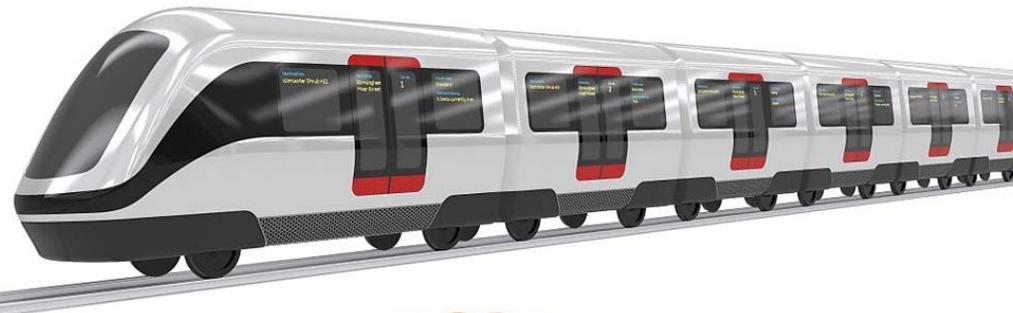
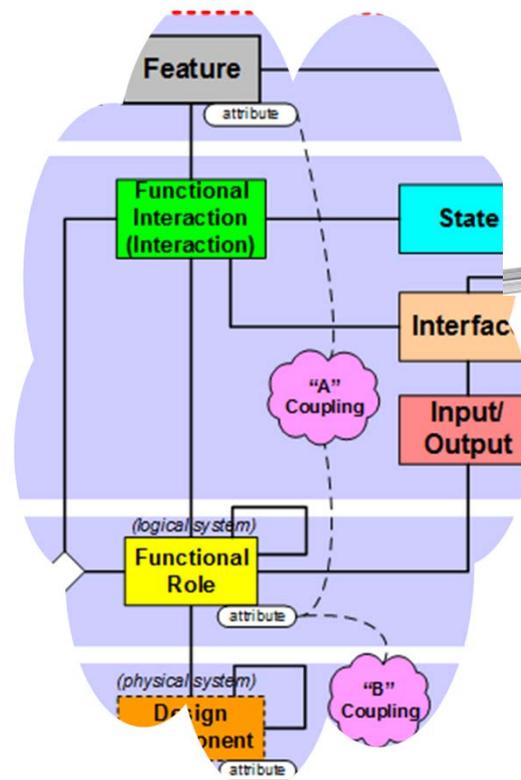
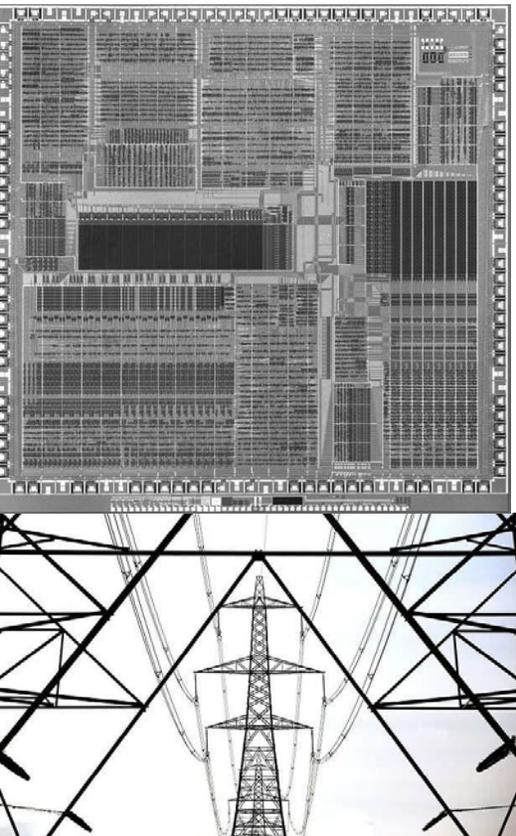
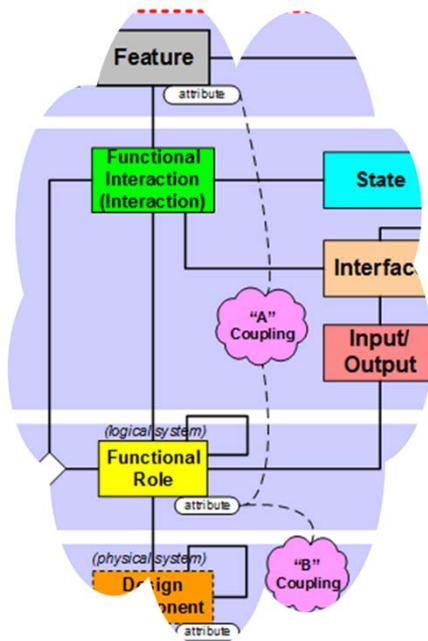




2018
Annual **INCOSE**
international workshop
Jacksonville, FL, USA
January 20 - 23, 2018

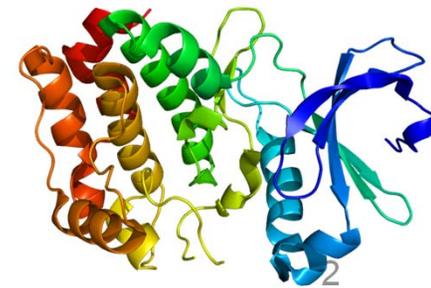
MBSE Patterns Working Group





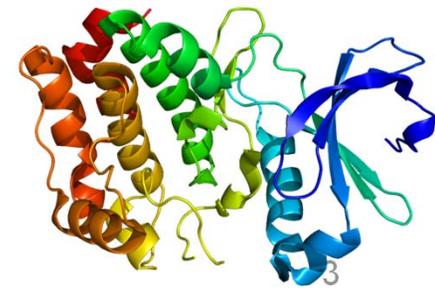
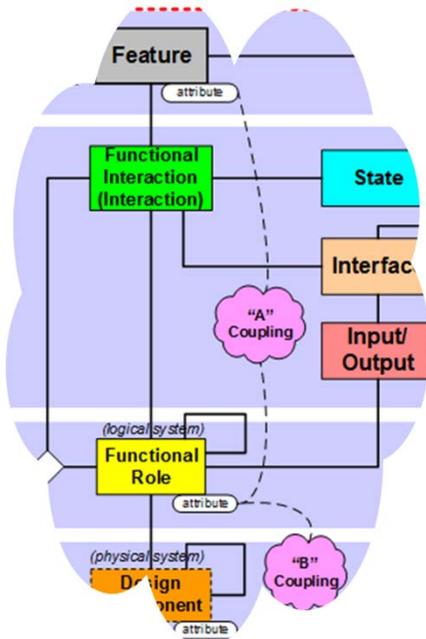
Contents

- Introduction to MBSE Patterns, and the Patterns WG
- Status of WG Projects
- Future Projects of Interest to Attendees
- References



Introduction to MBSE Patterns, and the Patterns WG

- Who we are—including our partners
- Types of activities
- IW2018 activities—when and where to find us
- How to get involved
- A “Patterns 101” introduction





We began four years ago, as the MBSE Initiative Patterns Challenge Team:

- Part of the joint INCOSE/OMG MBSE Initiative, formed years earlier as MBSE Patterns Challenge Team.
- In 2016, our team formally became the INCOSE MBSE Patterns Working Group
- Because of our MBSE focus, and in order to continue to support the MBSE Initiative, we continue to also be listed as part of that INCOSE/MBSE Initiative

This Working Group is concerned with configurable, re-usable system models: “S*Patterns”

1. Models containing a certain minimal set of elements are called S*Models (S* is short for “Systematica”)
2. Those underlying elements are called the S*Metamodel, which was inspired by the physical sciences
3. S*Models using those elements may be (have been) expressed in any modeling language (e.g., SysML, or other languages)
4. S*Models can be (have been) created and managed in many different COTS modeling tools.
5. Re-usable, configurable S*Models are called S*Patterns
6. By “Pattern-Based Systems Engineering” (PBSE) we mean MBSE enhanced by these generalized assets
7. These are system-level patterns (models of whole managed platforms), not just smaller-scale component design patterns



The INCOSE Patterns Working Group: Who are we?

- Our most active members come from across diverse domains:
 - Automotive
 - Advanced Manufacturing
 - Aerospace
 - Consumer Products
 - Defense
 - Health Care, Medical Devices, Pharmaceuticals
 - Others
 - Today's attendees?
- During the last four years, over 200 colleagues have participated in Patterns Working Group activities:
 - Team meetings, work sessions, tutorials, meetings with other groups
 - Construction of system patterns
 - Writing related papers for IS, IW, and regional INCOSE conferences
 - Invited presentations of our team's work to INCOSE chapter meetings

Patterns WG web site:

<http://www.omgwiki.org/MBSE/doku.php?id=mbse:patterns:patterns>

IW 2018 Patterns WG meeting web site:

http://www.omgwiki.org/MBSE/doku.php?id=mbse:patterns:mbse_patterns_wg_participation_in_incose_iw2018



Agenda, Partner Events of Interest: INCOSE MBSE Patterns Working Group, at IW2018, and Web Conferencing	US Eastern Time (ET)	Room	Global Meet
<p><u>MBSE Patterns WG:</u> <u>Joint IW activities,</u> <u>interests, conversations,</u> <u>project partners</u></p>			
<p><u>Patterns WG Pre-reading and Background:</u></p> <p>Meeting events and materials for activities of the MBSE Patterns WG at IW2018: http://www.omgwiki.org/MBSE/doku.php?id=mbse:patterns:patterns_challenge_team_mtg_01.28-31.17</p> <p>Minutes of previous meeting of the WG--July, 2017, at IS2017: http://www.omgwiki.org/MBSE/doku.php?id=mbse:patterns:mbse_patterns_wg_team_mtg_07.17.16</p> <p>INCOSE WG web site for MBSE Patterns WG: http://www.incose.org/ChaptersGroups/WorkingGroups/Transformational/mbse-patterns</p> <p>WG INCOSE/OMG mbse wiki site: http://www.omgwiki.org/MBSE/doku.php?id=mbse:patterns:patterns</p> <p>MBSE Patterns WG Charter: http://www.incose.org/docs/default-source/Working-Groups/MBSE-Patterns-WG/mbse-patterns-wg-re-charter-2016-incose-approved-v2-2-1.pdf?sfvrsn=2</p> <p>PBSE Methodology Summary from the Patterns WG: http://www.omgwiki.org/MBSE/doku.php?id=mbse:pbse</p>			



Agenda, Partner Events of Interest: INCOSE MBSE Patterns Working Group, at IW2018, and Web Conferencing	US Eastern Time (ET)	Room	Global Meet
Joint Agile-Patterns WGs review of INCOSE ASELCM Pattern Discovery Project INSIGHT Article on “Effective HW/SW Agile Systems Engineering at SSC-Pac” (Bill Schindel)	SATURDAY 11:00-11:30	City Terrace 4	
MBSE Workshop—Patterns WG Related Sessions: for additional MBSE Workshop sessions & details, see: https://www.incose.org/iw2018/program/mbse-initiative (Saturday 10:30-6:00)	SATURDAY	Grand Ballroom 6/7	
<i>MBSE Workshop Kickoff, Mark Sampson, Siemens</i>	10:30-11:00		
<i>Digital Engineering, Phil Zimmerman, US DoD</i>	1:00-1:30		
<i>Semantic Technologies for Systems Engineering, Steve Jenkins, JPL</i>	1:30-2:15		
<i>Future Directions for SysML V2, Sandy Friedenthal</i>	2:15-3:00		
Joint meeting of Patterns WG and Health Care WG, related HC MBSE Patterns project interests	3:00 – 4:30	City Terrace 8	
<i>System Science Working Group Session on Principles</i>	SUNDAY 9:00-12:00	St. John’s	
MBSE Patterns WG Meeting (Multiple Days): Introduction to MBSE Patterns, S*Models, and PBSE (a “Patterns 101 Introduction”) _____	1:00 – 2:30	City Terrace 6	YES
Status of Patterns WG Projects: Current Status Review, Next Steps Planning, Future Project Interests _____ Interface Patterns Project (see also below Monday work session on this project) ASME Model V&V Patterns Project, VVUQ Pattern (see also below Sunday MBSE Workshop) VSE Patterns Project (see also below Monday work session on this project) Agile Patterns Project; SPAWAR Case Study Article, Collaboration Pattern (also above Saturday) S3 Pattern and INCOSE OCM Patterns in the Public Square: GLRC 2017, ET2017, IS2018, GLRC 2018 TIMLM Patterns (includes ASME Model Life Cycle working group connection) HC WG Collaboration PLE WG Project CIPR Patterns IFSR Conversation SysSciWG Patterns SoS WG Collaboration	2:30 - 4:00 (Break: 3:00-3:30)		
Future Project Interests of Attendees _____	4:00-4:30		
MBSE Workshop—Patterns WG Related Sessions: for additional MBSE Workshop sessions & details, see: https://www.incose.org/iw2018/program/mbse-initiative			
<i>ASME Standardizing V&V of Models (Bill Schindel, ICTT)</i>	4:30-5:00		
<i>MBSE Workshop Wrap Up</i>	5:30-6:00	Grand Ballroom 6/7	
<i>MBSE Workshop Reception</i>	6:00-7:00		



Agenda, Partner Events of Interest: INCOSE MBSE Patterns Working Group, at IW2018, and Web Conferencing	US Eastern Time (ET)	Room	Global Meet
PWG joint meeting with Systems and Software Interface Working Group (Sarah Sheard, Chair)	MONDAY 11:00-12:00	City Terrace 8	
MBSE Patterns WG Project Work Sessions:			
PWG Work Session: Interface Patterns Project _____	1:00 – 2:30	City Terrace 6	YES
PWG Work Session: Very Small Entities (VSE) WG Joint Project on Configurable VSE Pattern _____	2:30 – 3:30		
PWG Work Session: Product Line Engineering (PLE) WG Joint Project on Harvesting Legacy Patterns _____	3:30 – 5:00		
System Science – Patterns WG Contributed Session: S*Patterns in support of systems science	TUESDAY 1:00 - 2:30	St. John's	
Working group poster displays at closing IW reception (Marketplace, formerly the WG Bazaar)	4:00 – 6:30		

For more information, contact-- **MBSE Patterns WG:** Bill Schindel schindel@ictt.com Troy Peterson tpeterson@systemxi.com

To remotely access the above Patterns WG sessions marked "YES" above for Global Meet in far-right column:

