WELCOME!

INCOSE Enchantment Chapter Monthly Meeting

We’re glad you’re here.

We respectfully request:

- Mute your audio when you are not speaking
- *6 toggle or in GlobalMeet left-side, your name

Discussion and questions are encouraged!

Put questions in the chat box or unmute yourself to speak up.

Meeting Materials

Slide presentations can be downloaded prior to start of the meeting from the Meeting Materials page of our website:

https://www.incose.org/incose-member-resources/chapters-groups/ChapterSites/enchantment/resources/meeting-materials

If recording is authorized by speaker, the video will be posted at the link above within 24 hours.

SEP Training

CSEP Courses by *Certification Training International:*

CTI currently is offering online course offerings, see https://certificationtraining-int.com/incose-sep-exam-prep-course/

Our chapter has two SEP mentors:

Ann Hodges alhodge@sandia.gov

Heidi Hahn drsquirt@outlook.com

Upcoming meetings

- February 10, 2021: Gan Wang – Implementing a Model-Based Digital Engineering Enterprise for a Defense System Integrator
- March 10, 2021: Dr. Ron Carson – Perspectives on the Boeing 737MAX Maneuvering Characteristics Augmentation System (MCAS)
- April 14, 2021: Raymond Wolfgang – INCOSE's Guide to Verification and Validation: Context, Progress, and Content

Introductions

- Please type your name, position, and organization in the Chat window

Photo by Adam Solomon on Unsplash

Survey

The link for the online survey for this meeting is

- www.surveymonkey.com/r/2021_01_MeetingEval

Your feedback is important!

Enchantment Chapter Monthly Meeting

Schema and Metamodels and Ontologies – Oh My!

Abstract: Over the last five years, there has been a growing fascination with conceptual data models, metamodels, and ontologies in systems engineering. What began as a murmur – something living largely at the fringes of systems engineering and MBSE – has grown as many projects and practitioners delve into these topics.

So what are these concepts? What differentiates them, and more importantly, why should I care? How do I properly leverage these ideas to advance my projects and my enterprise?

As organizations apply model-based systems engineering, managing information in a computer model requires a defined data structure. Combined with the ease of modern ontology editors such as OWL or capabilities embedded in many tools, practitioners have begun to develop their own conceptual data models and ontologies. As systems engineers experiment and leverage these capabilities, they cross into the area of language design, often developing custom languages for their projects without the greater depth or consideration necessary to connect enterprise practices.

There is a fundamental information model that underpins systems engineering. This information model characterizes the knowledge we must elicit, develop, analyze, and manage in order to successfully engineer systems. It lives implicitly in the process standards that guide our practice, the data item descriptions that define our artifacts, and the representations we use.

The challenge is to move from implicit and explicit, not to advance MBSE but to advance the greater practice of systems engineering. To do so means that we must do more than develop independent data models for projects (the trap of "define and use"). We can leverage decades of practical experience to develop a shared systems metamodel that enables us to effectively communicate, analyze, and reason as we address today's systems challenges. Rather than each project or each organization isolated on an island of their own language, we can and must achieve consistency of data and commonality of practice across the enterprise, across the supply chain, and across the profession.

Download recording from the Library at www.incose.org/enchantment

NOTE: This meeting will be recorded

Speaker Bio

For over 25 years, **David Long** has focused on helping organizations increase their systems engineering proficiency while simultaneously working to advance the state of the art. David is the founder and president of Vitech where he leads the team in delivering innovative, industry-leading methods and software (CORE™ and GENESYS™) to help organizations engineer next-generation systems. He co-authored *A Primer for Model-Based Systems Engineering* and frequently delivers keynotes and tutorials at industry events around the world. An INCOSE Fellow and Expert Systems Engineering Professional (ESEP), David was the 2014/2015 president of INCOSE.

Schema and Metamodels and Ontologies, Oh My!

David Long, ESEP
President, Vitech
INCOSE Past President and Fellow
david.long@vitechcorp.com

Enabling Communication, Analysis, Learning, and More

Technical Processes

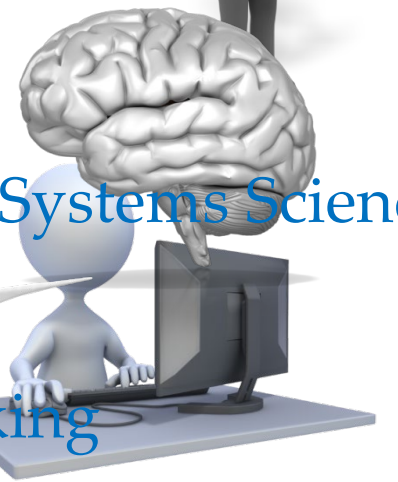
"Non-traditional domains"

