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Stepwise adoption of model-based solution for a full MBSE transition, an Industrial perspective

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September 2020

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- Dilemma: to MBSE or not to MBSE?
- Stepwise approach to System Engineering modeling
- The ELT case on model-based engineering
- Conclusions





The 3 Evils (Holt & Perry) citation SysML for Systems Engineering



1. Complexity

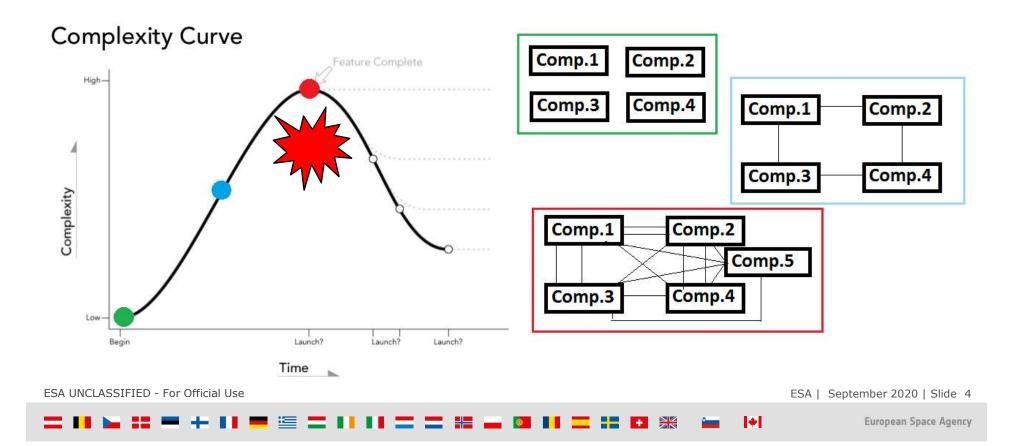
2. Lack of Understanding

3. Ineffective Communication



1st evil: **Complexity**





2nd evil: Lack of Understanding

Lack of understanding can happen at any point in the system-engineering lifecycle.

Examples:

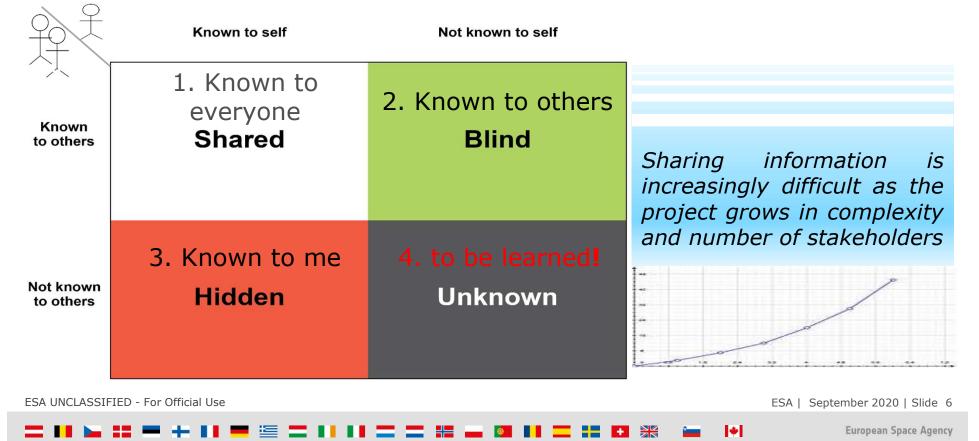
- **Specification**: unclear requirements
- Analysis: lack of skills leads to false assumptions
- **Operation**: incorrect use of the System.



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3rd evil: **Ineffective Communication** ... the Johari window



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esa The vicious triangle of System Engineering Complexity Lack of Ineffective Understanding Communication

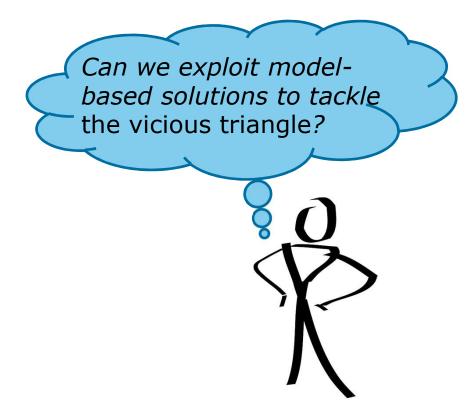
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Dilemma: To MBSE or not to MBSE?