- PARTICIPANT GlobalMeet Join Details - Join as GUEST
 Meeting Details Web Address: <https://incose.pgimeet.com/GlobalmeetNine>
 Access Number: 1-719-867-1571
 USA /Canada (toll free): 1-877-860-3058
 Guest Passcode: 940 973 4856

More Dial In Numbers:

USA/Canada: 1-719-867-1571
 Canada, Montreal: +1 514 669 5924
 Canada, Toronto: +1 647 426 9185
 Argentina (toll free): 0800 666 0109
 Australia (toll free): 1 800 205 565

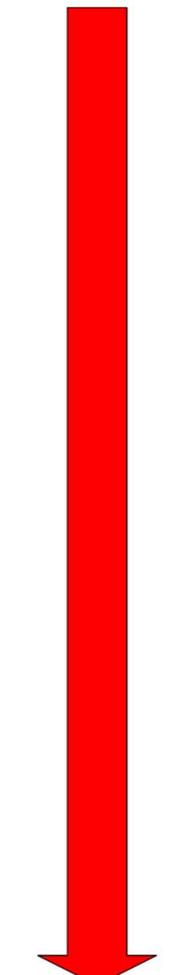
Australia, Brisbane: +61 (0) 7 3015 0534
 Australia, Melbourne: +61 (0) 3 8687 0563
 Australia, Sydney: +61 (0) 2 8017 6211
 Austria (toll free): 0800 8866 3423

Austria, Vienna: +43 (0) 1 25302 1796
 Bahrain (toll free): 800 81106
 Bahrain, Manama: +973 1619 8749
 Belarus (toll free): 8 820 0011 0346
 Belgium (toll free): 0800 39622
 Belgium, Brussels: +32 (0) 2 400 6945

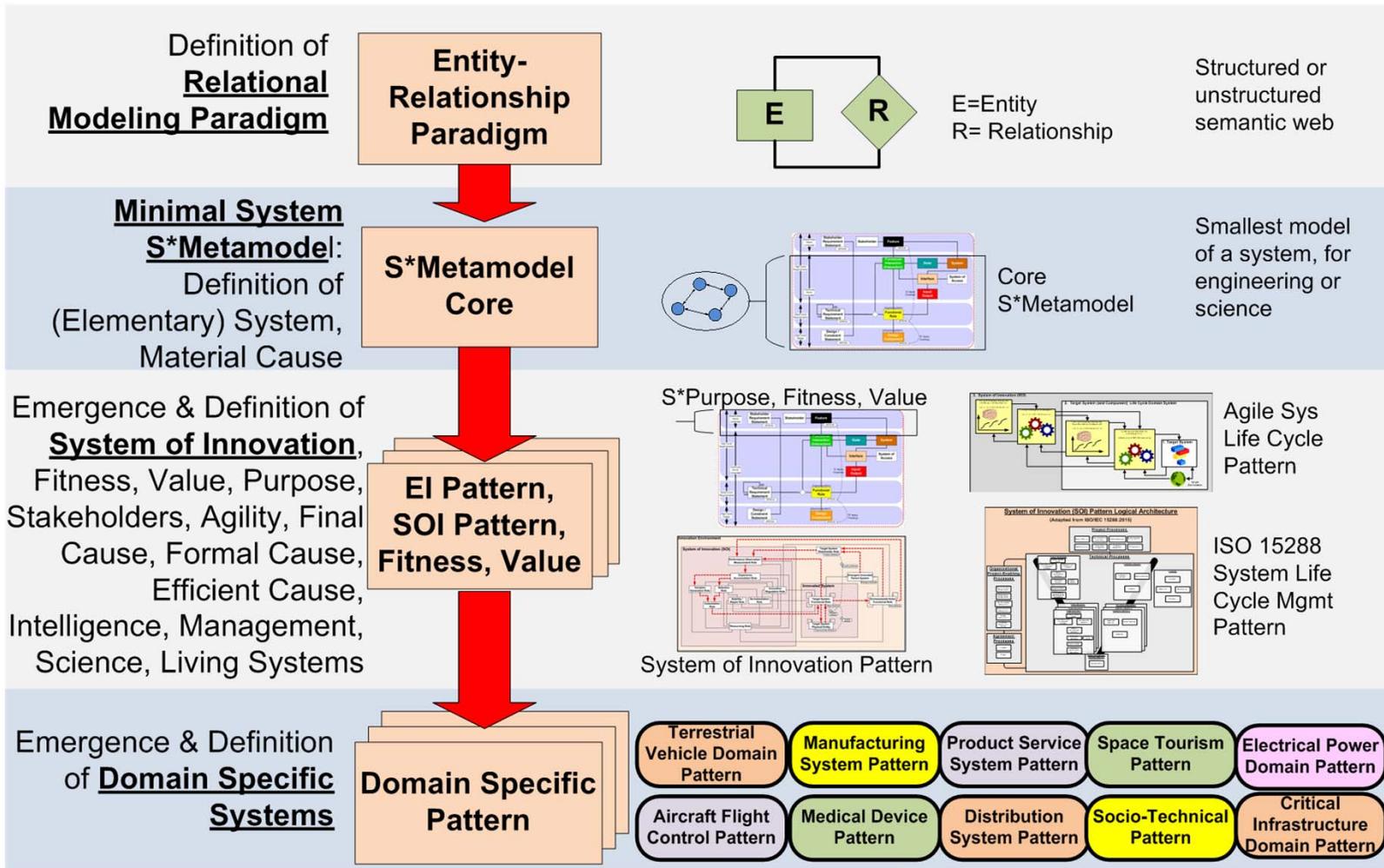


More General

Emergence of Patterns from Patterns: S*Pattern Class Hierarchy

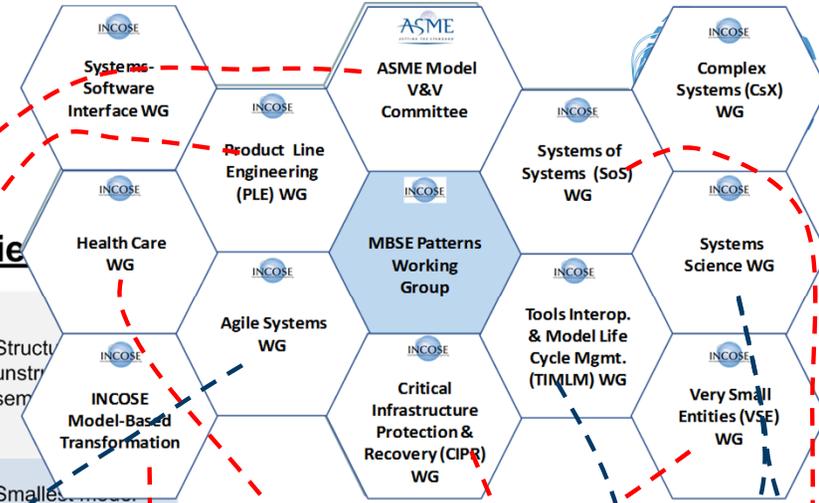
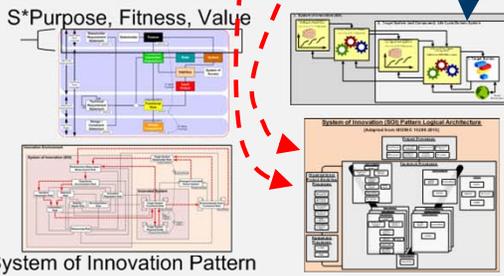
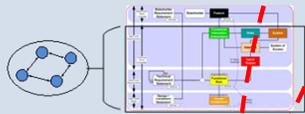
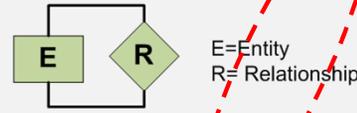
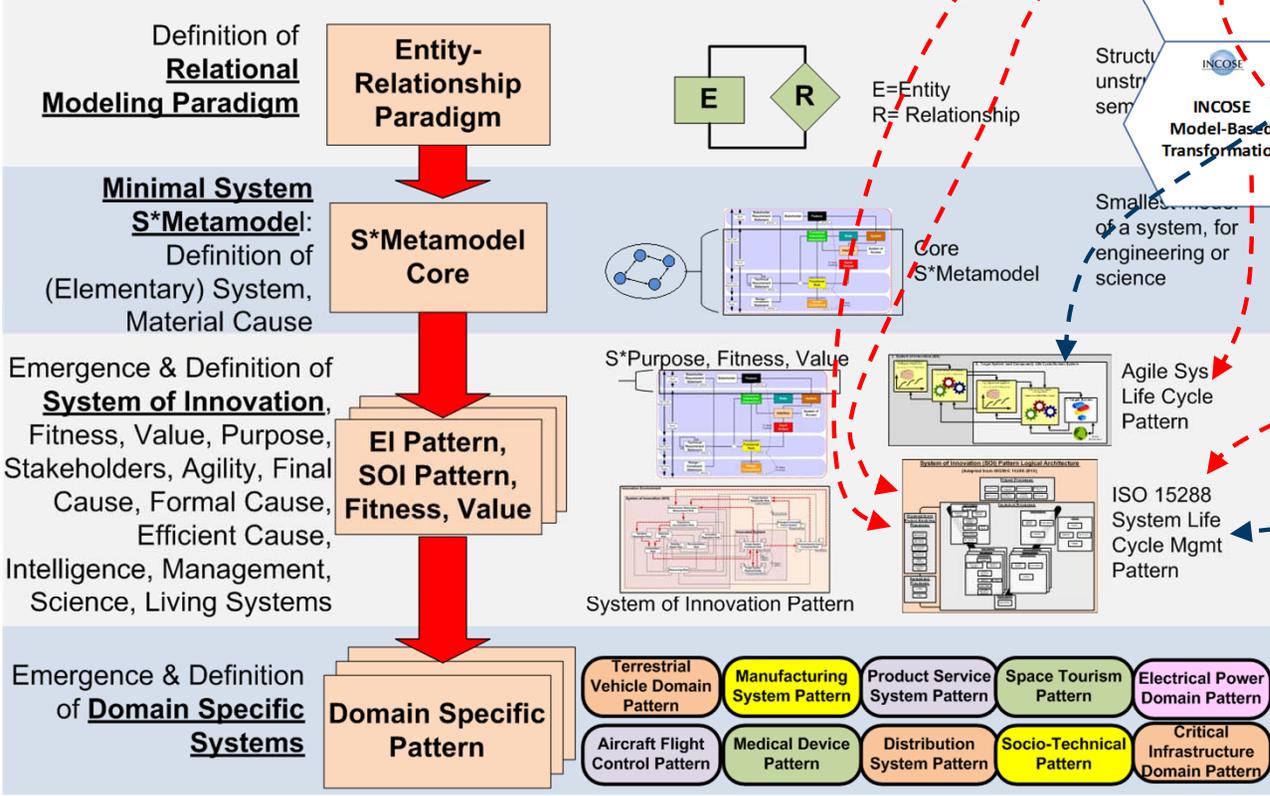


More Specific



Emergence of Patterns from Patterns: S*Pattern Class Hierarchy

More General
↓
More Specific



Structur
instru
sem

Smaller
of a system, for
engineering or
science

Agile Sys
Life Cycle
Pattern

ISO 15288
System Life
Cycle Mgmt
Pattern

Recent Patterns WG public activities



- INCOSE IS2017 (Jul, 2017)
- INCOSE Agile Health Care Systems Conference, 2017
- INCOSE Great Lakes Regional Conference 2017 (Oct, 2017)
- INCOSE Socorro Systems Summit (Oct, 2017)
- INCOSE/IEEE Energy Tech 2017 Conference (Nov, 2017)
- ASME VV 50 Model V&V Standards Committee (2016, 2017 working group meetings, May, 2017 Symposium)
- AIAA Aviation 2017 CASE Session, Denver (June, 2017)
- MBSE Symposium, No Magic, Inc. (May, 2017)
- V4 Institute Start Up (2017)



How to get involved with Patterns WG

- If you'd like to participate in, or follow, a current WG project, . . .
- If you would like to suggest a new WG project, . . .

Contact:

WG chair: Bill Schindel schindel@icctt.com

WG co-chair: Troy Peterson tpeterson@systemxi.com



A “Patterns 101” Introduction

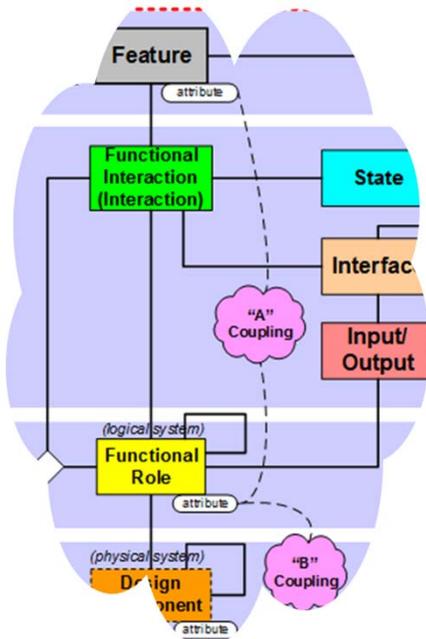
- (refer to separate materials)



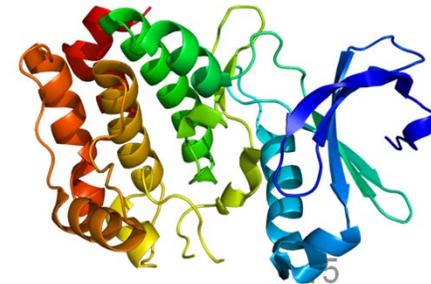
Example S*Pattern Content

- INCOSE PBSE Tutorial:
 - http://www.omgwiki.org/MBSE/lib/exe/fetch.php?media=mbse:patterns:pbse_tutorial_glrc_2016_v1.7.4.pdf
- More examples and materials on WG web wiki site:
 - <http://www.omgwiki.org/MBSE/doku.php?id=mbse:patterns:patterns>

Status of WG Projects

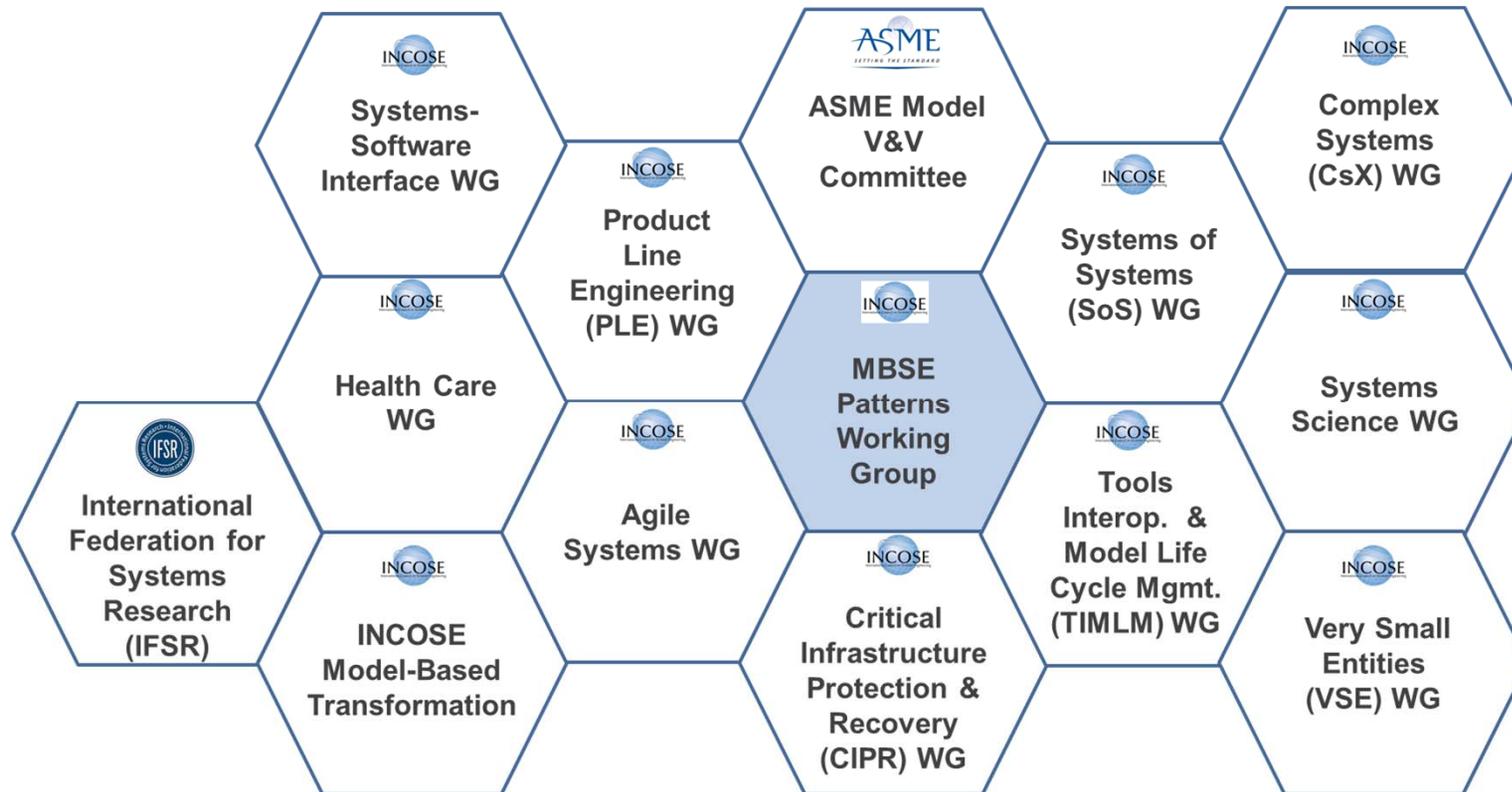


- Interface Patterns Project
- ASME Model V&V Patterns Project, VVUQ Pattern
- VSE Patterns Project
- Agile Patterns Project
- S3 Pattern and INCOSE OCM
- Patterns in the Public Square
- TIMLM Patterns
- HC WG Collaboration
- PLE WG Project
- CIPR Patterns
- IFSR Conversation
- SysSciWG Patterns
- SoS WG Collaboration





Working Group Partners in Progress



MBSE Patterns WG: Joint IW activities, interests, conversations, project partners

WG Project Team:
*Jon Torok, Frank Salvatore,
Jason Sherey, Stephen Lewis*



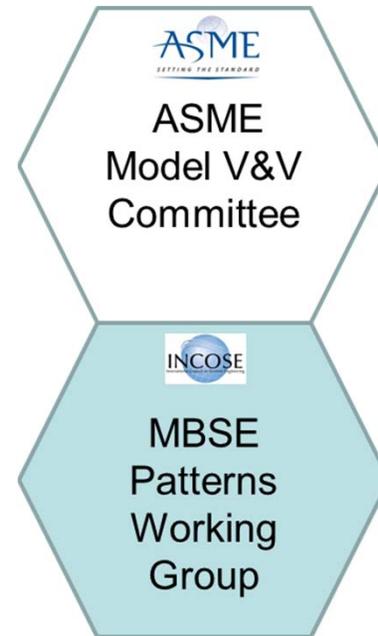
Interface Patterns Project: Jan 2018 Status

- Have identified relevant subset of S*Metamodel providing a basis for S*Interface Patterns
- Have identified and high level model framed a few interface types for initial attention, as configurable S*Interface Patterns (including initial use in V4 Institute and ST4SE Ontology work)
- Now creating high level model framed general Interface Control Document (ICD) query for any S*Interface
- Have reviewed related draft SysML 2.0 and JPL publications, and provided formal written feedback to SysML 2.0—in particular, on Interfaces, where some SysML updates are noted in direction of S*Interface metamodel.
- Meeting at IW2018 on 1/22 for next steps.

Working Group Partners in Progress



Primary Contact:
Joe Hightower, Boeing,
Gordon Shao, NIST,
ASME VV50 Committee



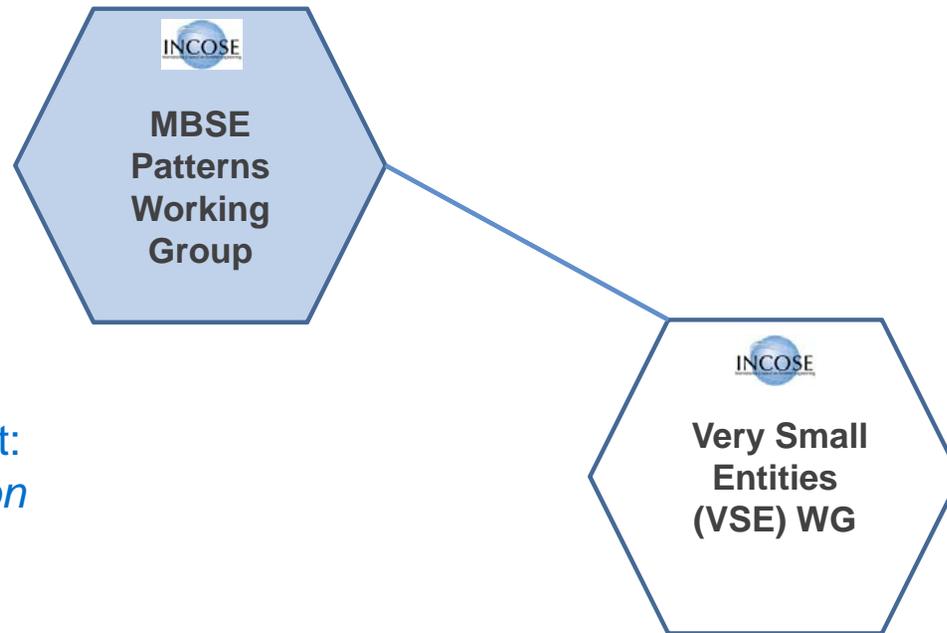
Supporting creation of ASME Guidelines & Standards for
Verification, Validation, Uncertainty Quantification of
Computational Models, over their Life Cycles



Model VVUQ Project Status Jan 2018

- Member ASME VV50 Standards Committee: Presenting related report to IW18 MBSE Workshop on Sunday, 1/21.
- Have generated VVUQ Pattern, a computational model meta-framework providing a uniform wrapper of metadata connecting any science or engineering model to its intended uses and related model VVUQ
- Basis for an INCOSE beta product for planning and assessing models of all types
- Being used in INCOSE MB Transformation team to package a series of example models sampled by that team across literature
- Have initiated a public panel series, “Patterns in the Public Square”, with invited participation by ASME, INCOSE, SAE, FDA, FAA, DoD, on issues of credible / trustable models in regulated and other public markets (at GLRC 2017, ET 2017, IS 2018, GLRC 2018)
- One of the Founding Members of the V4 Institute, under NCDMM, concerned with increasing competency to accelerate innovation using more virtual verification and validation of systems, based on trusted models. (Others include Rolls-Royce, Johnson & Johnson, Indiana University Pervasive Computing Scientific Gateways, Notre Dame University, others.)

Working Group Partners in Progress



Primary Contact:
Angela Robinson

Very Small Entities (VSE) Joint Project: VSE Project Pattern

VSE Working Group: Project Status Jan 2018



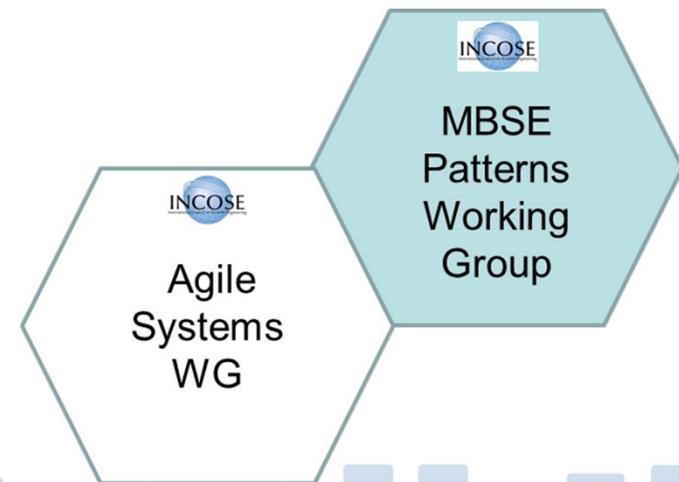
- Identified joint interest during 2017: S*Pattern representation of VSE deliverables
- IW2018: first joint meeting advancing this work
- Based on specialization of the S*Pattern for ISO 15288
- This also aligns this work with INCOSE ASELCM Pattern, System of Innovation Pattern, etc.

With Agile SE WG: Joint Activity Materials



- Agile Systems Engineering Life Cycle Management (ASELCM) Discovery Project: Creating, validating the ASELCM S*Pattern

Primary Contact:
*Rick Dove, Paradigm
Shift, Intl.*

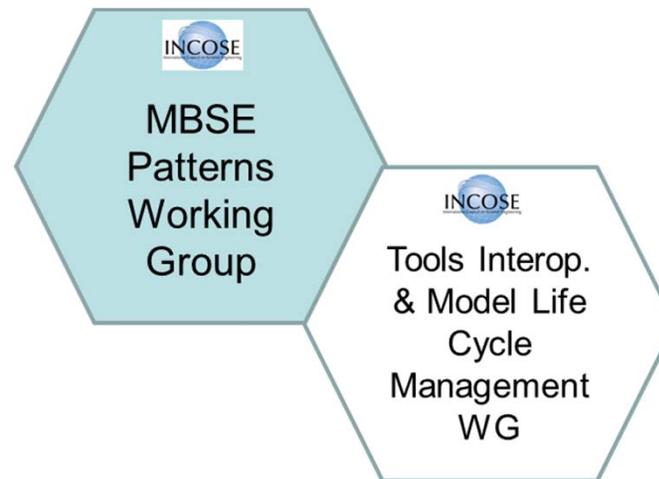


ASELCM Pattern Project: Jan 2018 Status



- ASELCM Pattern, specialized from ISO15288 Pattern, as been the basis of five co-authored INCOSE and IEEE case study papers, including an IS2017 best paper.
- Special issue of INCOSE INSIGHT in 2018 will feature another article on use of this model in the Navy SPAWAR case studies, being reviewed at IW18 on Saturday, 1/19.
- Has been successfully applied in multiple commercial projects during 2016-2017, establishing agile pattern-based SE frameworks for advanced manufacturing, automotive, consumer products, ...
- S3 portion of ASEMCL providing basis for reference model frameworks for study of challenges to innovation in Health Care (INCOSE Health Care Conferences of 2016, 2017), Electrical Power Grid and other Critical Infrastructure (INCOSE / IEEE / NASA ET 2016, 2017)
- Basis of V4 Institute framework for advanced virtual-based innovation competencies
- S3 portion of ASELCM is providing the basis for model-based reference framework for study of systems of innovation--

Working Group Partners in Progress



Primary Contact:
Lonnie VanZandt,
John Nallon

Patterns of collaboration in future innovation ecosystems,
including illustrative content

TIMLM Patterns Project: Jan 2018 Status



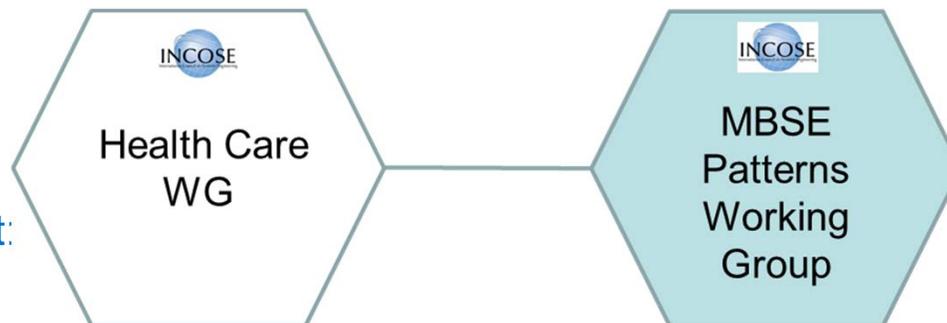
- Model Life Cycle Management:
 - Joined ASME VV50 Standards Committee, Model Life Cycle Working Group, in 2016
 - NIST, DOE, Boeing, ICTT System Sciences, Bosch, GE, others working on a model-based framework describing the life cycle management of models, with special emphasis on gaining and maintaining the credibility (VVUQ) of models over their life.
 - Part of this is also a model planning framework INCOSE beta product of the Patterns WG and INCOSE MBSE Transformation
- Mapping to COTS-based toolchain:
 - Demonstrated mapping of the underlying S*Metamodel underlying all S*MBSE Patterns to multiple third party COTS toolsets, including multiple SysML modeling tools, multiple PLM systems, engineering Requirements Management toolsets, etc. (steady flow of additions)
 - Part of the overall S*Patterns Reference Landscape for managing public, private, and hybrid IP



With Health Care WG: Joint Activity Materials

- Supporting the INCOSE Agile Health Care Systems Conference (third year) & the Health Care version of ASELCM Pattern