SE Management

Soft Systems

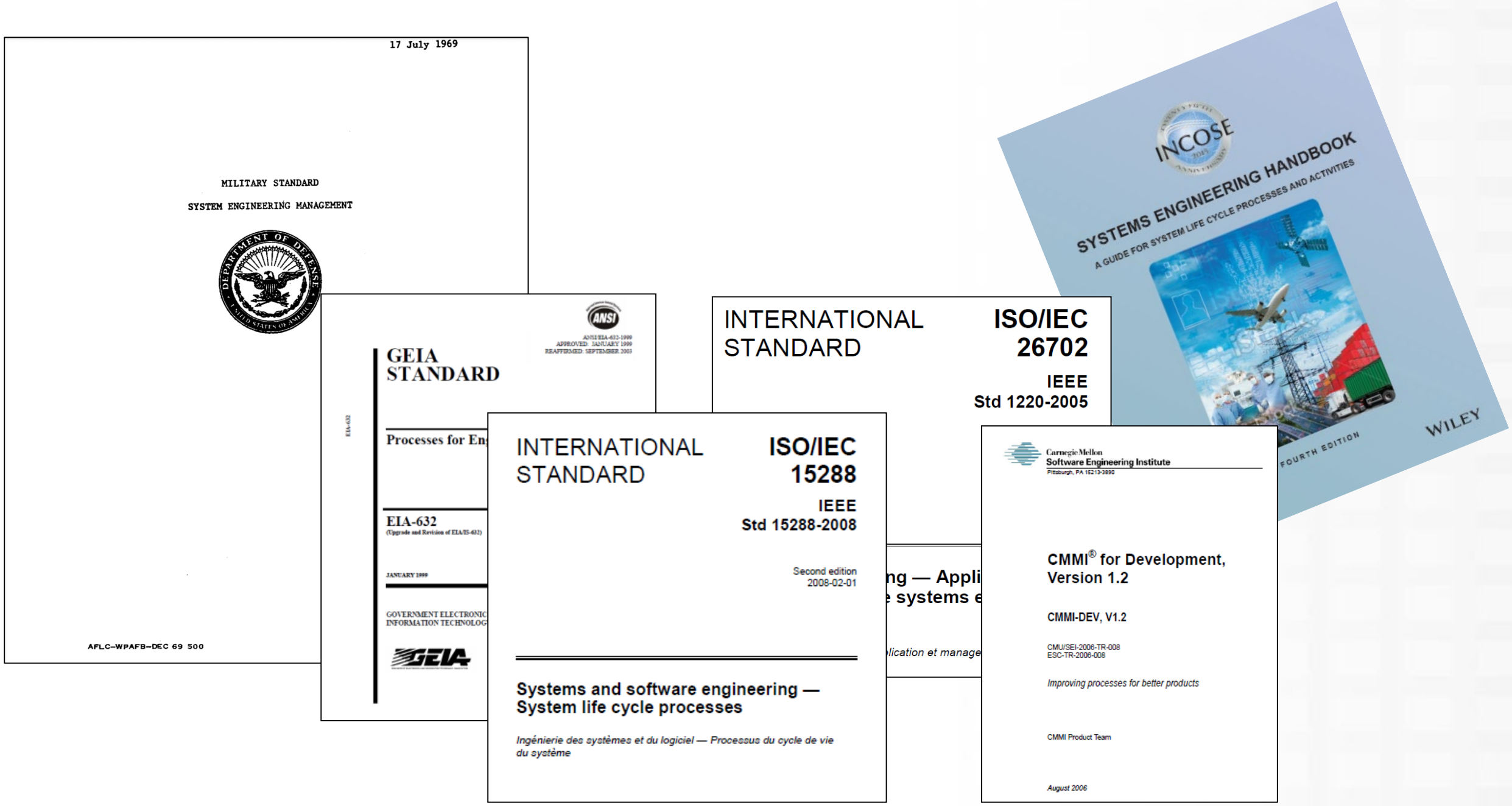
Model-Based SE

SE Leadership

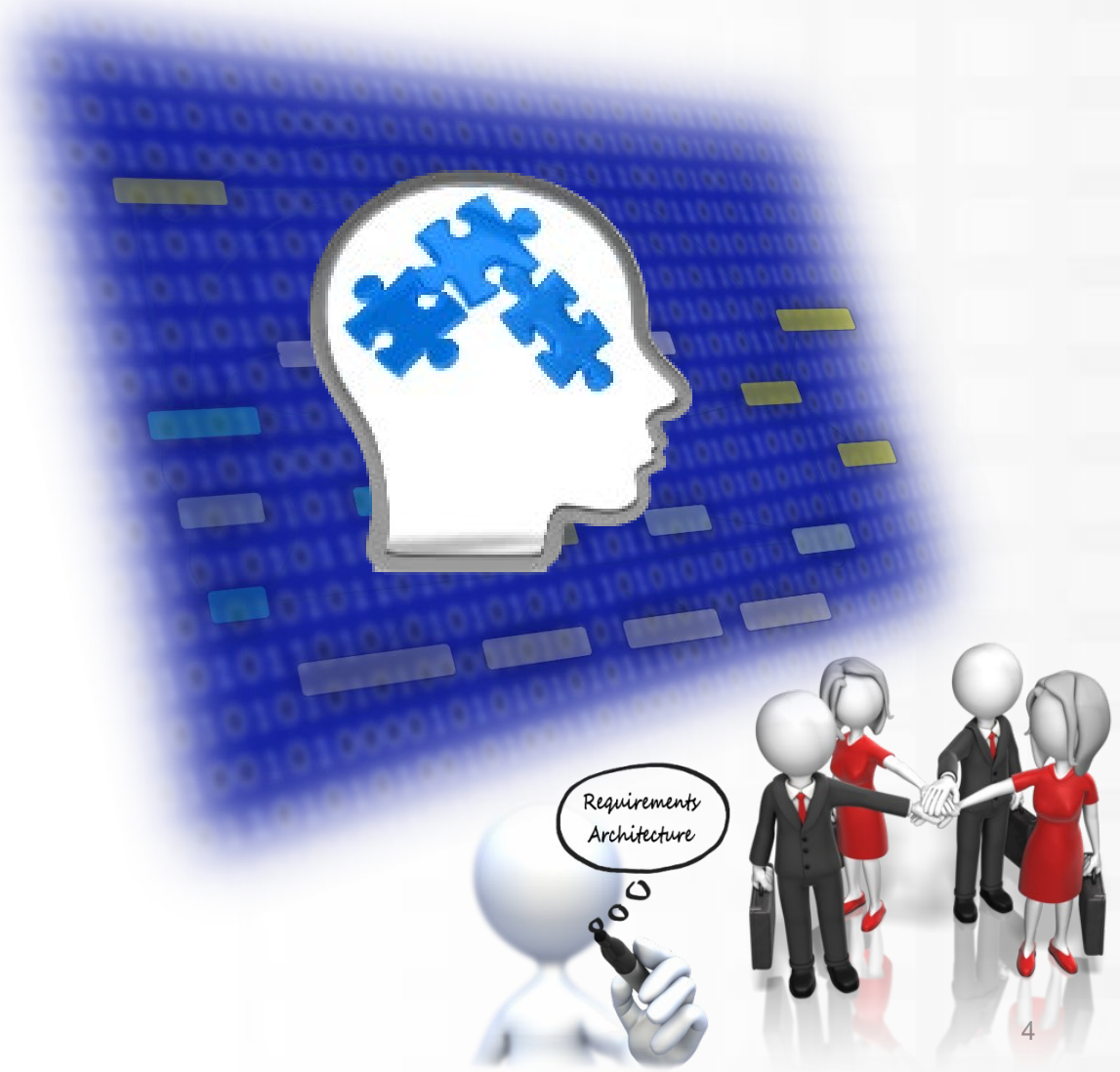


Systems Science

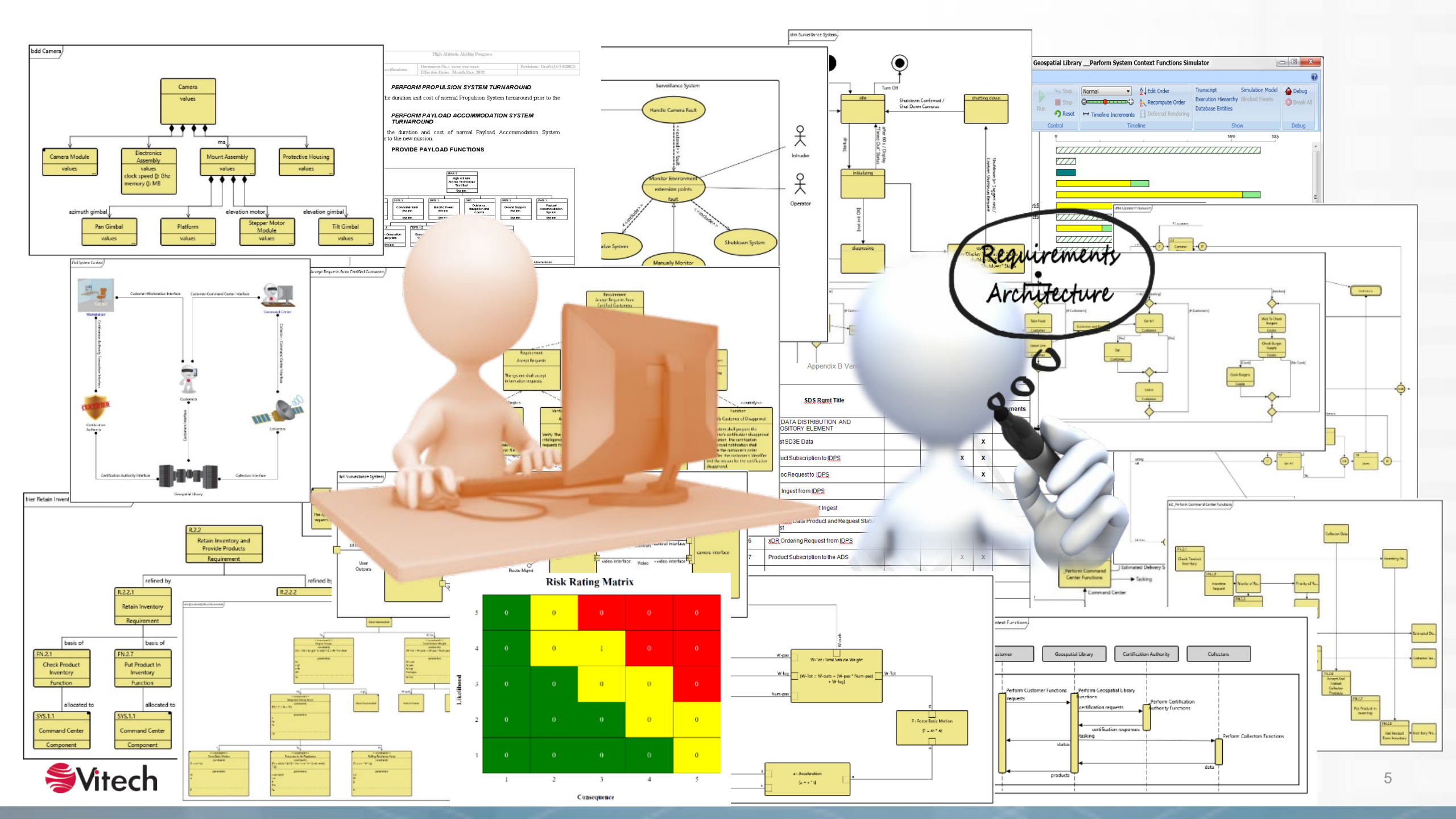
Systems Thinking


17 July 1969
MILITARY STANDARD
SYSTEM ENGINEERING MANAGEMENT
AFLC–WPAFB–DEC 69 500
GEIA STANDARD
EIA-632
JANUARY 1999
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
INCOSE
SYSTEMS ENGINEERING HANDBOOK
A GUIDE FOR SYSTEM LIFE CYCLE PROCESSES AND ACTIVITIES
FOURTH EDITION
WILEY
Carnegie Mellon
Software Engineering Institute
Pittsburgh, PA 15213-3890
CMMI® for Development, Version 1.2
CMMI-DEV, V1.2
CMU/SEI-2006-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”



Vitech


bdd Camera
Camera
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Camera Module
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Electronics Assembly
values
clock speed (): Ghz
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Protective Housing
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azimuth gimbal
elevation motor
elevation gimbal
Pan Gimbal
values
Platform
values
Stepper Motor Module
values
Tilt Gimbal
values
PERFORM PROPULSION SYSTEM TURNAROUND
PERFORM PAYLOAD ACCOMMODATION SYSTEM TURNAROUND
PROVIDE PAYLOAD FUNCTIONS
Surveillance System
Handle Camera Fault
Monitor Environment
Shutdown System
Manually Monitor
Intruder
Operator
Turn Off
Shutdown Confirmed / Shut Down Cameras
shutting down
idle
initializing
Startup
Geospatial Library __Perform System Context Functions Simulator
Run
Step
Stop
Reset
Normal
Edit Order
Recompute Order
Deferred Rendering
Timeline Increments
Transcript
Execution Hierarchy
Database Entities
Simulation Model
Blocked Events
Debug
Break All
Control
Timeline
Show
Debug
Requirements
Architecture
SDS Rqmt Title
DATA DISTRIBUTION AND
OSITORY ELEMENT
st SD3E Data
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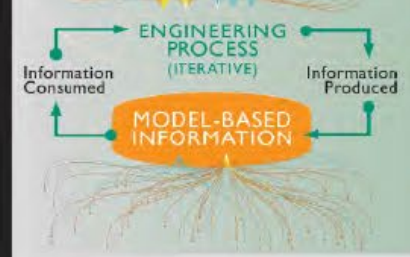
oc Request to IDPS
Ingest from IDPS
Ingest
Data Product and Request Stat
st
6
XDR Ordering Request from IDPS
7
Product Subscription to the ADS
R.2.2
Retain Inventory and Provide Products
Requirement
refined by
R.2.2.1
Retain Inventory
Requirement
R.2.2.2
basis of
FN.2.1
Check Product Inventory
Function
FN.2.7
Put Product In Inventory
Function
allocated to
SYS.1.1
Command Center
Component
Risk Rating Matrix
Likelihood
Consequence
Geospatial Library
Certification Authority
Collectors
Perform Customer Functions
Perform Geospatial Library Functions
Perform Certification Authority Functions
Perform Collectors Functions
requests
certification requests
certification responses
tasking
status
products
data

Transforming Engineering: A New Manifesto

A MODEL-BASED ENGINEERING (MBE) MANIFESTO

PURPOSE: *To motivate the transformation to Model-Based Engineering.*



Faced with increasing system complexity, interdependencies, breakdown of document-based methods, and other challenges, MBE provides the transformation in which we value:

1. ***Information** over **artifacts***
2. ***Integration** over **independence***
3. ***Expressiveness with rigor** over **flexibility***
4. ***Model usage** over **model creation***

We value the items on the right, but not at the sacrifice of the items on the left.

THE TEAM:

The team was assembled by invitation, intentionally drawing together different perspectives.

Sandia National Laboratories

Ed Carroll
Team lead-Sandia National Laboratories–Engineering Methods Research

Nancy Hayden
SNL–Autonomous Systems/ Engineering Policy

Sharon Trauth
SNL-Systems Engineering/ MBSE Practice

Dana Grisham

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

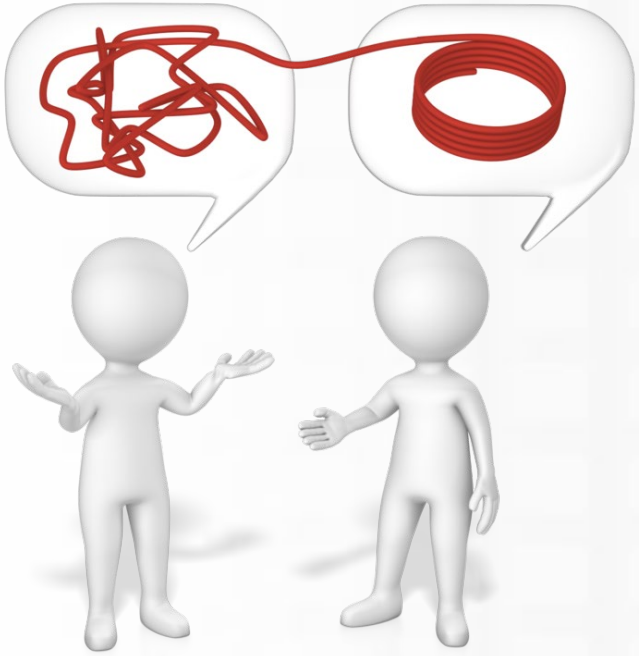
Metamodel: a model which is intended to give an all-inclusive picture of a process, system, etc., especially by abstracting from more detailed individual models contained within it

Oxford Languages

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

Wikipedia

EXPLICIT > IMPLICIT



CLARITY > AMBIGUITY

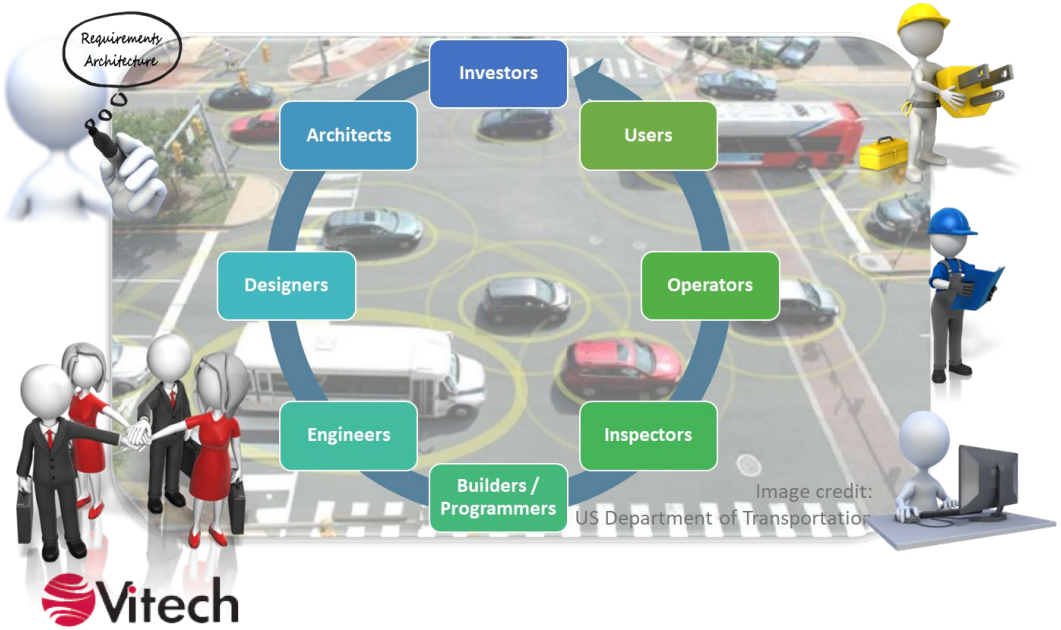


Image credit:
US Department of Transportation

ACCURACY || PRECISION

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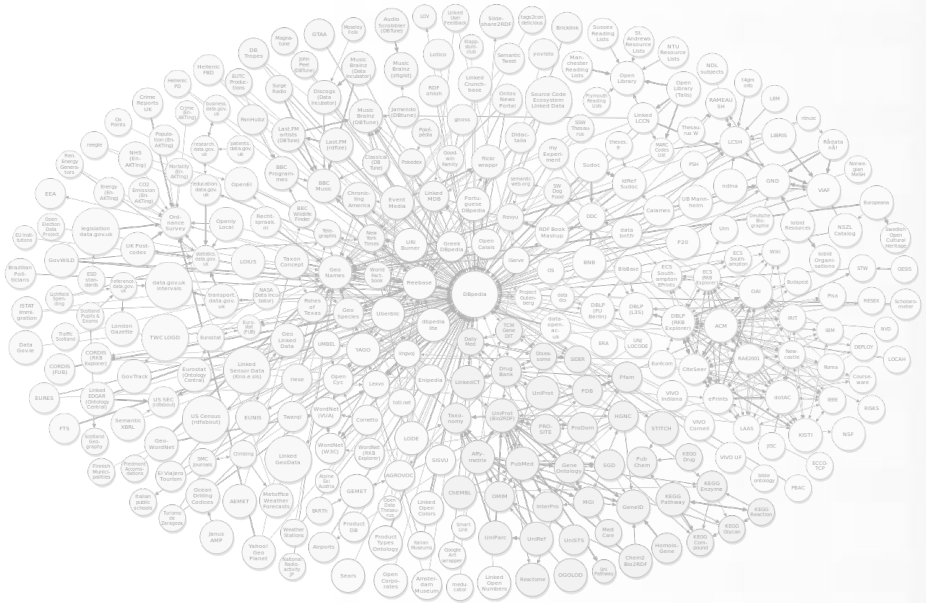
Avoiding the Perils of the Extremes

"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 …

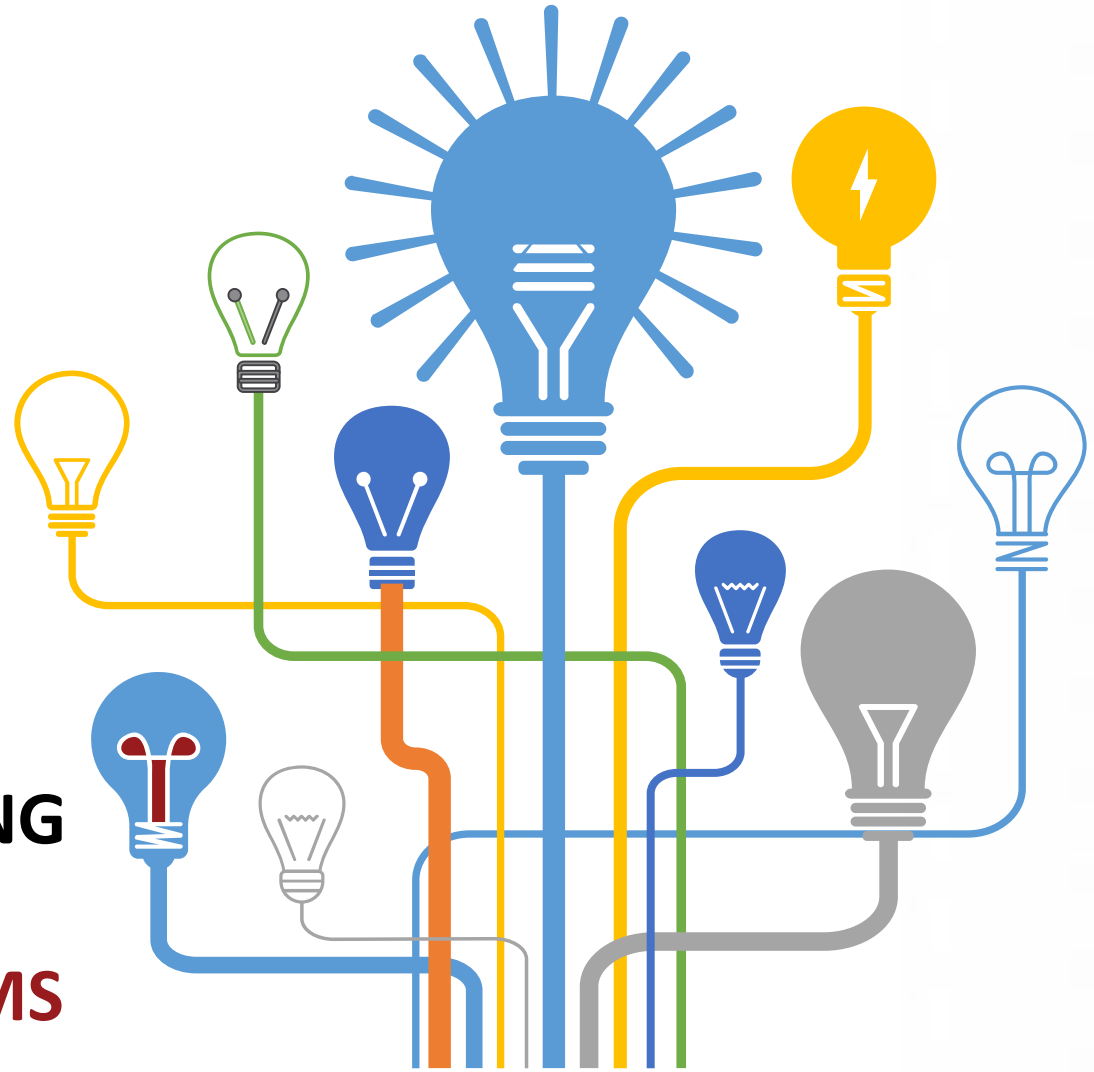
Setting the Right Context

HUMAN

MACHINE

SYSTEMS ENGINEERING

ENGINEERING SYSTEMS



FOUNDATION

EDUCATION

INTERCHANGE

INTEROPERABILITY

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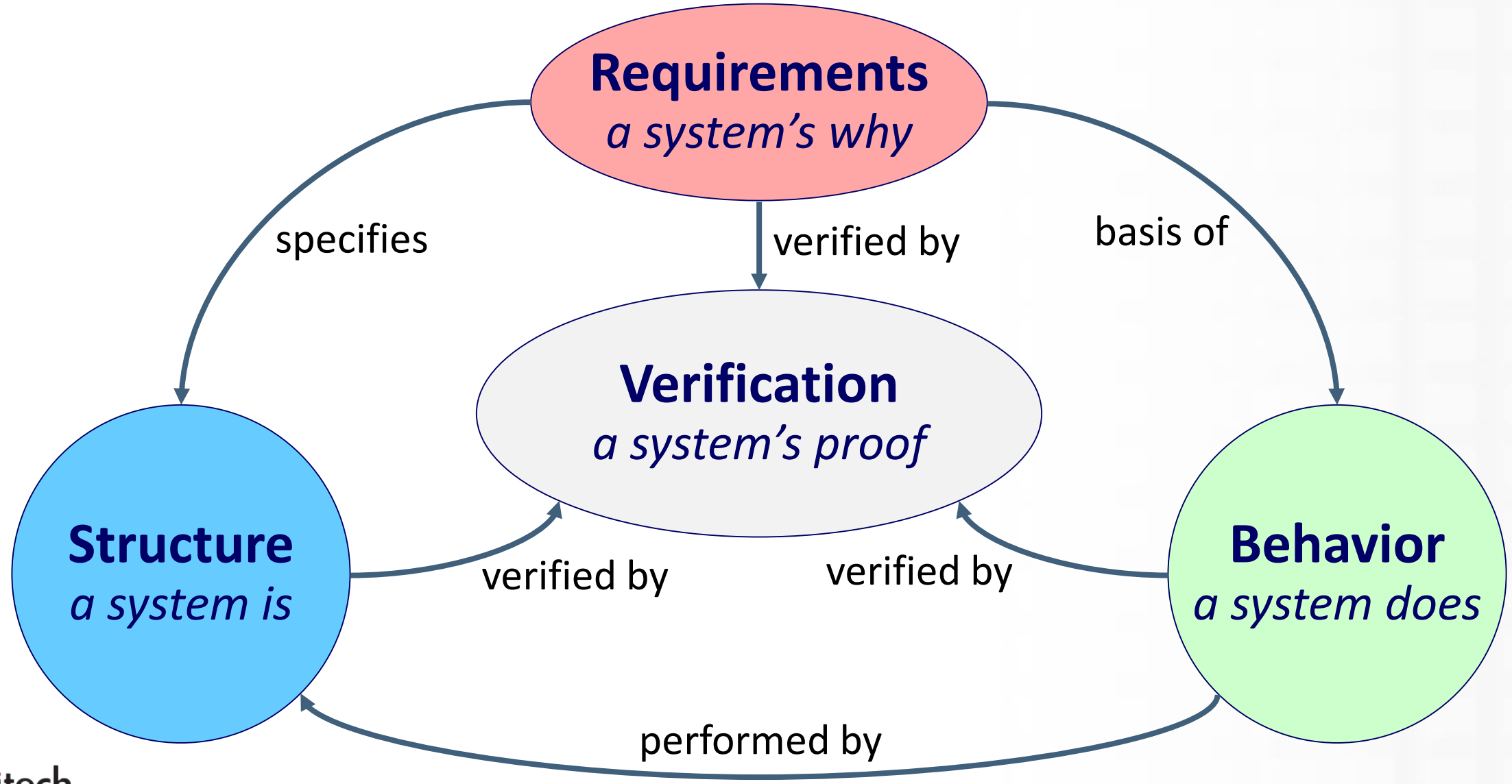
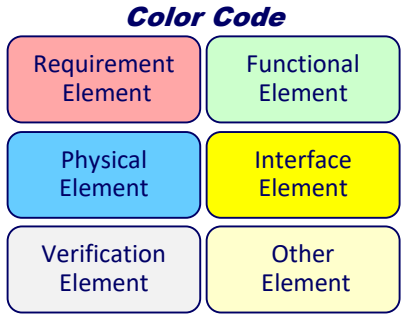
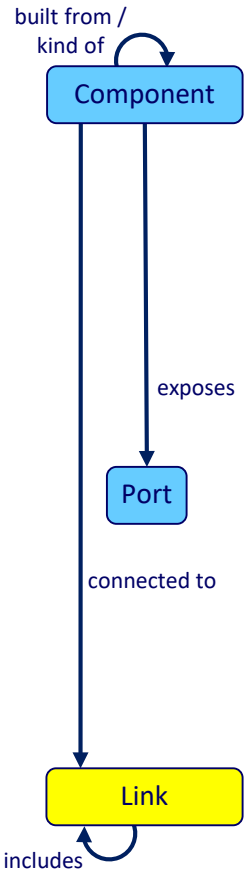
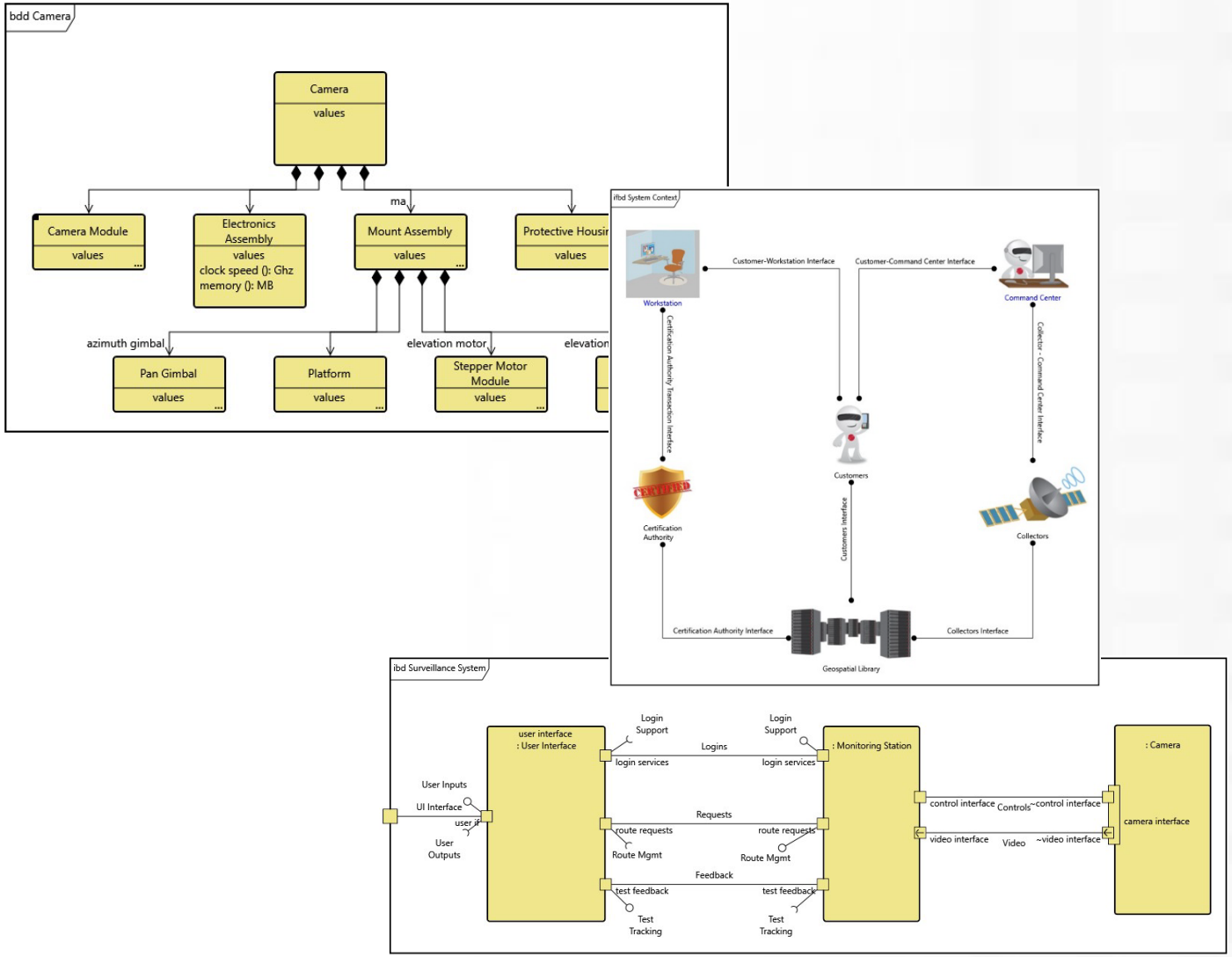
Focusing on the Foundational Concepts



