



# STANDARDIZING UNCERTAINTY MODELING AT OMG

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# INVESTIGATING EXISTING STANDARDS

- Investigated ISO, IEEE, IEC, JCGM, OMG, ETSI and OASIS from two perspectives: modelling uncertainty and CPS, and testing uncertainty and CPS, to identify relevant standards.
- Results show that:
  - ✓ ISO/IEC 61508, OMG SysML and MARTE all define the concept of **Probability**.
  - ✓ OMG SACM defines **Evidence**, **Confidence** and **Confidence Level**.
  - ✓ ISO/IEC and JCGM defined few standards on **Uncertainty Measurement**.
  - ✓ ISO 31000 defines the concept of **Uncertainty**.
- Conclusion:
  - ✓ **There does yet not exist an OMG technology recommendation that can characterize uncertainty both subjectively and objectively.**

# OMG

- International Standardization Body
- Standards: UML, SysML, MARTE, BPMN, UTP, etc.
- No standard on uncertainty modeling
- We want to propose one!
- Standardization is an important aspect of the U-Test project.

# MOTIVATION

- CPSs tend to operate in highly dynamic and highly complex environments, it is infeasible to uncover or predict all possible events or circumstances that such systems will encounter.
  - ✓ Uncertainty is inherent in the design of large scale systems such as CPSs.
- It may be possible to understand and even mitigate the negative impact of uncertainty if it is explicitly identified and characterized during development.
  - ✓ For example, testing strategies can be directed to focus on aspects where the level of uncertainty is high.

# OBJECTIVE

- Face Uncertainty
- Understand Uncertainty
  - ✓ E.g., U-Model, U-Taxonomy (for CPSs)
- Specify/Model Uncertainty
  - ✓ Identify, categories and quantify it.
  - ✓ Associate uncertainty with other artefacts such as requirements, etc.
  - ✓ E.g., Uncertainty Modeling Framework (UMF)
- Integrate with other OMG specifications
  - ✓ UML Profile for Uncertainty (UUP), UMF

# USE CASES

- Specifying uncertainty requirements in use case models
- Modelling uncertainties as part of SysML or UML models
- Modelling uncertainties as part of test-ready models, which might be specified with extensions to SysML, UML and/or MARTE and UTP V2.0.
- Modelling uncertainties as part of BPMN models
- Modelling uncertainties with an independent modelling notation.
- Uncertainty models could then be used for performing analyses (e.g., discovering unanticipated uncertainties) or generating other artefacts.
- RFI aims to identify more use cases!

# TIMELINE OF STANDARDIZING UNCERTAINTY MODELING

- **RFI – June 2016**
- RFP – Dec 2016
  - ✓ Letter of Intent (LOI)
- