



INCOSE Model Based Systems Engineering (MBSE) Workshop

February 1-3, 2009

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Workshop Objectives



- Share results from
 - Activity Leads
 - Challenge Teams
- Foster Activity Lead/Challenge Team Interaction
- Elicit broader participation

MBSE Vision



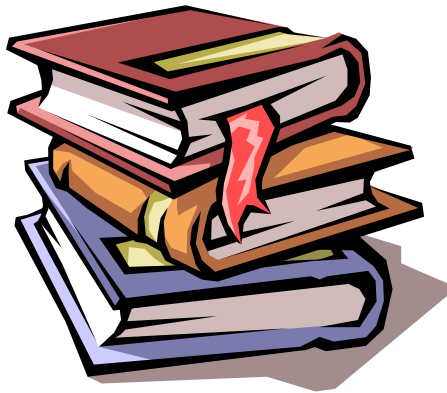
***Reference: SYSTEMS ENGINEERING VISION 2020
INCOSE-TP-2004-004-02, Version 2.03, September 2007**

The screenshot shows the INCOSE website interface. At the top, the INCOSE logo and tagline 'International Council on Systems Engineering' are visible. Below this is a navigation bar with tabs for Home, About INCOSE, Membership, Chapters, News & Events, Products & Publications, Education & Careers, and Advancing the Practice. The 'Products & Publications' tab is selected, and a dropdown menu is open, listing various resources such as Overview, SE Handbook, Measurement Primer, Metrics Guidebook, Technical Measurement Guide, Tools Database, SE Primer, Conops of SE, Education Community, SECAM, SE Leading Indicators Guide, and SE Vision 2020. A mouse cursor is pointing at the 'SE Vision 2020' option. On the left side of the page, there is a sidebar with a 'Products & Publications' section containing a list of items: Overview, SE Handbook, Measurement Primer, Metrics Guidebook, and Technical Measurement. The main content area features an 'Overview' section with text about INCOSE Technical Products and their approval process, followed by a list of product types: Technical Publications, Primers, and Database Products.

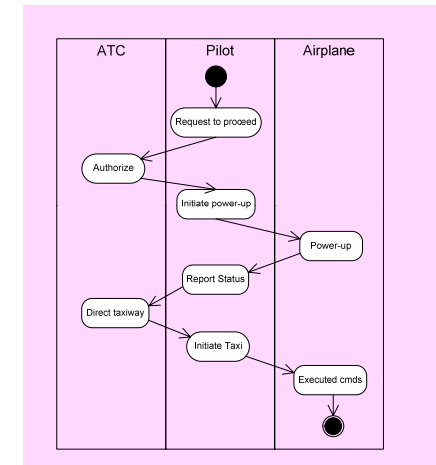
SE Practices for Describing Systems



Past



- Specifications
- Interface requirements
- System design
- Analysis & Trade-off
- Test plans