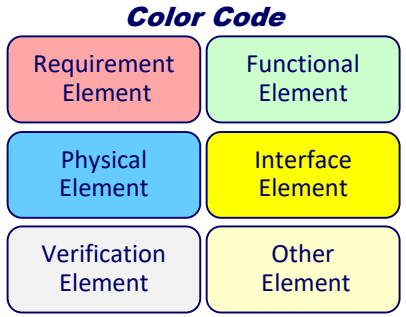
Understanding the Systems Metamodel

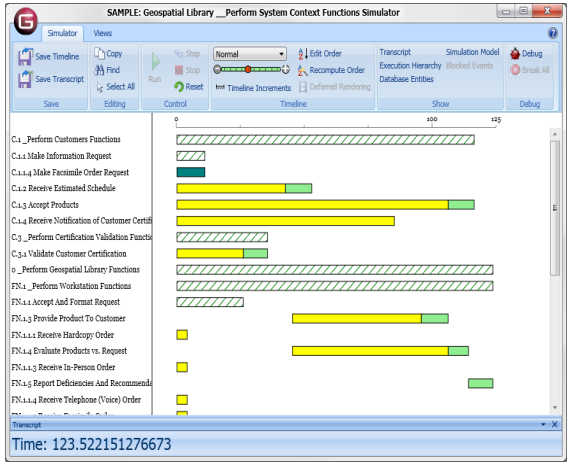


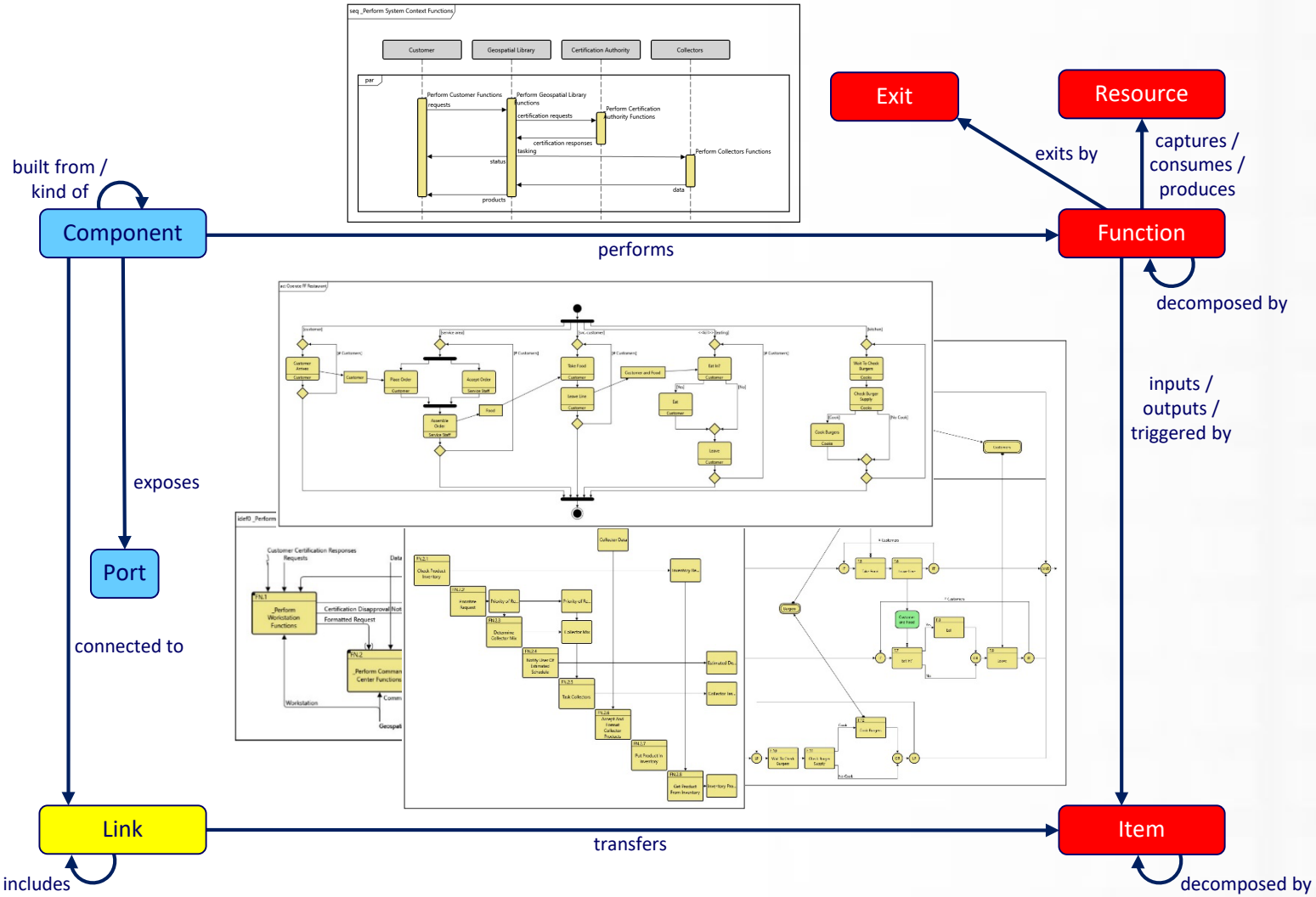




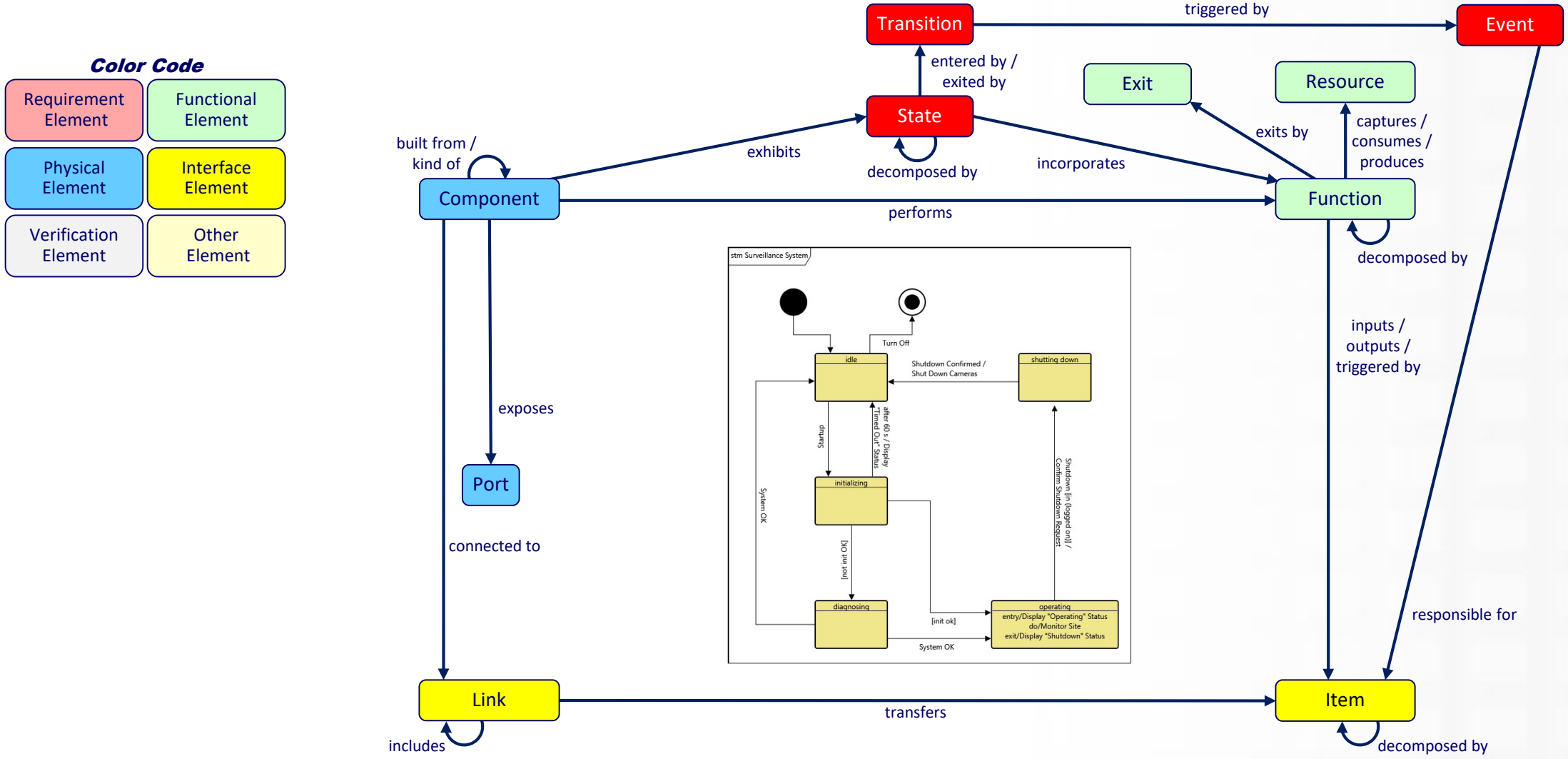
Understanding the Systems Metamodel



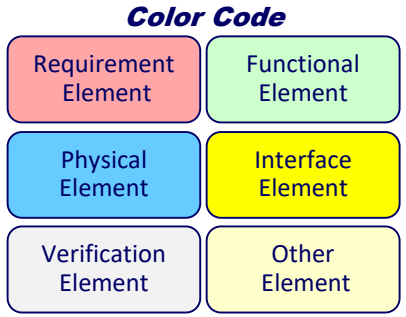


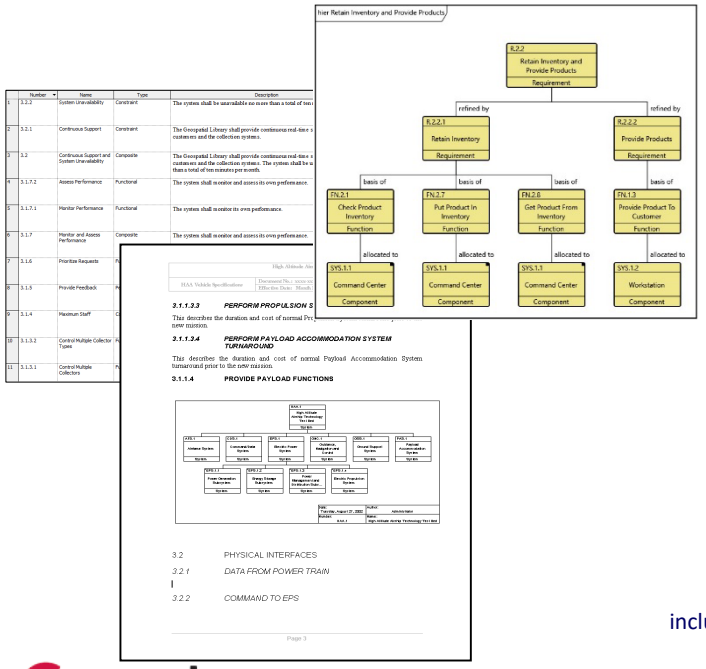


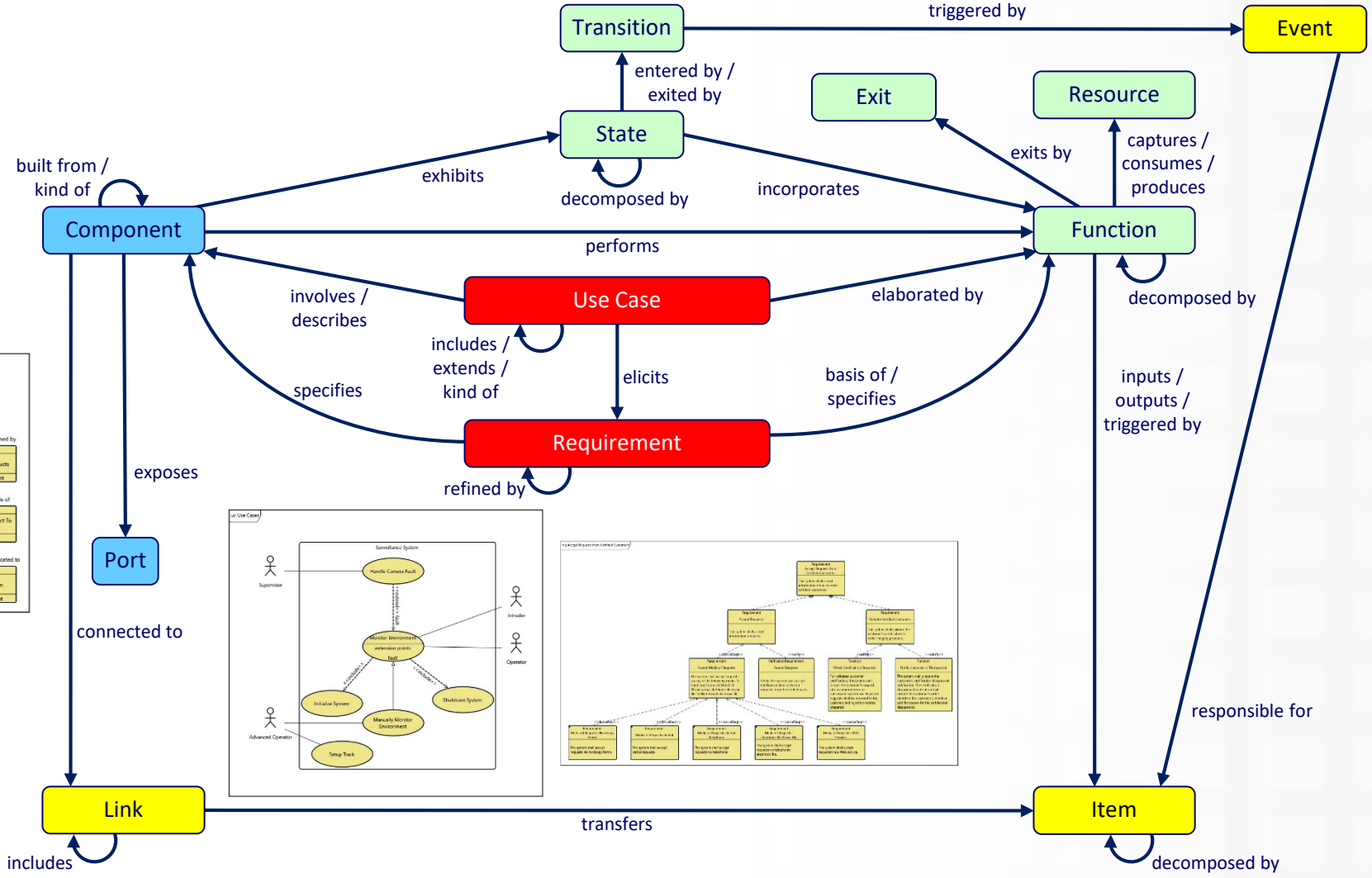
Understanding the Systems Metamodel



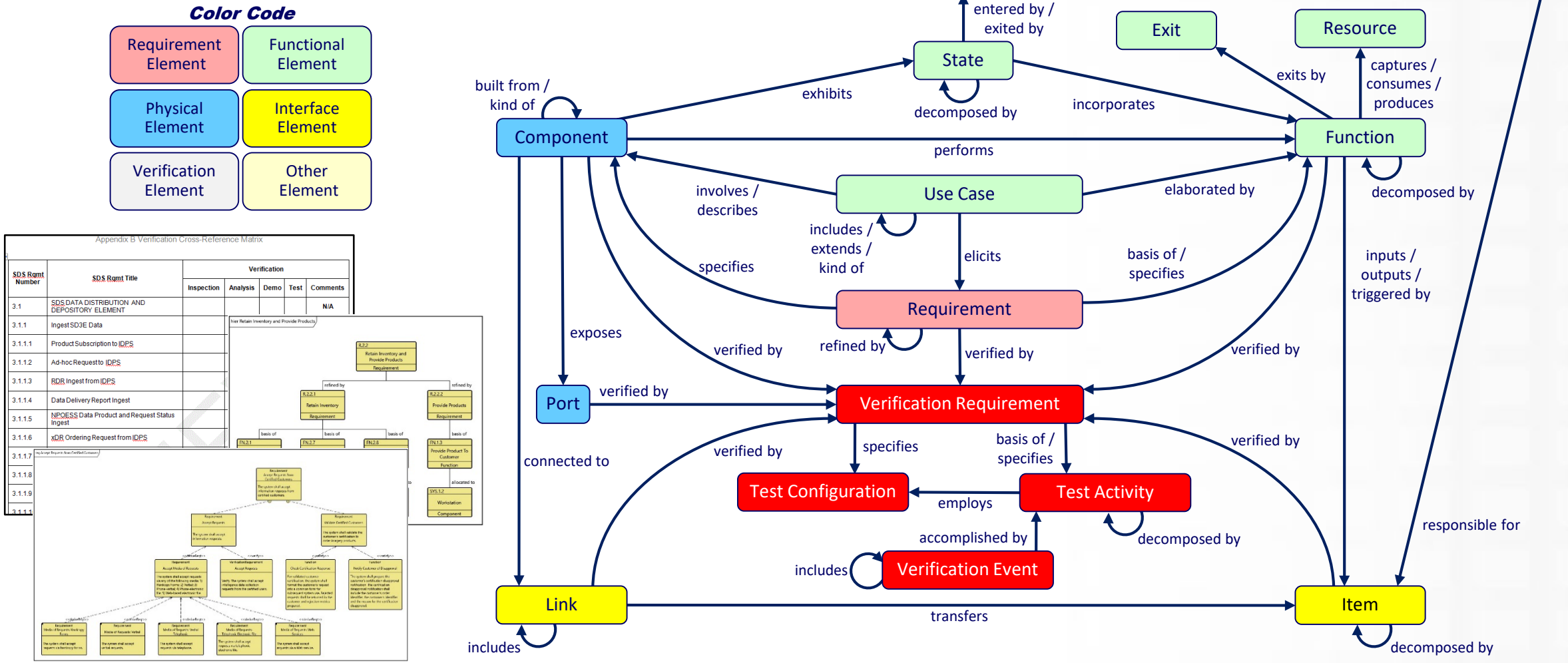
Understanding the Systems Metamodel



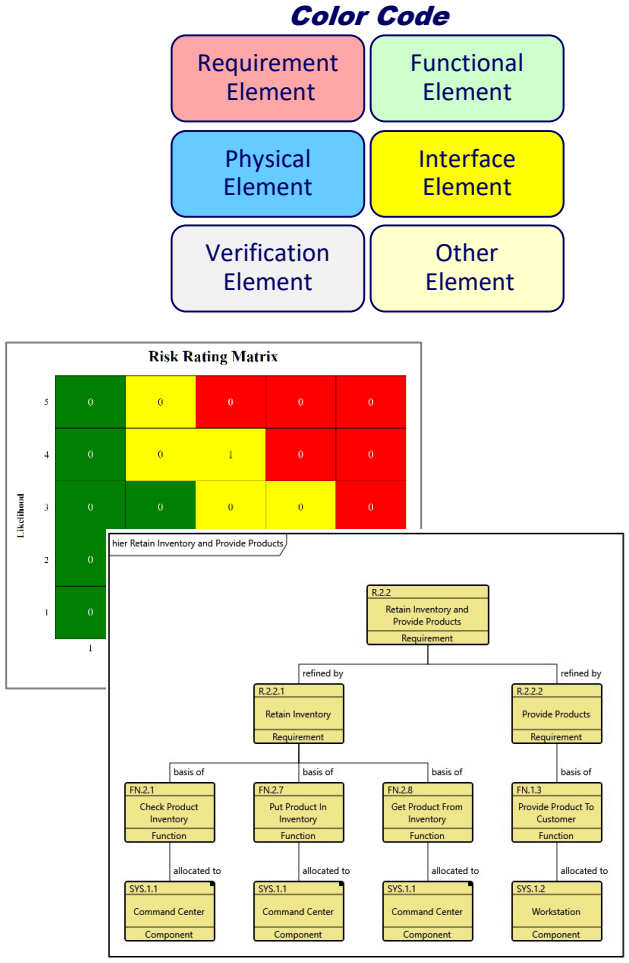


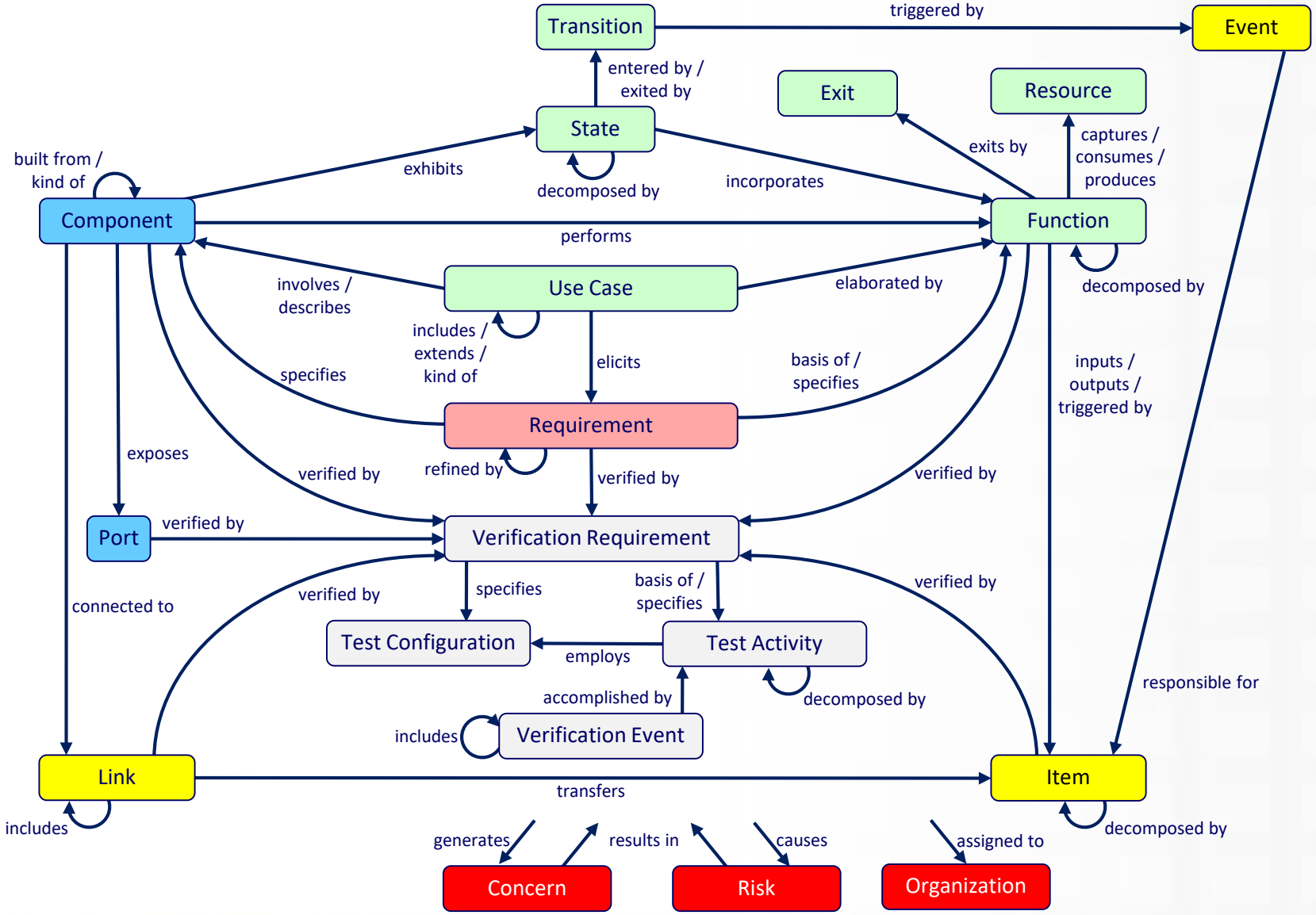


Understanding the Systems Metamodel



Understanding the Systems Metamodel

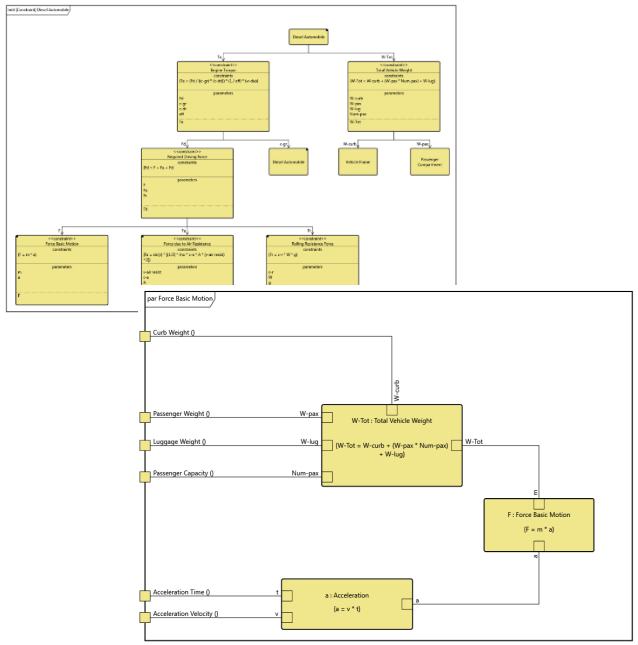




Understanding the Systems Metamodel

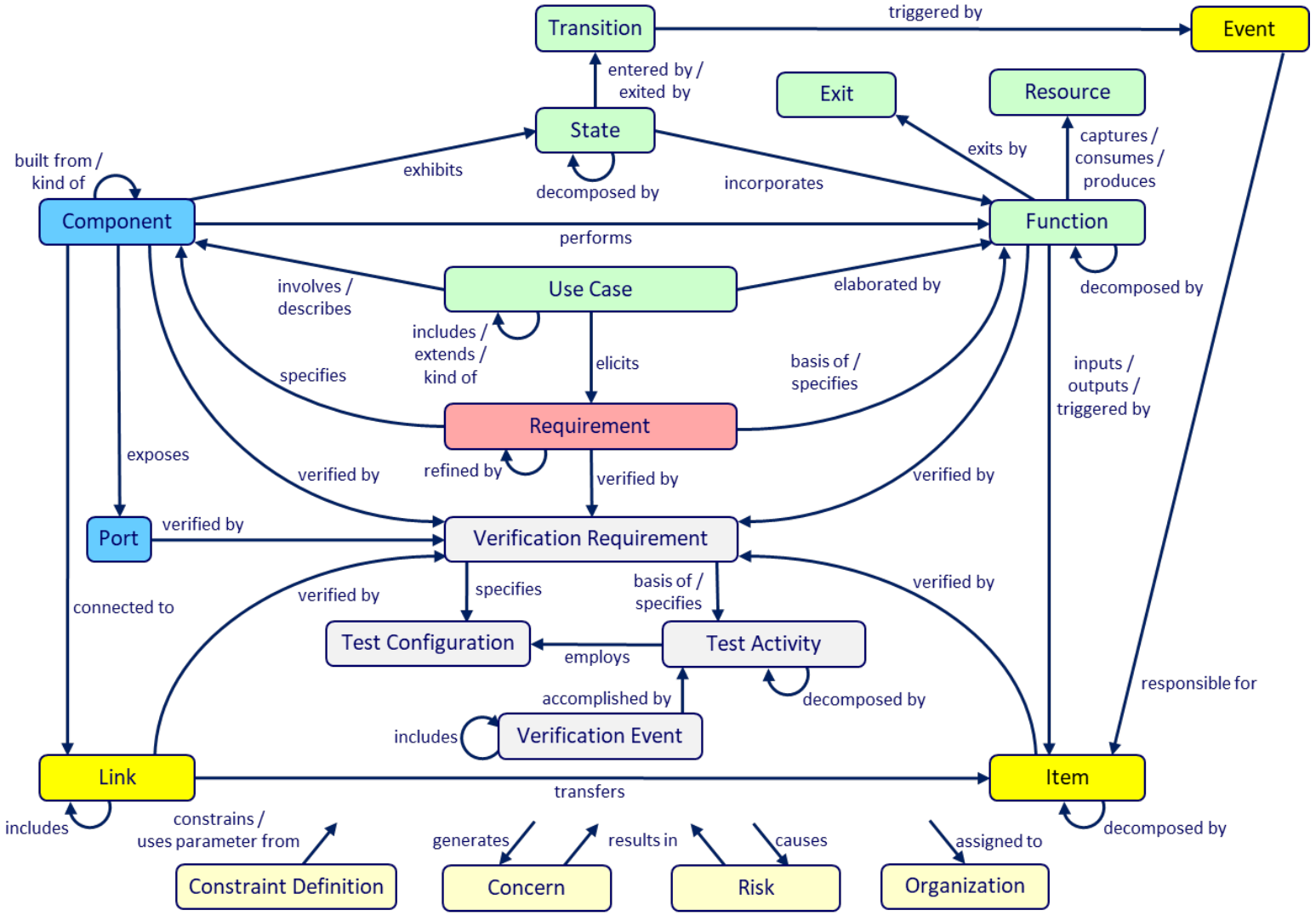
Color Code

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



Transition
triggered by
Event
entered by / exited by
Exit
Resource
State
exits by
captures / consumes / produces
built from / kind of
exhibits
decomposed by
incorporates
Component
Function
performs
involves / describes
Use Case
elaborated by
decomposed by
includes / extends / kind of
specifies
elicits
basis of / specifies
inputs / outputs / triggered by
Requirement
exposes
verified by
refined by
verified by
verified by
Port
verified by
Verification Requirement
connected to
verified by
specifies
basis of / specifies
verified by
Test Configuration
employs
Test Activity
accomplished by
decomposed by
responsible for
includes
Verification Event
Link
Item
transfers
includes
constrains / uses parameter from
generates
results in
causes
assigned to
decomposed by
Constraint Definition
Concern
Risk
Organization

Understanding the Systems Metamodel



…more than diagrams

…more than a data dictionary

…more than capture

…more than specification

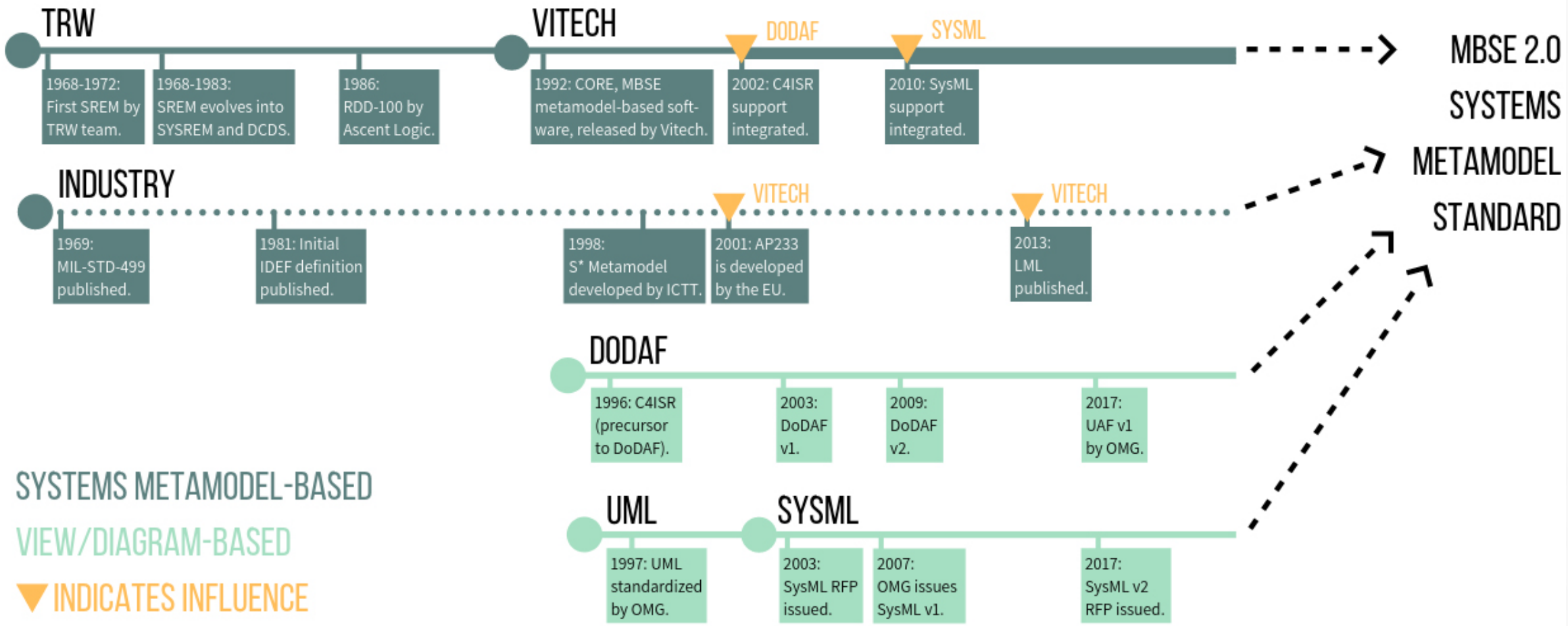
…more than the system of interest

Developing a Better Metamodel

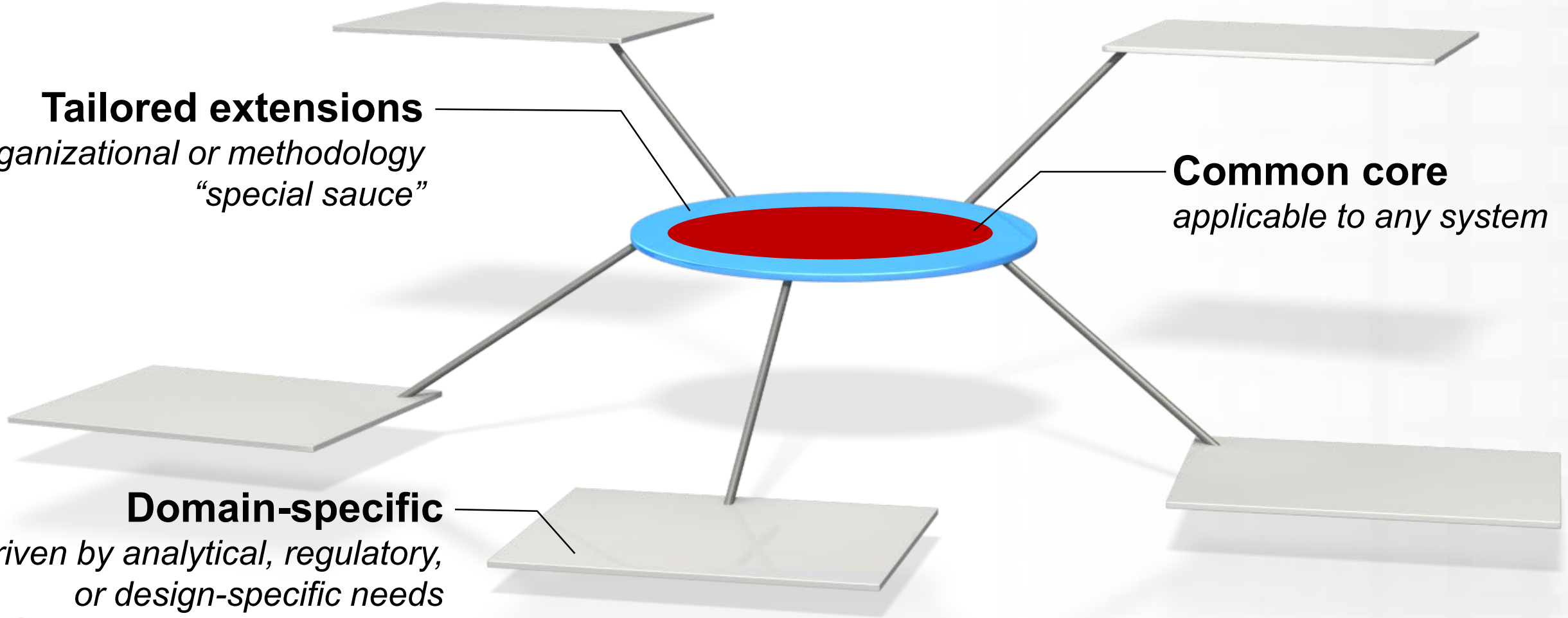
- Define your scope (engineering > modeling)
- Focus on the language of the domain
- Leverage both domain and language experts (but few heads are better than many)
- Manage the size (100 >> 1000 >> 10000)
- Emphasize interrelationships alongside concepts
- Begin with a proven base

DEVELOPMENT OF THE SYSTEMS METAMODEL

50 YEARS OF ADVANCEMENT



Leveraging and Connecting Core, Tailored, and Domain-Specific



Vitech

Aligning across the Engineering Enterprise

Right Data, Right Place, Right Time, Right Presentation

Program Mgt.

Configuration Management

Publications

Training & Personnel

Environmental

Operations

Maintenance

Logistics

Test

Security

Manufacturability

Reliability, Availability, Maintainability

Safety

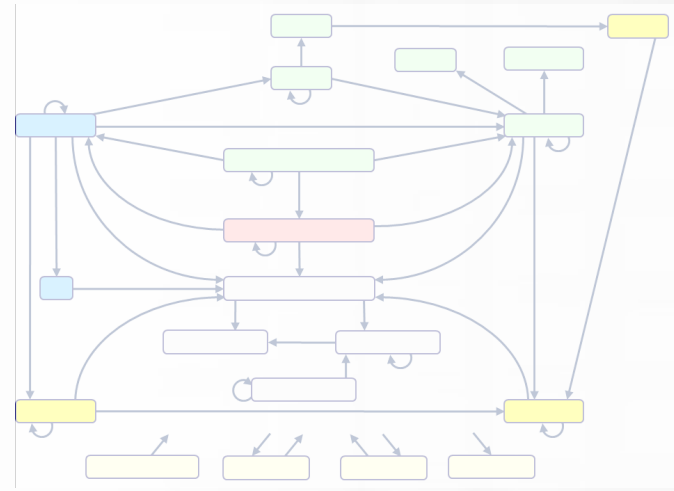
Software

Hardware

Chief Engineer

Customer

Systems Engineering Team



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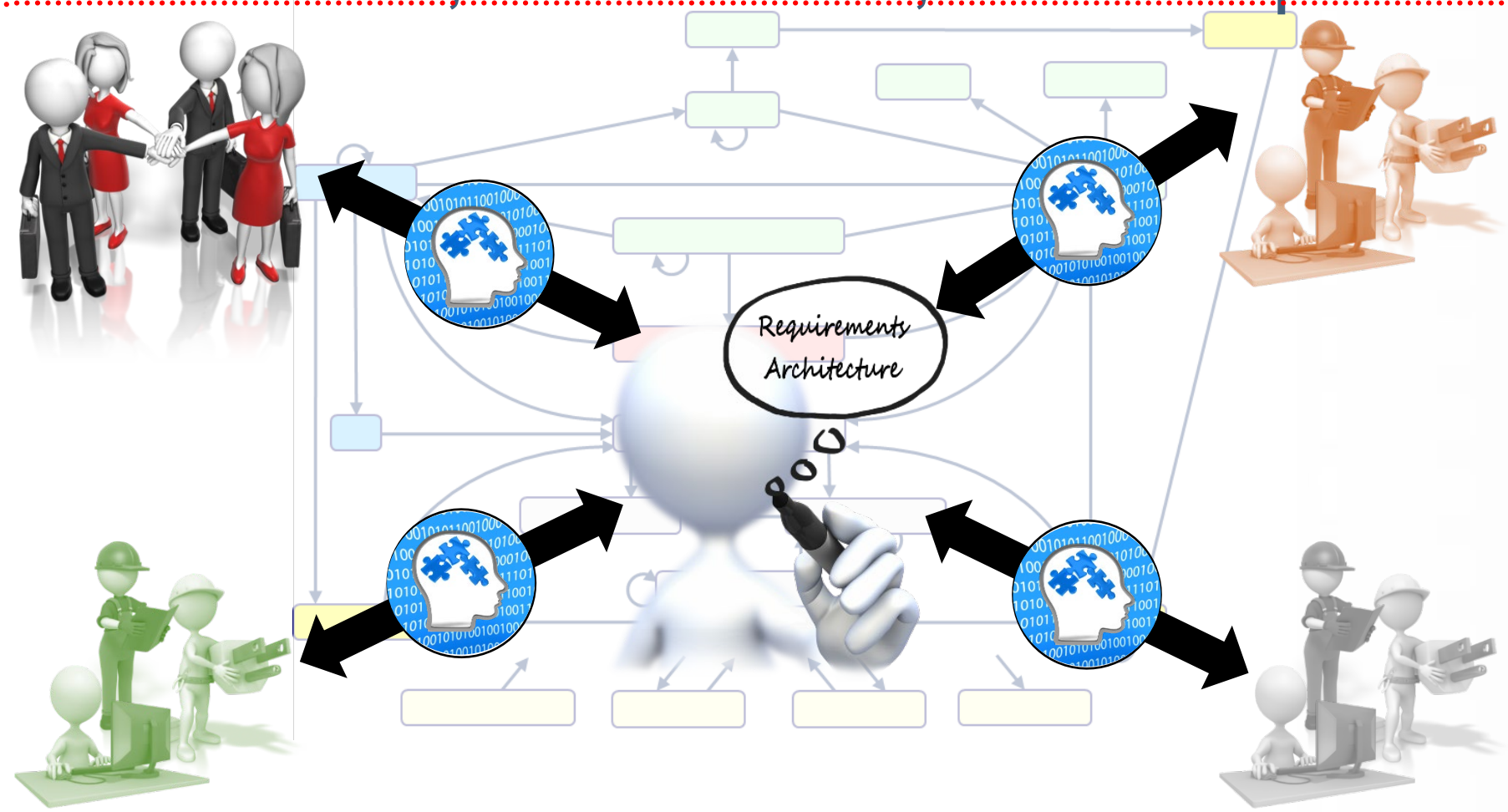
Seeing Many Dimensions: Tools, Concept, Connection, World View, and People



Functioning in an interdependent environment requires that every team possess a holistic understanding of the interaction between all the moving parts.

***Team of Teams*, 2015**

REQUIRED FUNCTIONAL LOGICAL AS DESIGNED AS ORDERED AS BUILT AS DELIVERED AS SERVICED

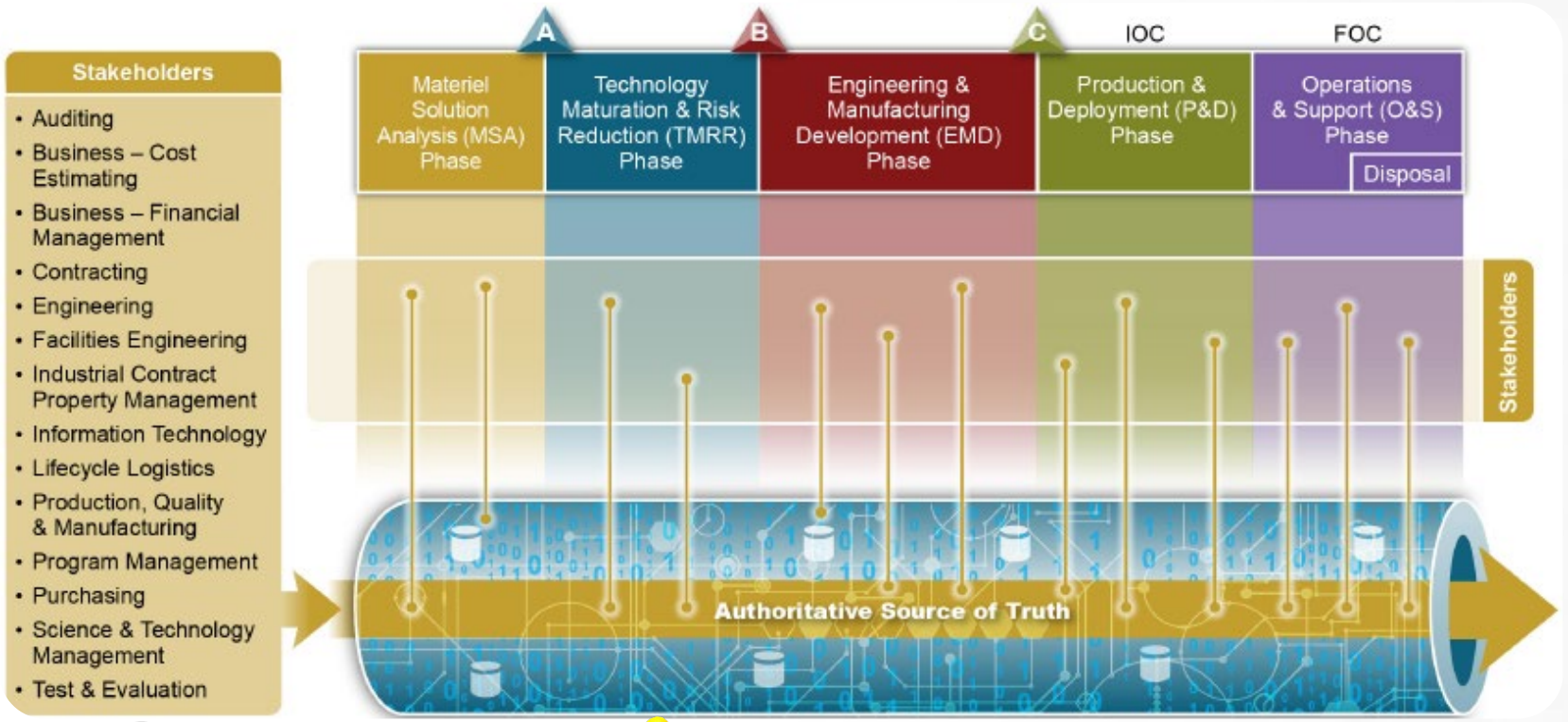
CONCEPT DEVELOPMENT PRODUCTION UTILIZATION & SUPPORT RETIRE

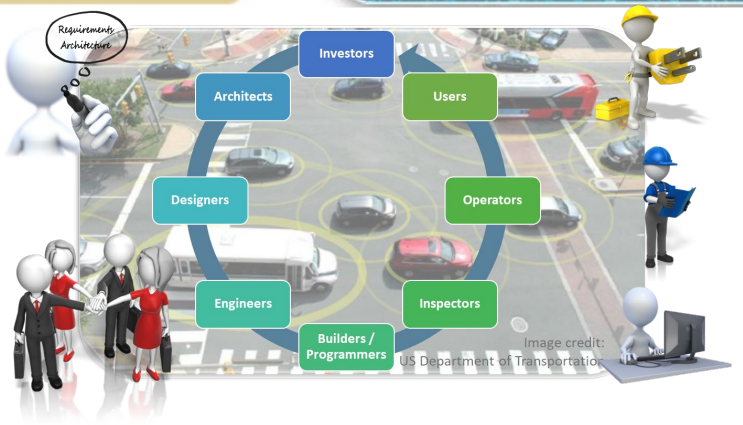
Aligning SE, MBSE, and Digital Engineering

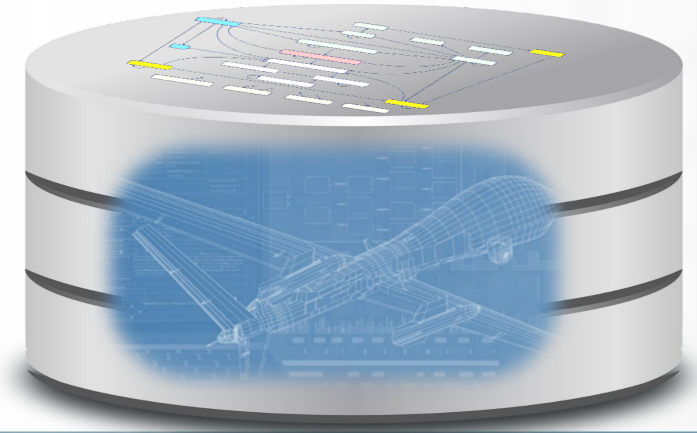
Digital Engineering
critical enabler for the modern engineering enterprise

MBSE
connective tissue of the Digital Engineering environment

Systems Engineering
technical connective tissue of the project team



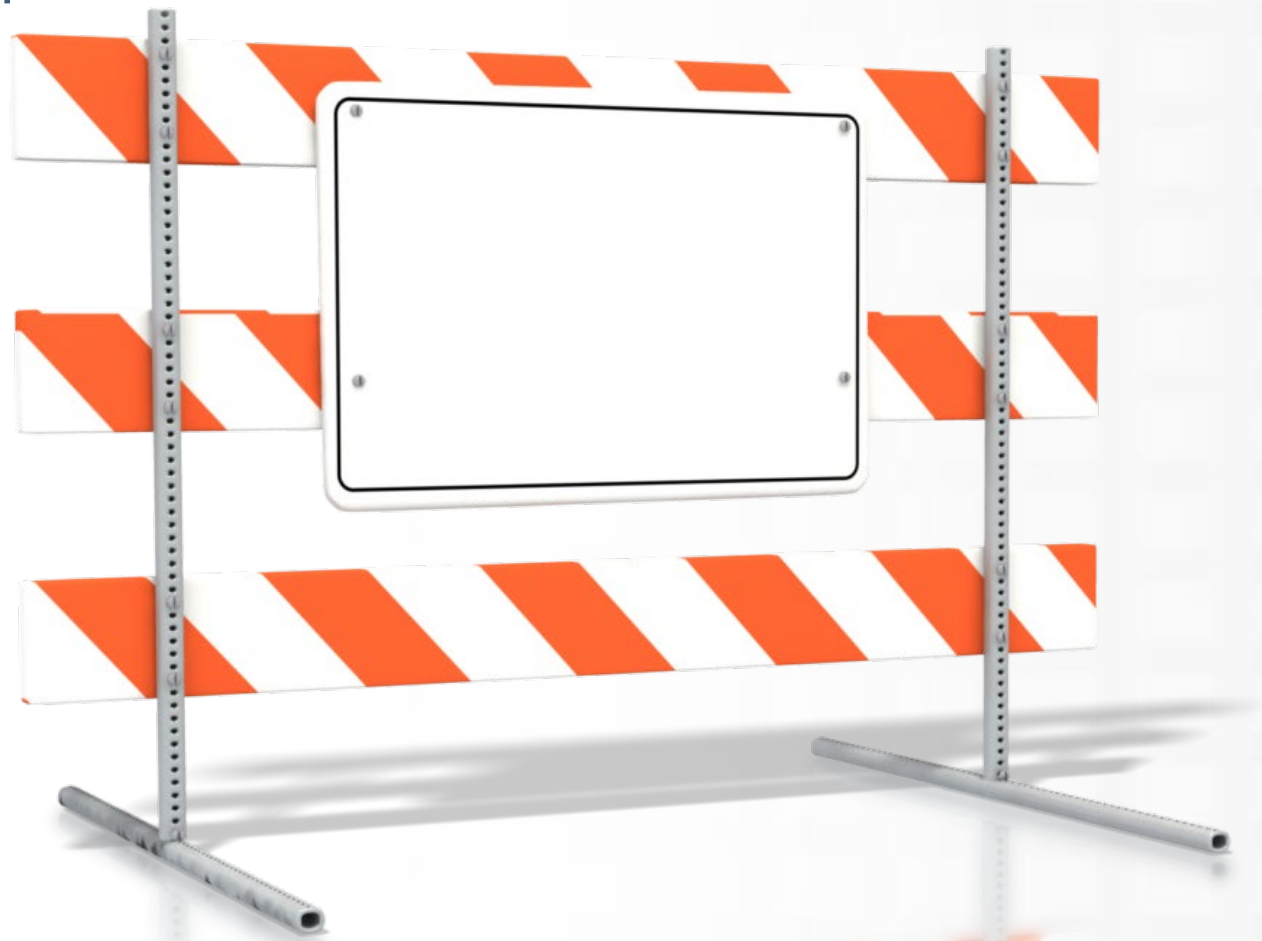




Vitech

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



Vitech

From Challenges to Successes: Engineering Systems in the Age of Complexity

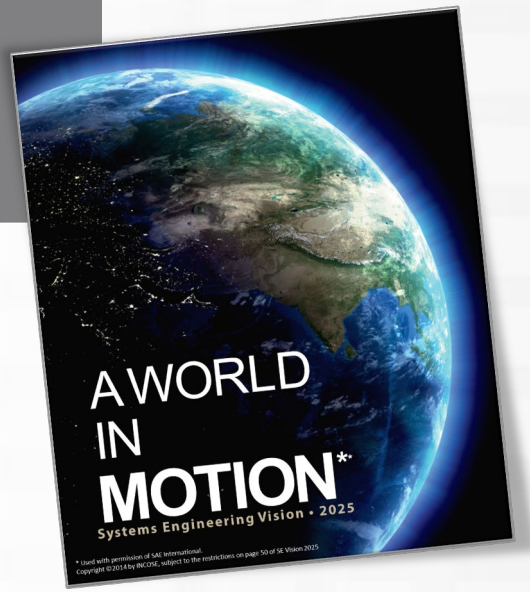
1. Insight into interactions and dependencies, both direct and indirect . . . equipping the team to respond effectively in the face of complexity and reduce mission risk.

2. Shared understanding of problem and solution across the team . . . resulting in resilient architectures and elegant solutions informed by the wisdom of multiple viewpoints.

3. Authoritative source of truth reflecting both design and rationale . . . accelerating programs and reducing costs by effective thru-life knowledge management.

4. Knowledge retention and organizational learning enabled by a proven metamodel . . . increasing effectiveness, reuse, and return on investment.

5. Coordination between SE and PM from architecting the program to architecting the system . . . informed by dependencies and impacts enabling effective decision making



Vitech

Questions and Discussion

Vitech
Insight through integration

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