□ **complexity hiding** by means of Views and Filters.

□ to **stimulate reasoning** and **alternatives evaluation**.

□ **automatic translation** to artefacts (code, documentation, tests,...).

□ **automatic verification** of integrity and consistency.

□ **enhanced communication** through formal representations





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Stepwise approach to System Engineering modeling

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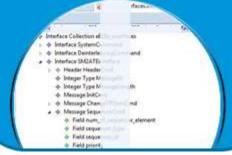


Stepwise approach to System Engineering modeling

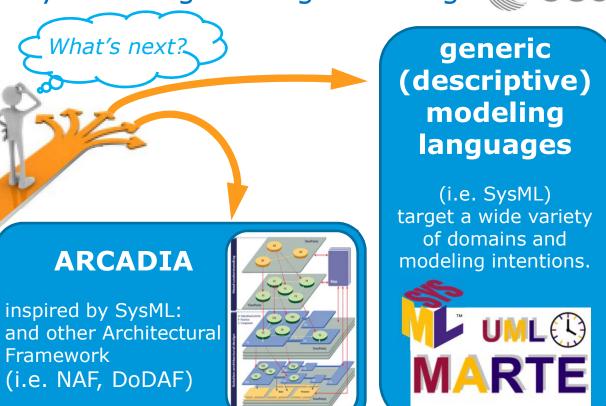
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DSML Domain Specific Modeling Languages

reduced coverage and more focused intentions. Provide solutions for particular domains



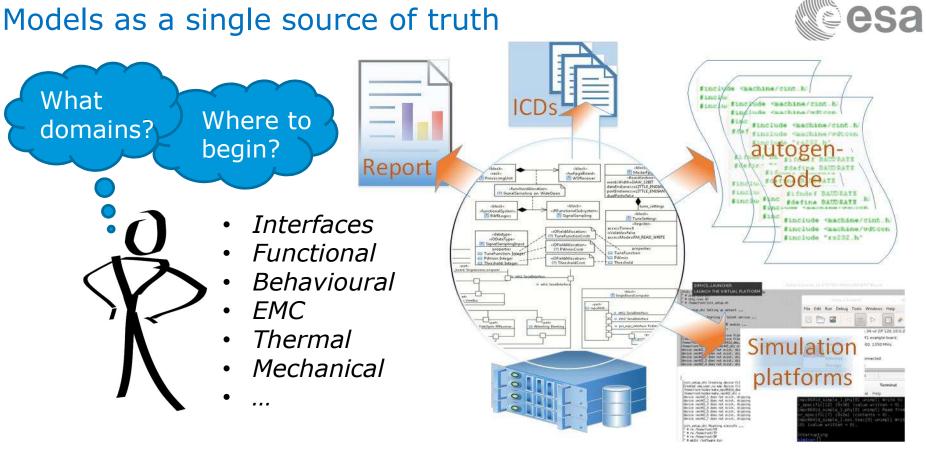
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Models as a single source of truth

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The ELT case on model-based engineering



ELT is a Solution Provider and Capability integrator in the Electromagnetic Spectrum Operations (EMSO) market for Defence & Security

In a process of **continuous improvement** of ELT internal processes, MBE (model-based engineering) was applied to three development processes of increasing complexity:

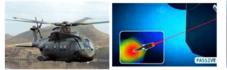
- managing complexity of software interfaces
- model-based software verification facility
- support for specification and design of a System of Systems (SoS)

COUNTERMEASURES & SELF PROTECTION



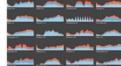
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CYBER EW & INTELLIGENCE









EDUCATION TRAINING & OPERATIONAL SUPPORT



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• The ELT case on model-based engineering:

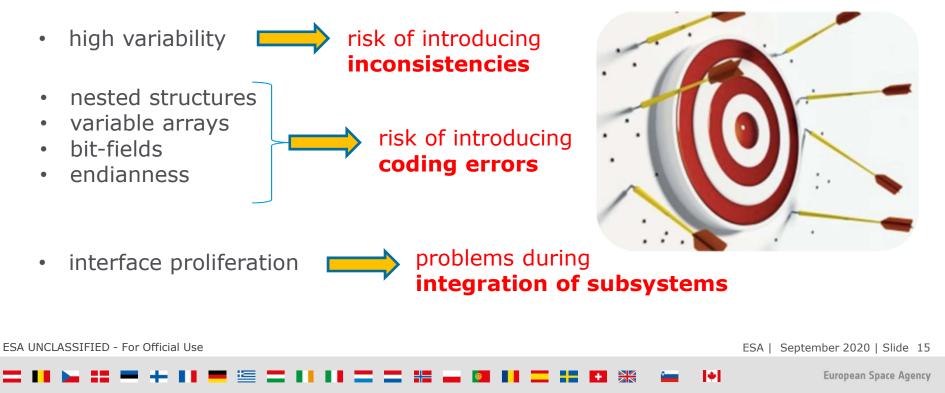
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- experimentation of the Arcadia method to support specification and design of a System of Systems (SoS)
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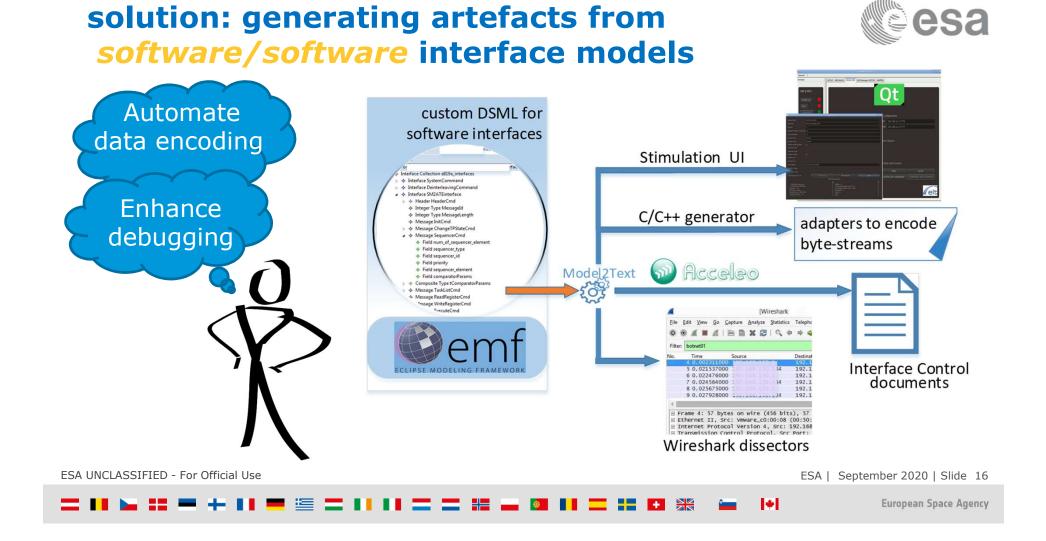
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Problem: managing complexity of *software* **interfaces**



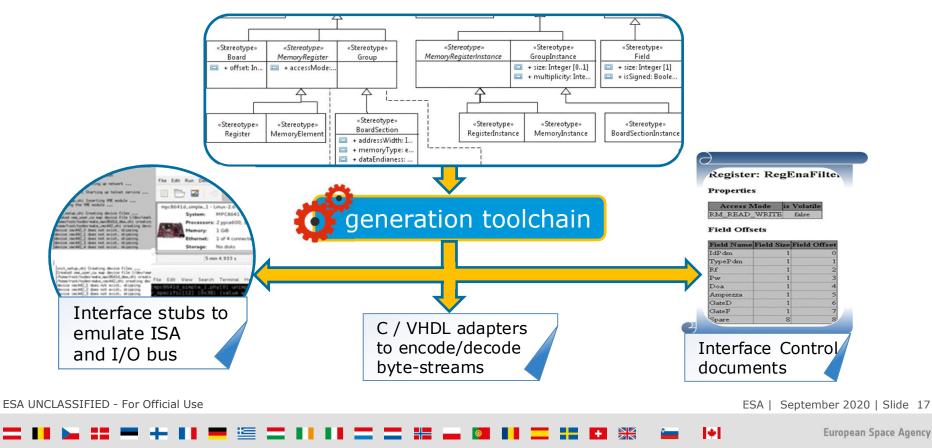
Managing complex software interfaces can be challenging:





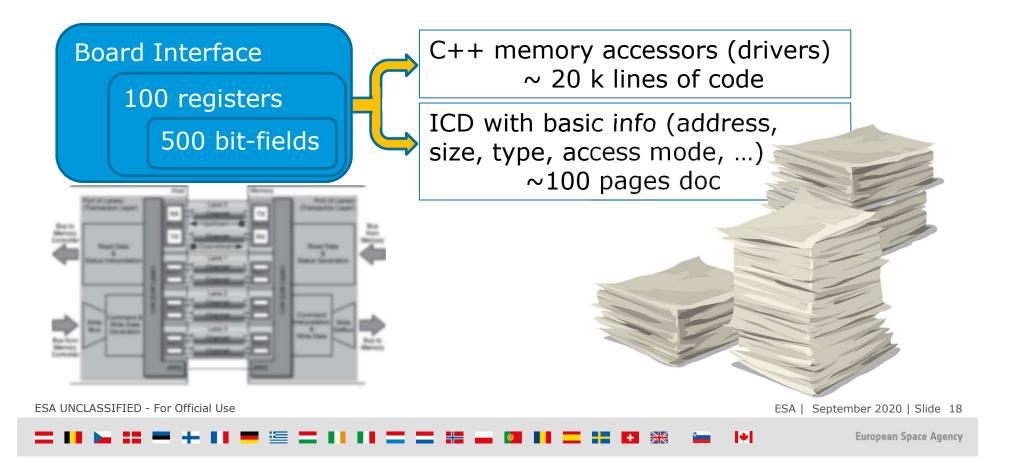
solution: generating artefacts from software/firmware interface models





some example numbers







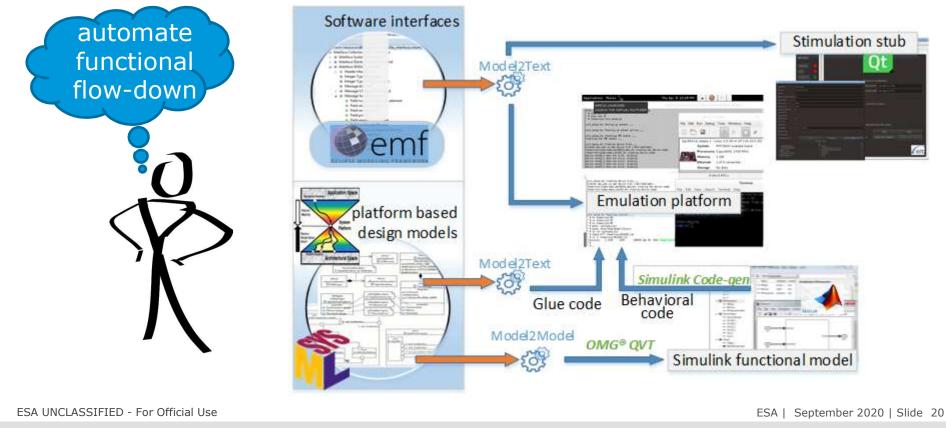
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integrating functional models to synthesize a software verification facility (experimental)



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The ELT case on model-based engineering:

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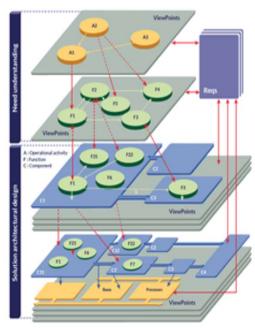
Conclusions

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experimenting the Arcadia approach in ELT innovative programs



ARCADIA



PROJECT-OBJECT: to develop a multi-domain System of Systems(SoS) supporting armed forces in the operations of integrated Missions.