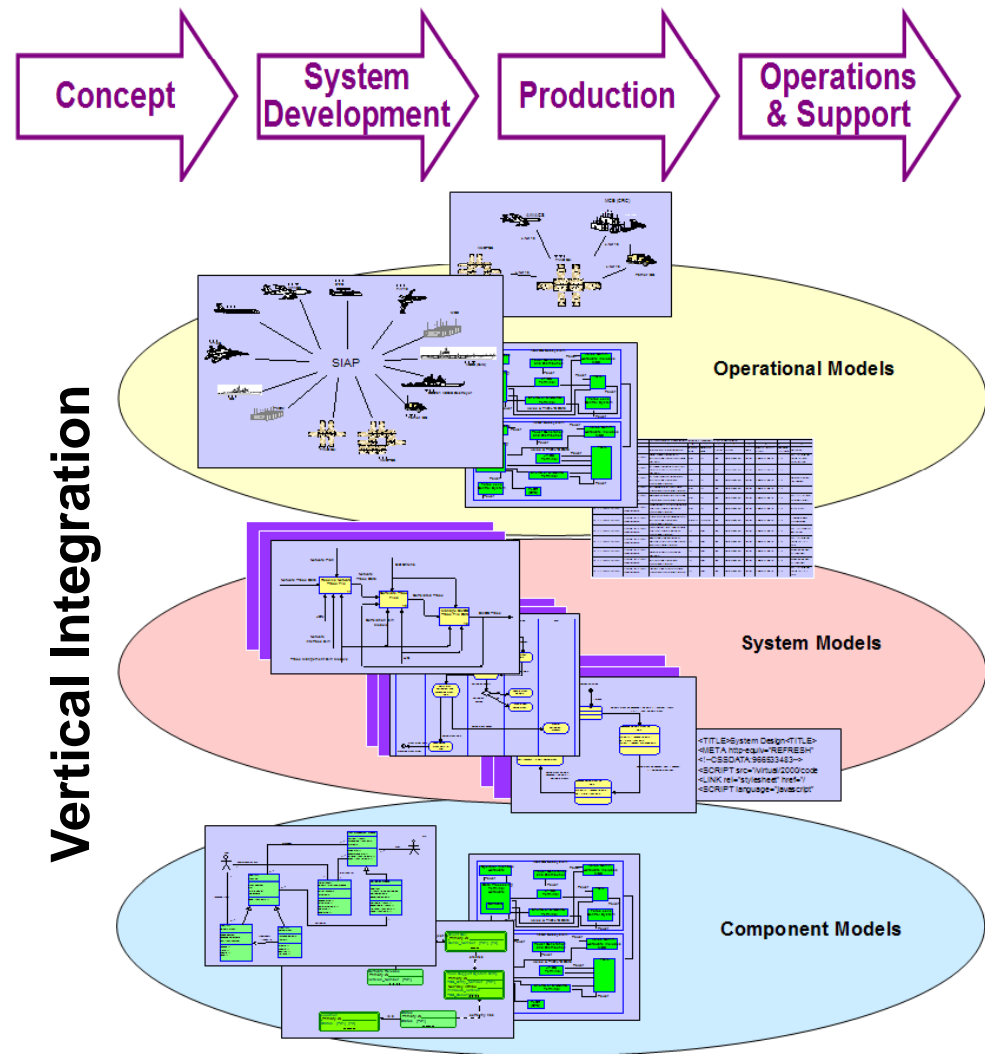


Moving from Document centric to Model centric

Model-based Systems Engineering (MBSE)



Life Cycle Support



- Formalizes the practice of systems engineering through the use of models
- Broad in scope
 - Integrates with multiple modeling domains across life cycle from SoS to component
- Results in quality/productivity improvements & lower risk
 - Rigor and precision
 - Communications among system/project stakeholders
 - Management of complexity

MBSE Benefits



- Improved quality
 - Early identification of requirements issues
 - Enhanced system design integrity
 - Improved specification of allocated requirements to HW/SW
 - Fewer errors during I&T
 - More rigorous requirements traceability
- Increased productivity
 - Improved impact analysis of requirements changes
 - Reuse of existing models to support design/technology evolution
 - Auto-generation of documentation
- Reduced risk
 - Improved cost estimates
 - Early/on-going requirements validation & design verification

Integrated Systems Engineering Vision



Power
Rate



Sensor
MTBF:
3000 hrs

Minimum Turn Radius: 24 ft.
Dry Pavement Braking Distance at 60 MPH: ~~110~~ ft. 90 ft

FAILURE MODE AND EFFECTS ANALYSIS (DESIGN FMEA)

Rev	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
2	Print #	01 03 Body															
3	System/Subsystem/Component	SubSystem															
5	Model Year(s)/Vehicle(s)	2005															
7	Team	T. Fender- Car Prod. Dev. Children- Man, J. Ford-Assembly Opps															
9	Design Responsibility	Body Engineering															
10	Key Date	9/1/04															
11	Date (Orig)	8/1/04															
12	Date (Rev)	8/22/04															
13	FMEA Number	1234															
14	Prepared by	J. Ford-Assembly Opps															
15	Rev	A															
16	Rev	A															
17	Rev	A															
18	Rev	A															
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FIGURE NOT INCLUDED IN VISION page 7



