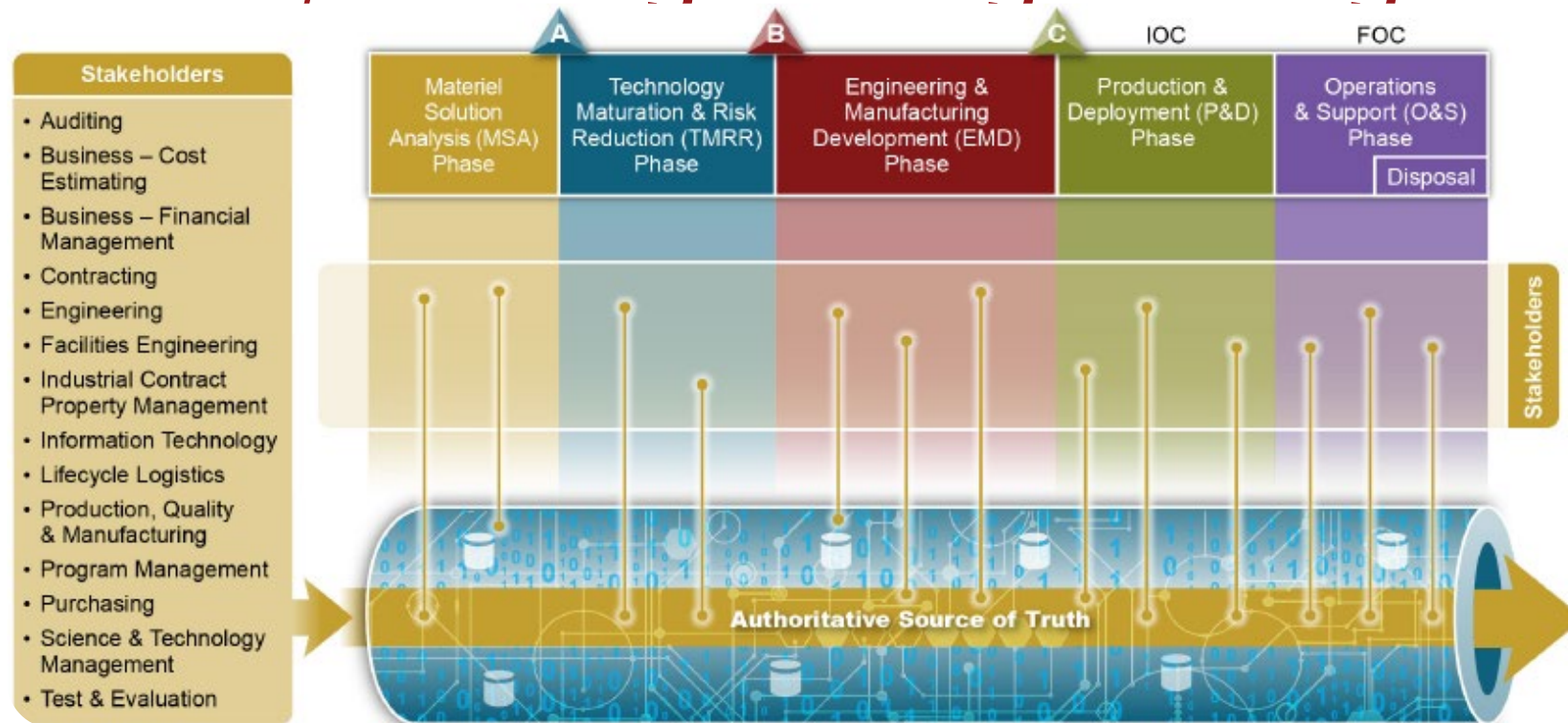


Aligning SE, MBSE, and Digital Engineering

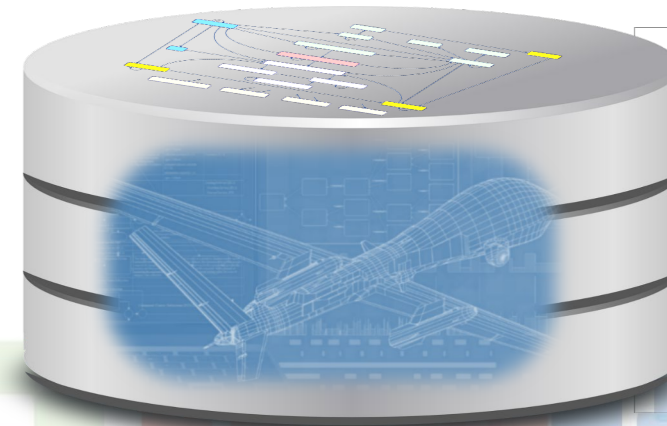
Digital Engineering
*critical enabler
for the modern
engineering enterprise*

MBSE
*connective tissue of the
Digital Engineering
environment*

Systems Engineering
*technical connective
tissue of the project team*



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For More Information or to Continue the Dialog



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