Primary Contact:
Chris Unger,
GE Health Care

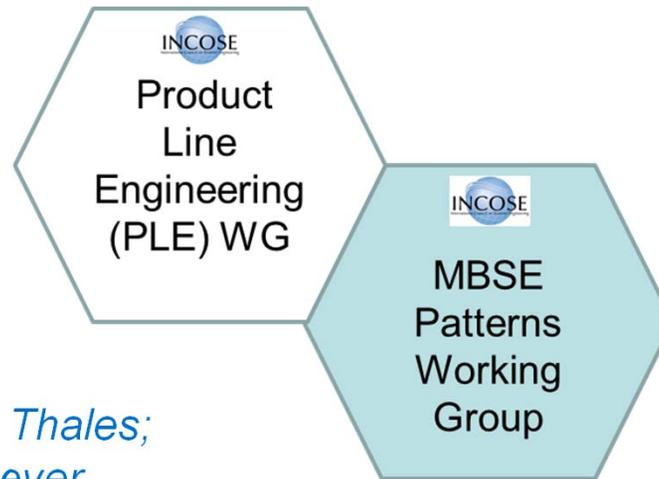


Health Care WG Collab: Jan 2018 Status



- Supported 2016 & 2017 HC Conference, including ASELCM Pattern application to a HC Industry SOI Pattern:
 - Resulted in identification of a collection of S3 and S2 issues and opportunities, including a key observation about missing gateway
 - Will participate in an “after PCAST Report” session at the IISE conference in February, 2018, to pursue this further
- Now originating a regulated products control systems model VVUQ paper:
 - Meeting at this IW2018 to make related plans
- Supporting ASME AABME planning of their first health care conference in 2018.
- Dr. Tina Morrison, FDA, will participate in our invited panel at IS2018, “Patterns in the Public Square”.

Working Group Partners in Progress



Primary Contacts:
Guillermo Chale-Gongora, Thales;
Charles Krueger, Big Lever

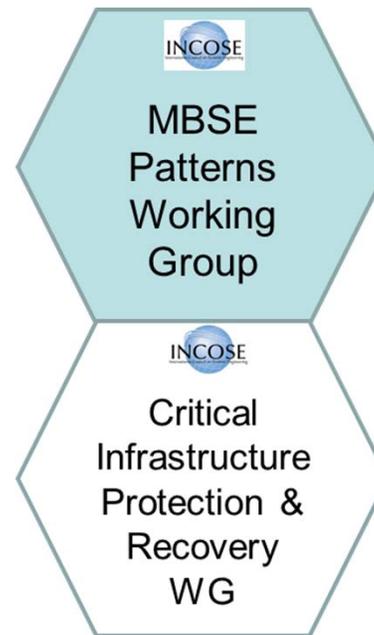
Joint demonstration of Legacy Product Line Pattern Harvest and Ecosystem for Product Line Life Cycle Patterns & Configurations



PLE WG Joint Project: Jan 2018 Status

- Sample COTS legacy system document (sanitized) provided by PLE WG, for a legacy pneumatic control system product line
- Projected legacy data onto S*Pattern space, identifying S*Features, S*Interactions, S*Interfaces, S*States, S*Requirements
- Meeting with PLE WG at IW2018 to determine next steps and interests

Working Group Partners in Progress



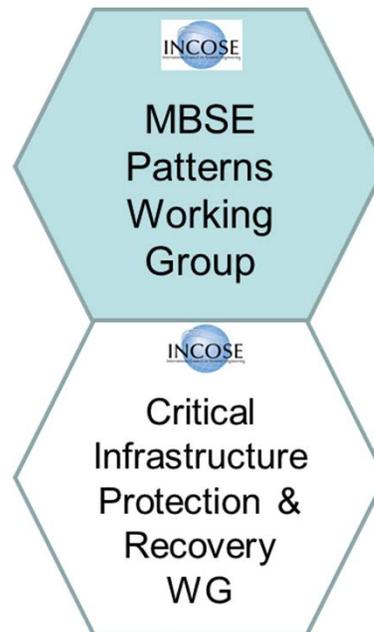
Primary Contact:
Mike DeLamar,
Bechtel

S*Patterns for Critical Infrastructure, Electrical Power,
Common Recovery Model; including ASELCM Systems 1, 2, 3

With Critical Infrastructure Protection, and Recovery WG: Joint Activity Materials



- S*Patterns for Critical Infrastructure, Electrical Power, Common Recovery Model: including ASELCM Systems 1, 2, 3



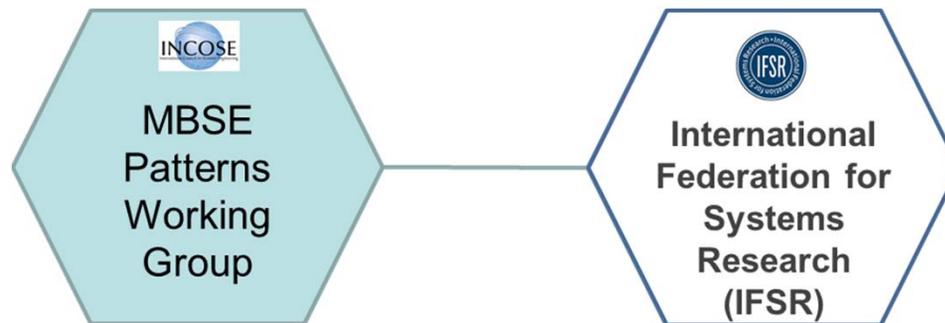
Primary Contact:
Mike DeLamar, Bechtel
Mark Walker, BCT

CIPR Pattern Collaboration: Jan 2018 Status



- During 2016-17, applied the ASELCM Pattern to a general Critical Infrastructure Pattern (all 16 DHS CI Systems) and a more detailed Electrical Power Grid Pattern
 - Used as basis summarizing related track discussion at ET 2016, and now subject of a related ET Proceedings publication being created by the conference.
 - Used as basis of support for project by J. Marvin, J. Cadigan, et al to demonstrate model-based framework for Big Data simulation and validation of power grid model behavior in presence of local solar generation and resale, weather variation, etc., presented by J Marvin at ET2017.
- During 2017, CIPR WG pursued SysML model of Microgrid, providing a case study about why the industry (EPRI, then ISO) CIM model is not being used as basis for that model:
 - Perhaps an illustration of the ASELCM System 3 observation we have made about general enthusiasm/tendency for re-creating from scratch models repeatedly versus sharing and improving existing models—an interesting challenge for INCOSE to consider.

Working Group Partners in Progress



Primary Contact:
*Ed Carroll, Sandia
Laboratories*

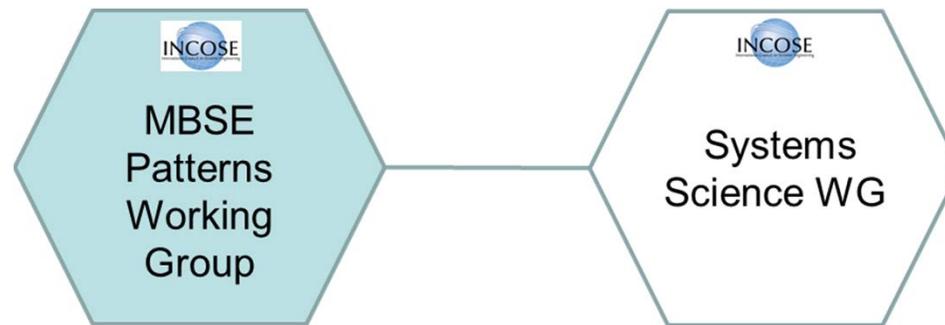
*A stronger foundation for information in systems
engineering practice.*

IFSR 2018 Conversation, Linz, Austria



- Patterns WG will participate in International Federation for Systems Research (IFSR) “Conversation” event April 13-18, 2018:
 - Organized by Ed Carroll, Sandia Laboratories
 - Seeking a stronger foundation for data-driven systems engineering
 - Very related to ASELCM Pattern, Model VVUQ Pattern, Systems Phenomenon Pattern, et.