MBSE Initiative



MBSE Initiative Background



- INCOSE held a series of workshops to formulate the MBSE Vision as part of the overall SE Vision 2020
- Established MBSE Initiative to help realize the MBSE Vision
 - Need for Initiative identified at IW07
 - MBSE Initiative kickoff at IS07
 - First MBSE Initiative Workshop at IW08
 - Emphasis on initial planning
 - Refer to INSIGHT Article (April, 2008) for summary
 - Challenge Team presentations at IS08
 - Significant progress and much to share and learn from



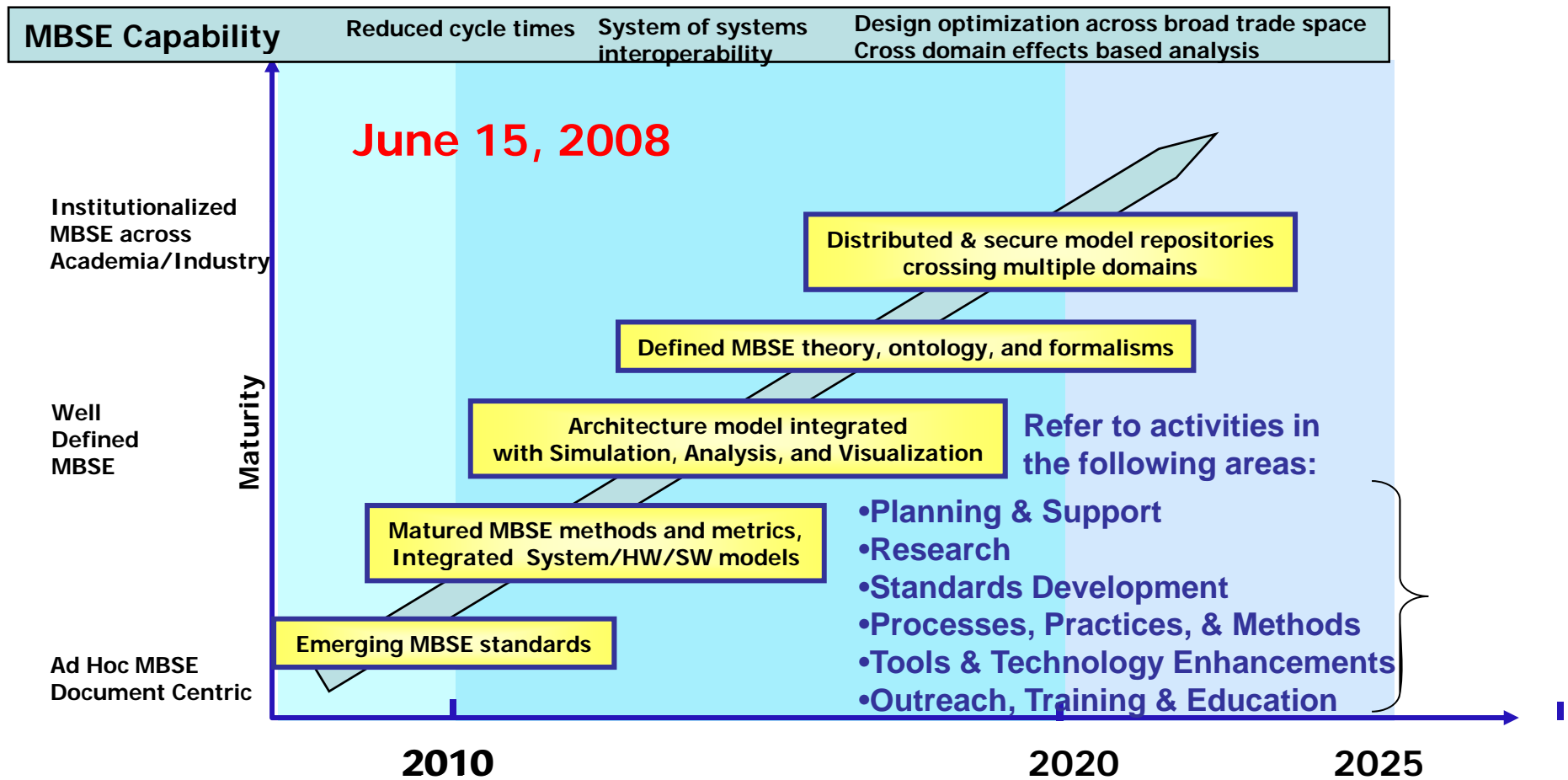
MBSE Initiative Charter



- Promote, advance, and institutionalize the practice of MBSE to attain the MBSE 2020 Vision through broad industry and academic involvement in:
 - Research
 - Standards
 - Processes, Practices, & Methods
 - Tools & Technology
 - Outreach, Training & Education



INCOSE MBSE Roadmap





MBSE Initiative Organizational Approach



- Leadership
 - Facilitate and communicate MBSE direction
 - Chair: Mark Sampson
 - Deputy; Sanford Friedenthal
 - Deputy: Regina Griego
 - Communication Lead - Ray Jorgensen
 - Collaboration Technology Support - Tim Dilks
- Challenge Team Leads
 - Lead challenge teams to promote MBSE, advance the state of practice, and share lessons learned
- Activity Leads
 - Foster and facilitate integration of MBSE roadmap activities across industry, government and academia

MBSE IS08 Activities and Challenge Teams



- Human Systems Integration - Jen Narkevicius/Abe Meilich
- System of Systems – Ron Williamson
- System modeling ontology - Ralph Hodgson
- Complex Adaptive Systems – Sandy Friedenthal for Ken Lloyd
- MDA for SE - Rob Cloutier
- SysML – Sandy Friedenthal/Roger Burkhart
- Simulation and SysML - Tom Haley
- AP-233 - Phil Spiby
- MBSE Methodology Survey – Jeff Estefan
- Model-based Testing – Max Lorenzo, Tom Tenorio
- SE Interoperability – Peter Denno
- Telescope Modeling – Robert Karban (ESO)
- Space Systems – Chris Delp (INCOSE SSWG)
- MBSE Applied to Urban Transportation – Larry Head (UA)
- Mechatronics/Model Interoperability – Russell Peak (GIT)
 - <http://www.pslm.gatech.edu/projects/incose-mbse-msi/>

MBSE Workshop IW09 Agenda



Sunday, February 1: 08:30 - 17:00 – Activity Lead Sessions

08:30 - 09:00 Workshop Introduction - Friedenthal

09:00 - 11:00 Activity Session #1 (3 concurrent presentations)

- MBSE Methodologies – Jeff Estefan
- Model Management - Joe Bedocs
- Human System Integration – Abe Meilich

11:00 - 12:00 IW Opening Plenary

12:00 - 13:00 Lunch

13:00 - 15:00 Activity Session #2 (3 concurrent presentations)

- MBSE Methodologies – Jeff Estefan
- Model Management - Joe Bedocs
- Human System Integration – Abe Meilich

15:00 - 17:00 Activity Session #3 (2 concurrent presentations)

- System Modeling Ontologies - Ralph Hodgson
- System of Systems Modeling - Ron Williamson

MBSE Activity Sessions Descriptions



- **MBSE Methodologies** – Presentation of the MBSE Methodologies based on the MBSE Methodologies Survey (Rev B)
- **Model Management** – How are people maintaining configuration of models? How are people modeling as a distributed teams? What are some naming conventions being used? What about variant modeling?
- **Human System Integration** – How are human system concerns addressed as part of system modeling.
- **System Model Ontologies** – How can ontologies help with MBSE? In particular, can it help with modeling multiple aspects of a problem using different tools? A brief overview of ontologies and there uses will be provided as it relates to MBSE Challenge problems.
- **System of Systems Modeling** – How can we extend our current modeling to System of Systems? How can these concepts be applied to the MBSE Challenge Team problems?

MBSE Activity Sessions Guidelines



- Approximately 45 minute presentation
- Open it up to discussion from participants
 - Prepared questions
 - Appoint a scribe

MBSE Workshop IW09 Agenda (cont.)