INNOVATION GOAL: formal representation of the SoS to be automatically validated for consistency and completeness of the design

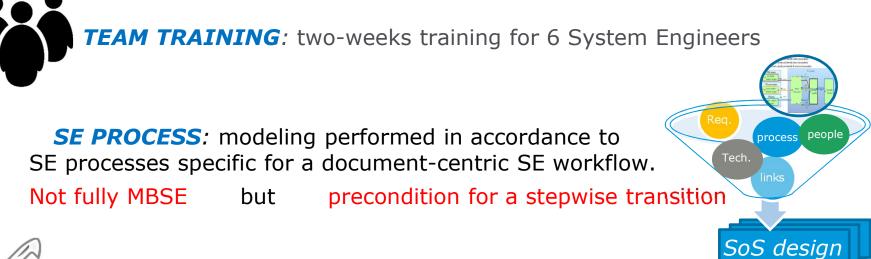
CHALLENGES:

- intrinsic scalable and reconfigurable shape;
- high number of actors (internal and external);
- high number of program's stakeholders.











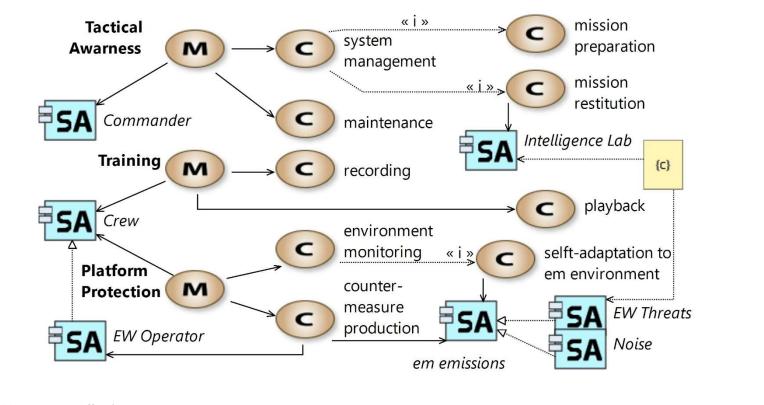
UTILITY: investigated architectural issues just by validating the model:

i.e. Functional Exchange not supported by any Physical Link



example Operational-Capability diagram





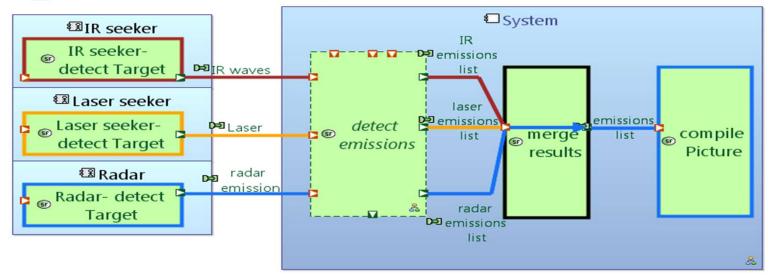


example System Architecture diagram



🗧 🗞 detect,track, classify and identify radars (incomplete)

- detect,track, classify and identify lasers (incomplete)
- detect,track, classify and identify IR sources (incomplete)



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Conclusions and Take away message



This experience demonstrated that adoption of formal notations:

- 1. can support System Engineers at least in the following activities:
 - to reason about architectural choices
 - to reason about the impact on Stakeholders
 - to catch design errors in early design stage (*front loading*)
- 2. contributes to automate processes providing a Return on Investment
- 3. can be a first step toward more structured MBSE solutions
- 4. is a key for more enhanced communication.

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Acknowledgments



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"A Model-based approach for the synthesis of software to firmware adapters for use with automatically generated components", SoSyM 2018, Di Natale, et al.

"Model-based System and Architecture" - Jean-Luc Voirin

"SysML for Systems Engineering: A model-based approach", Holt, Perry



THANK YOU



Questions?



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