Digital Engineering in the Age of AI as Basis for System of Systems Engineering:

Digital Design & Integration

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Bingran Wang	The University of Sydney





KEY CHALLENGES AND PROPOSED SOLUTIONS/ACTIONS

1. Educating Digital Engineering (incl. AI)

- Introducing students to digital engineering with industry software - when & how?
- Keeping pace with AI, data-driven processes and changing roles
- Teaching responsibility and human-AI cooperation
- Dealing with unequal access to AI models
- Preparing students for (international) teamwork, creativity and problem solving
- Providing physical experiences to back up theoretical knowledge

- Run "Follow the Sun" international team exercises.
- Provide student matchmaking and explore industry sponsorship.
- Organize digital engineering / aircraft-design hackathons.
- Identify available open software & data.
- Take initiative to find/create missing software tools & data.
- Share successful applications and education experiences.



KEY CHALLENGES AND PROPOSED SOLUTIONS/ACTIONS

2. AI in (Digital) Engineering

- Curated data for training and validation
- Evaluation metrics and data quality
- Engineering intent; non-deterministic behavior
- Vendor claims versus real capabilities
- Digital sovereignty and IP protection

- Promote awareness and rigorous evaluation metrics.
- Explore a joint ICAS / AIAA / INCOSE white paper.
- Compile a list of curated data sets.
- Extend digital engineering across ICAS topics and identify links.
- Consider annual DPI workshops with partner societies.



KEY CHALLENGES AND PROPOSED SOLUTIONS/ACTIONS

3. Reference Data / Tools Set

- Data-hosting costs and intellectual property
- Industry-relevant detail and model fidelity
- Fragmented model and interface standards

- Create resource: "yellow pages"
- Create and maintain a curated ICAS body of knowledge.
- Invite contributions to fill data and model gaps.
- Consider a group on interfacing / harmonizing standards.



KEY CHALLENGES AND PROPOSED SOLUTIONS/ACTIONS

4. (Open) Digital Ecosystems

- Non-open proprietary formats; vendor-specific ecosystems
- Dependence on particular software vendors

- Invite sessions on interoperability, data governance and the digital thread.
- Bring academia, software vendors and industry together.
- Run a tool-vendor challenge on a realistic problem.



KEY CHALLENGES AND PROPOSED SOLUTIONS/ACTIONS

5. Explaining the Value of Digital Engineering

- Quantifying benefits and acknowledging limits
- Varied definitions; resistance from specialists
- Benefits may not reach those asked to participate

- Share successes, failures and unresolved problems.
- Develop benchmark applications and KPIs.
- Examine value across the supply chain, especially for suppliers.
- Ask why people support or resist digital engineering.



SUMMARY of KEY CHALLENGES and POTENTIAL ACHIEVEMENTS

1. Educating Digital Engineering	Increased Practical experience, better teamw skills and access to resources
2. AI in (Digital) Engineering	Better-informed use and evaluation of AI in engineering
3. Reference Data / Tools Set	Better resource discovery and standards coordination
4. (Open) Digital Ecosystems	A shared forum for interoperability and vendor-independence issues
5. Explaining the Value of Dig. Eng.	A clearer view of benefits, limitations and who gains value