Monday, February 2: 08:30 - 16:30 – Challenge Team Sessions

08:30 - 10:00 Intelligent Enterprise – Jose Garcia

10:30 - 12:00 GEOSS Structure & Opportunity – Larry McGovern

12:00 – 13:00 Lunch

13:00 - 14:30 M&S Interoperability (incl. Mechatronics Appl.) - Russell Peak

15:00 - 16:30 Space Systems Modeling - Chris Delp

Tuesday, February 3: 08:30 - 17:00 – Wrap-up Session

11:00 - 12:00 MBSE Leadership meeting

(Mark, Regina, Sandy, Roger, Phil, Rob Cloutier, Ray, Tim)

13:00 - 14:00 AP233/SysML Mapping Status - Roger Burkhart and Phil Spiby

14:00 – 14:30 MBSE Wrap-up - All



INSIGHT Magazine MBSE Special Issue

Model-Based Systems Engineering: ~~A~~ *The*
New Paradigm

Rob Cloutier, Stevens Institute

MBSE Special Issue of *INSIGHT* - Introduction



- At the INCOSE Workshop 2008 the MBSE Challenge Team to manage an issue of *INSIGHT* magazine dedicated to Model Based Systems Engineering.
- Purpose:
 - Recognition of the unique challenges and progress related to the use of model based systems engineering across multiple domains
- Rob Cloutier will act as the Editor for the MBSE content.
- The MBSE theme edition is scheduled for Volume 12, Number 4, with a submission due date of 15 October 2009 for a publication date in December 2009 .
- **Articles are due in July 15 2009.**

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REGAL*

***A web based tool to collect, share and evolve
Systems Engineering good practices***



*Requirements Engineering Guide for All, but applicable to Systems Engineering

What is REGAL ?

- A web-based interactive solution to find helpful systems (requirements)* engineering practices
 - Not only a repository of best practices, but a living database enriched by the experience of practitioners
- It is structured to align with the INCOSE SE HandBook Version 3, as a requirements engineering Book of Knowledge.
- REGAL is a dynamic, growing Body of Knowledge for Requirements Engineers, as any user can:
 - Comment on existing good practices
 - Submit good practices
 - Rate good practices interactively and view other people's ratings of good practices
 - Select good practices applicable to their domain

Access to REGAL

- <http://www.incose.org/REGAL>
- Available to any INCOSE member
- Use login & password from connect.incose.org

Use cases of REGAL

Use case	REGAL	Benefits
How do I implement a requirements engineering process ?	REGAL includes the SE Handbook from INCOSE. Good practices are linked to activities. From activities in the Hbook, REGAL provides links to good practices.	A practical guide to requirements engineering
How can quickly identify requirements best practices from existing good practices ?	REGAL gives the list of the top 20 good practices from the average of the users' evaluations.	A quick focus on best practices (rated by users)
How can I know which good practices are suitable for my industry domain ?	Good practices are classified by project context.	Quick focus on good practices by project context
Can I have an big picture across good practices ?	Good practices are classified by categories such as Elicitation, Traceability ...	A direct access to good practices by topics
How do I know that good practices are approved ?	Draft good practices are identified. Comments on draft or approved good practices are available to any users. Good practices are reviewed twice a year by RWG and other INCOSE concerned WG to be approved.	A guarantee that good practices available in REGAL are shared by the requirements community.

Next steps

- Deploy REGAL
 - Train REGAL administrators in WG
 - Organize reviews, common WG meetings
 - Present papers
- Connect REGAL to the SEHBook on Wiki
- Organize good practices according to CMMI levels
- An expert system to advise good practices to apply in a particular context: RAFT

RAFT Objectives

- To help selecting “the right” RE practices for a specific project by making the judgment of experienced product developers available to the project team:
 - Have the RE practices been selected / implemented that will most likely contribute in a cost-effective way to a successful project?
- NOT to:
 - perform project control
 - describe / prescribe / define the methods to implement / deploy /apply the selected RE practices
 - assess the other Critical Success Factors from the SE and Project Management “tool box”

