Model Based Systems Engineering – Interoperability: Where Are We?

An Open Discussion

John Nallon: Chair, INCOSE TIMLM Working Group

Presenters Bio

John Nallon

- John has over 35 years of product development, systems engineering and PLM consulting experience in the Aerospace & Defense, Automotive, Semi-Conductor and Government markets.

- John has been a member of the INCOSE (International Council on Systems Engineering) since 1993 and is the chairman of the INCOSE TIMLM (Tools Integration and Model Lifecycle Management) Working Group and the SE Tools Database Working Group.

- John is a U.S. Navy veteran and an Electrical Engineering graduate of Old Dominion University.

Definitions for Tool integration and Interoperability for this Discussion

- ***Tool Integration:***

The co-operation between tools i.e their capability to communicate, exchange data and present information to users in a coherent fashion.

- ***Tool Interoperability:***

The ability of two or more tools to exchange information and to be able to use the information that has been exchanged without a special effort from the user.

Data Exchange: CAUTION

The process of taking data structured under a source schema and actually transforming it into data structured under a target schema, so that the target data is an accurate representation of the source data.

Except that data is often actually restructured (with possible loss of content) during a data exchange given all of the constraints of the source and the target compatibility.

In 1999 There Was an Identified Problem

From Dr. Julian Johnson, Panel Discussion at INCOSE IS 2014.

- **~15 years ago – We Identified a Problem!**

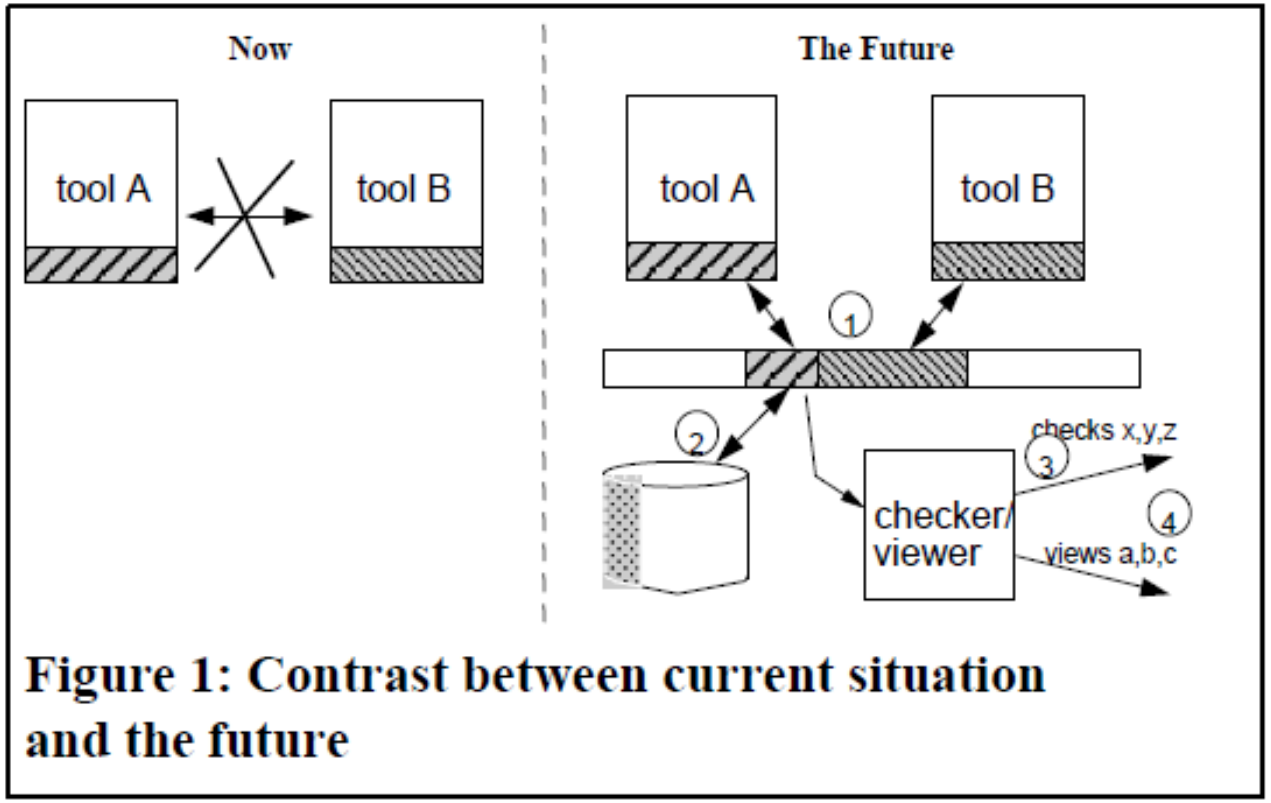
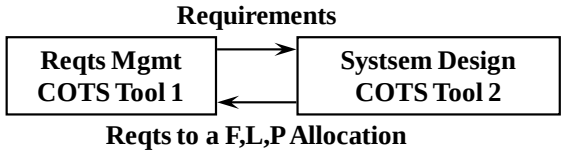


Figure 1: Contrast between current situation and the future

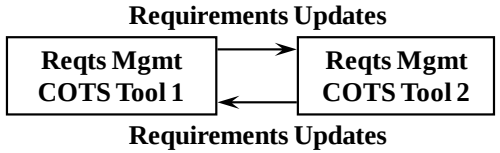
Question: It is now ~24 years later have we REACHED the future?