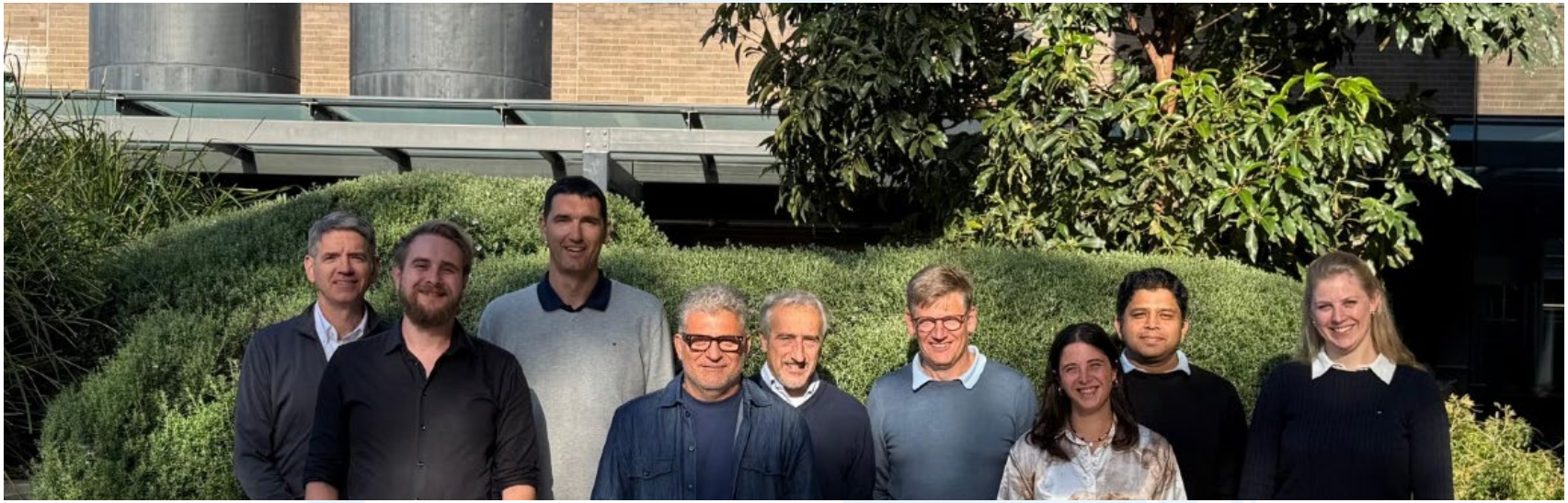
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SOS/SE/MBSE
IT'S NOT A COMPETITION!



ICAS DPI

- **Important role for ICAS in advancing SoS.**
- **Build on and connect with existing SoS communities.**
- **DPI as a vector forward.**



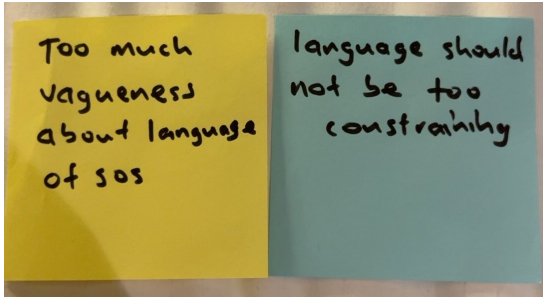
Motivations

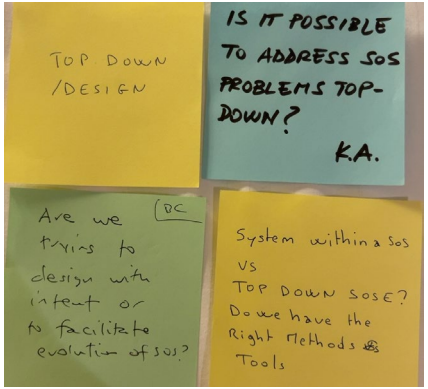
- Two decades of SoS research have confirmed its importance
- Progress in SoS engineering methods still lags behind ambition
- ICAS DPI can drive the dialogue needed to close this gap

