

# Introduction

- **Traditional** requirements engineering tools **lack** access to the system **architecture model**, resulting in **duplication & imprecision**
- **Integration** with the architecture model defined in SysML contributes to the Authoritative Source of **Truth** (ASoT) while facilitating **Verification &** Validation (V&V) activities.
- Model-Based Structured Requirements (MBSR) [2][3] using **ISO**-standard [4] statement **templates** and **INCOSE**-recommended [5] attributes and rules contributed to higher quality, consistent system **requirements** with a **ready V&V** interface

By encoding the *Guide to Writing Requirements* [5] into SysML, a reusable Profile with embedded documentation, examples, and metrics becomes available to enrich requirements engineering.

# Methods

• **Structured requirements** [1][4] provide consistency and improve quality by using a **standard template**:

[Subject] [Action] [Constraint of Action] OR [Condition] [Subject] [Action] [Object] [Constraint of Action]

- **SysML (meta-)modeling** defines stereotypes, value **types**, enumerations, relationships and grouping so modelers have ready access to:
  - Attributes A • Rules
  - Organization-tailored Need Need & Requirement R
- Matrix, Decomposition, Relation Map, Requirement Diagrams and **Tables** present **tailored views** and exhibit model element relationships in a **customizable** and **exportable** manner

### **Digital Requirements Engineering Using Model-Based Structured Requirements**

James S. Wheaton, Daniel R. Herber, Department of Systems Engineering



• Characteristics C

# Conclusions

- Continued development and feedback from project stakeholders **needed** to fully validate this **INCOSE-grounded MBSR approach**
- This approach was used to **revise over 100** Mars Sample Return requirements at NASA JPL
- **Initial feedback** at JPL indicates that consistent terminology provided by model-canonical names & defined terms using **SysML-enabled glossaries** facilitates team alignment and positively influences the systems engineering culture



### References

- [1] Carson, R. S. (2015). Implementing structured requirements to improve requirements quality. INCOSE International Symposium, 25(1), 54–67. doi: 10.1002/j.2334-5837.2015.00048.x
- [2] Herber, D. R., Eftekhari-Shahroudi, K. (Sep 2023). Building a requirements digital thread from concept to testing using model-based structured requirements applied to thrust reverser actuation system development. In Recent Advances in Aerospace Actuation Systems and Components.
- [3] Herber, D. R., Narsinghani, J. B., and Eftekhari-Shahroudi, K. (2022). Model-based Structured Requirements in SysML. IEEE International Systems Conference. doi: 10.1109/SysCon53536.2022.9773813
- [4] IEEE. (2018). ISO/IEC/IEEE international standard systems and software engineering – life cycle processes – requirements engineering. doi: 10.1109/ieeestd.2018.8559686
- [5] Wheatcraft, L., Ryan, M. (2023). Guide to Writing Requirements (Tech. Prod. INCOSE-TP-2010-006-04). INCOSE Requirements Working Group. ISBN: 978-1-93707-05-4

WOODWARD