1999 Difficulties in Achieving Tool Integration

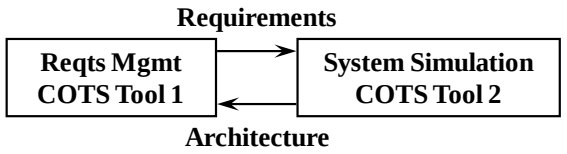
1. Integrate across (COTS) tools performing different functions within System Lifecycle



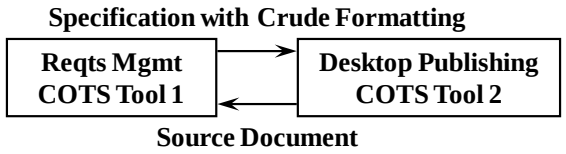
2. Integrate across (COTS) tools performing same SE function



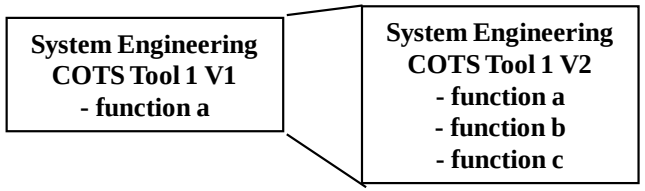
3. Integrate across (COTS) tools performing different SE functions



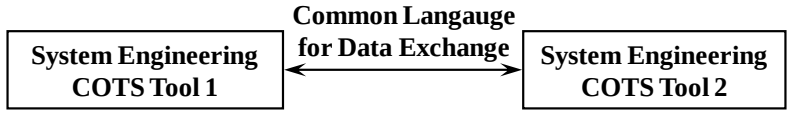
4. Integrate (COTS) SE tool with (COTS) tools performing non-SE functions



5. Integrate new SE functions into (COTS) tool



6. Establish standards for communi-cating across (COTS) SE tools



Ref: February 2003; A Concept of Operations for an Integrated Systems Engineering Environment; INCOSE Modeling and Tools Technical Committee, Tools Integration and Interoperability Working Group

But Things Have Changed

- **Emergence of MBSE, MBEE, MBME, MBD, the Digital Thread, Digital Twins……**
- **More widespread adoption of ‘agile’ approaches, ‘agile systems engineering’**
- **Much more capable and comprehensive toolsets and systems**
- **Development, maturation of processes, standards and frameworks: ISO 15288, UML, SysML, “STEP” ISO 10303 (AP233, AP242, AP243), UPDM, MODAF / DODAF / NAF, RDF, ReQIF, OWL, XML / XSD, SparQL, SOA, OSLC, AADL, …**
- **Need LOTAR Support for MBX Models**

Discussion Questions

- **Are the obstacles [to accessing data] that used to face systems engineers doing their job 24+ years ago still out there? What are they now?**
- **Have the Integration and interoperability problems been solved?**
- **Are COTS tools enabling ‘seamless’ access to data from different disciplines or different tool silos for use by all elements of the design, manufacturing and supply chain?**
- **Do we have traceability between tools in the chain? Requirements to Architecture to Models (Functional, Logical, Physical) to Analysis, to V&V?**

Discussion Questions

- **What is the state of maturity of achieving the vision of seamless access to engineering information for systems engineers?**
  - **[very low | low | mixed | high | very high]**
- **Top three obstacles?**
- **Top three opportunities?**

2014 Summary of Concerns- Still True in 2023?

A. Focus on interaction between all stakeholders and the disciplines
B. Effective systems engineering process, enabling profitability / effective use of resources (funds, people), program delivery
C. Seamless tracing of information across discipline specific tools
D. Appropriate access by systems engineers to reqts /design engineering info, respecting difference in usage: modelling (design / engineering) and reviewing model information that have different needs concerning tools and infrastructure
E. Robust system engineering environment - no vendor dependent tool interfaces (very heterogeneous integrated environment)
F. Agreed interaction along the supplier chain (customer – supplier) based on accessible engineering information

THANK YOU FOR ATTENDING AND YOUR PARTICIPATION

- **The INCOSE MBSE Initiative and numerous Working Groups are collaborating with The PDES Inc. MBSE Working Group about the issues and working on solutions and vendor demonstrations.**

- **ISO-10303-Ap243 MoSSEC is a result of 20 some years of work to provide solutions. There are tool vendors implementing this standard in their products, we need more tool supplier support.**

- **If this subject interests you, get involved or stay in touch with the groups that are represented here.**

Thank You for Your Participation

John Nallon: Chair, INCOSE TIMLM Working Group
John.Nallon@incose.net