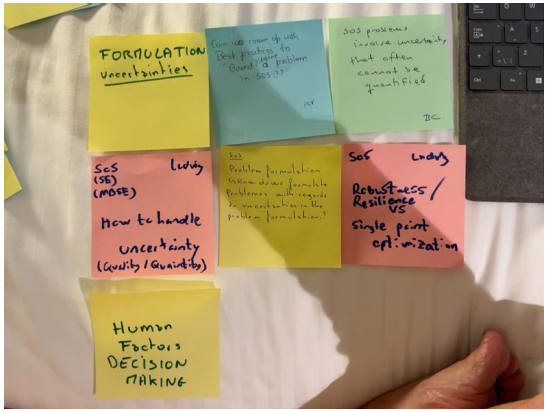


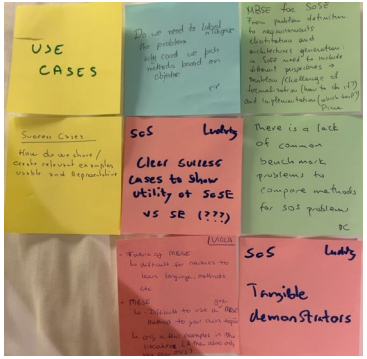


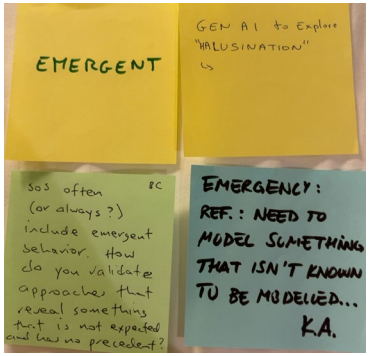
WORKSHOP

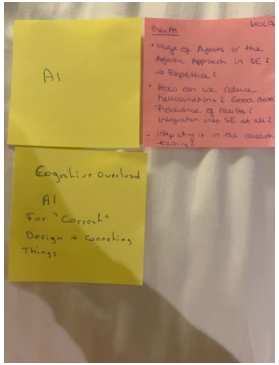

Too much vagueness about language of SoS
language should not be too constrainhy

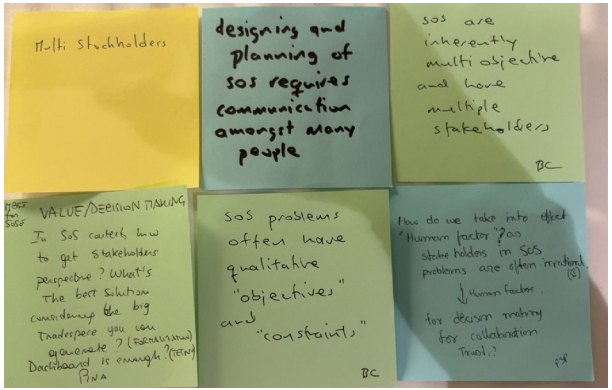

TOP DOWN /DESIGN
IS IT POSSIBLE TO ADDRESS SoS PROBLEMS TOP-DOWN?
K.A.
Are we trying to design with intent or to facilitate evolution of SoS?
System within a SoS vs TOP DOWN SoSE? Do we have the Right Methods & Tools


FORMULATION
Uncertainties
SoS (SE) (MBSE)
How to handle uncertainty
SoS
Robustness / Resilience vs Single point optimization
Human Factors DECISION MAKING


USE CASES
SoS
Clear Success cases to show utility of SoSE vs SE (???)
SoS
Tangible demonstrators


EMERGENT
GEN AI to Explore "HALUSINATION"
SoS often (or always?) include emergent behavior. How do you validate approaches that reveal something that is not expected and has no precedent?
EMERGENCY: REF.: NEED TO MODEL SOMETHING THAT ISN'T KNOWN TO BE MODELLED...
K.A.


AI
Cognitive overload
AI For "Correct" Design + Connecting Things


Multi Stakeholders
designing and planning of SoS requires communication amongst many people
SoS are inherently multi objective and have multiple stakeholders
VALUE/DECISION MAKING
SoS problems often have qualitative "objectives" and "constraints"

THEMES FOR THE CHALLENGES

CONCEPTUAL FOUNDATIONS

What are we actually engineering?

- Formulation / uncertainties
- Language
- Emergence
- Fidelity & abstraction

ENGINEERING & DESIGN APPROACHES

How do we engineer SoS?

- Architecture
- Top-down / design
- Process, methods & tools

STAKEHOLDERS & ADOPTION

How do we make it work in practice?

- Multi-stakeholders
- Use cases

ENABLING TECHNOLOGIES

What can accelerate progress?

- AI
- Modeling
- Simulation



What do we need?

- **One Challenge, Many Perspectives**
  - Wildfire as the common SoS scenario
  - Shared problem space, different approaches
- **Method Over Domain**
  - Focus on *how* problems are tackled
  - Identify the essential characteristics of SoS
- **Learn, Don't Compete**
  - No winners or rankings
  - Compare methods, insights, and decisions
  - Understand strengths and limitations



John Newman, from the interagency, Public Domaine

PATHFORWARDS and PLANED ACTIVITIES

NOW
ALIGN
Confirm the shared SoS direction

OCT–NOV 2026
CO-CREATE
Online meetings
Develop the draft

SCITECH 2027
DISCUSS
Review and refine with the community

AVIATION 2027
CONSOLIDATE
Finalise motivation, scenario and SoS features

SEP 2028
SHARE
Invited session
ICAS 2028, Montréal

DEVELOP → DISCUSS → CONSOLIDATE → SHARE

Common context • Common minimum features • Different methods • Shared insights



Want to learn more or contribute

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