Working Group Partners in Progress



Primary Contact:
James Martin

S*Interactions & S*Patterns as
a basis for a hard science of systems



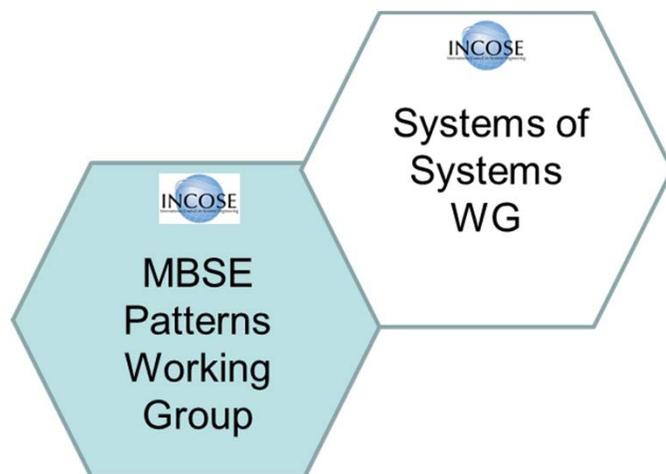
SSWG Collaboration Status Jan 2018

- Presented invited session to IW2017 SSWG, on System Phenomenon Pattern as the existing used basis for the domain-specific hard sciences (mechanics, chemistry, et al)
 - Related INCOSE publication on System Phenomenon, IS2017.
- Summary: Some systems people seem to be asserting there is a wonderful theory of systems not yet discovered. We assert that there is a wonderful theory of systems already discovered by the pioneers of physical sciences and mathematics, but it is being overlooked by some of the systems community.
- Using well-established existing frameworks from Hamilton (principle of stationary action, leading to fundamental equations at root of each physical science discipline), Noether (previous follows from symmetries, leading to conservation laws and emergent parameters), etc., (e.g., Lagrangian Coherent Structures) general Lagrangian-based simulations (Marija Illic, etc.)
- Further discussion of above to occur:
 - Contributing session at SSWG IW2018 on Tuesday afternoon
 - Contributing to IFSR Conversation, Linz, Austria, 2018



With SoS WG: Joint Activity Materials

- Support of SoS Pattern Library, including build-out of S*Metaclasses

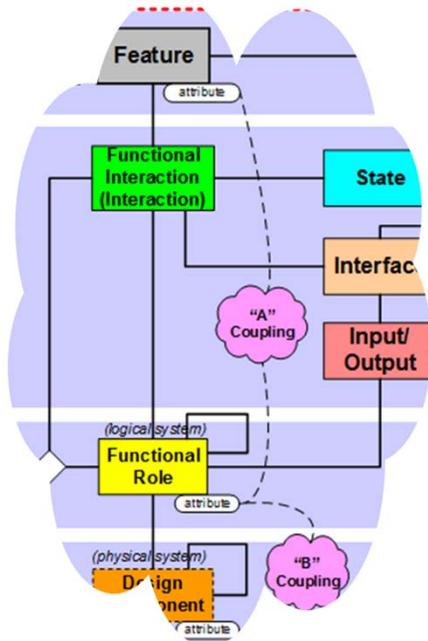


Primary Contact:
*John Fitzgerald,
Newcastle U.*

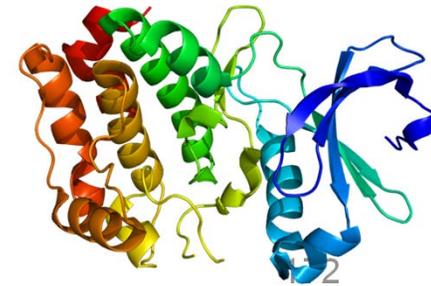
SoS WG Collaboration: Jan 2018 Status



- Held joint “SoS Patterns Workshop” at IW2016.
- Reviewed SoS architectural patterns presented by SoS WG
- Identified S*Feature sets as key illustration of S*Pattern content that could be used to express in the explicit pattern-based model various information previously shown as external prose discussion (e.g., fitness space, etc.)
- Offered to convert a few selected SoS WG Patterns to S*Pattern form to illustrate this:
 - SoS WG has indicated those patterns not yet available



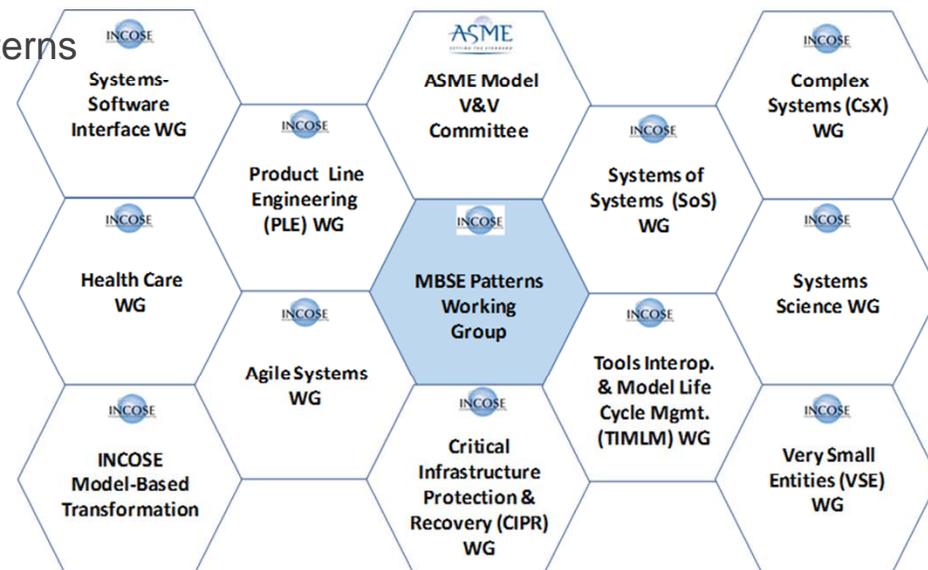
- Future Projects of Interest to Attendees:
 - Current and Future projects
 - PBSE Infrastructure
 - Open discussion





Patterns WG Planning and Support

- Future potential PWG Projects:
 - Depends on your interest to work on them
 - Existing projects with partners
 - Others that our members have mentioned in the past:
 - Support for deliverables of the INCOSE MBSE Transformation Lead Team
 - Additional targeted system application domain patterns
 - Targeted science domain patterns
 - ISO 15288 Implications of PBSE
 - PBSE support for COTS Tools and Information Systems
 - Visualization
 - PBSE Implementation strategies & roadmaps, scenarios
 - PBSE contribution to SEBoK
- Interest in these or other projects
- Open Discussion





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