INCOSE

Architecture Working Group (AWG)

Presented to:

IW09 AWG Session

3rd February 2009

Dr Mike Wilkinson
INCOSE AWG Co-Chair

AWG Purpose & Objectives

- The purpose of the AWG is to expand the practice of architecture and the body of knowledge (BOK) in Systems Engineering
 - Promote the use and practice of architecture principles in systems engineering
 - Share best practices for the use of architecture in systems engineering projects
 - Promote the principles of architecture in systems engineering within the member's home organizations
- The main objectives of the Architecture Working Group are to
 - Capture and evolve the architecture body of knowledge
 - Increase AWG membership knowledge of architecture in the practice of systems engineering
 - Expand effort in Architecture related standards
 - Provide quality technical products to the INCOSE members, following the guidelines of the Technical Leadership Team

2008 Organisation of the AWG

- Chair
 - Professor Charles Dickerson, Loughborough University
 - Royal Academy Chair of Systems Engineering
- Co-Chairs
 - Dr. Mike Wilkinson, Atkins, Co-Chair UK Chapter AWG
 - Professor Dimitri Mavris, Georgia Institute of Technology
- Leadership Team: 12 members
- Community of Practise: 15 members
- At Large Members: about 30 members
 - And about 30 IS08 attendees expressed interest

2008 Contributions (1 of 3)

- Two major AWG contributions
 - Adding to the architecture body of knowledge
 - Collaboration with ISO and the IEEE on the ISO WG 42 for architecture definitions
- Adding to the architecture body of knowledge
 - Converged concepts and concepts from
 - Aerospace and defence systems engineering
 - Model Driven Architecture (MDA™) for S/W engineering
 - Model Based Systems Engineering (MBSE)
 - Book to be in print by April 2009
 - *Architecture and Principles of Systems Engineering*
 - by Dickerson and Mavris

2008 Contributions (2 of 3)

- Collaboration with ISO and the IEEE
 - Special 3 day Workshop held at IW08
 - Moderated by Dr. Bill Ewald
- AWG Session at IS08 on the Collaboration
 - Moderated by Dr. Sumeet Malhotra
 - Review of results from IW08 workshop
 - Exploration of two approaches to support ISO
 - Logical Modelling of sentences for precision comparison
 - Belief System Modelling for resolution of differences

2008 Contributions (3 of 3)

- Links to UK Chapter AWG
 - Belief Systems Methodology
 - Being developed further
- Links to INCOSE Security WG
 - Interplay of Security, architecture & Systems Engineering
 - Special issue of Insight in April

2008 Issues

- Final documentation of Collaboration with ISO/IEEE
 - Summary of IW08/IS08 results
 - Logical Modelling or Belief System Modelling?
 - Results of IW08 insufficient for Logical Modelling
- INCOSE AWG Webmaster
 - Previously was Lynda Balthrop
 - Need to identify someone who has the time and talent
- The AWG Chair and Co-Chairs are overloaded!
- Other issues?

2009 Vision

- Proposed Focus of 2009
 - An AWG level discussion of key topics
 - Reorganise the AWG to an international level
- Future Vision
 - Chapter Level AWGs for an international footing
 - Chairs of Chapter AWGs are INCOSE AWG Co-Chairs
 - Joint working with other WGs
 - LEAN, Security, etc

Possible work topics

- System of systems architecture
 - MDA (for systems engineering)/MBSE
 - Integration of Software and Systems Engineering
 - Open architecture for through life capability
 - Architecture for rapid procurement (eg UORs)
 - Evolution models for architecture
 - Use of architecture to support systems engineering trades
 - Architecture practice in different market sectors
 - Use of architecture in test, evaluation and acceptance
-

Organisation

- Management Team
 - Co-Chairs and Workstream Leads
 - Contributions via regular ex-committee work expected
- Workstream Contributors
 - Contributions via regular ex-committee work expected
- AWG Members
 - Contributions via regular attendance at meetings or via wiki
 - provide 'Quality Control' review function
- General Public
 - Access to public part of wiki and access to AWG technical products?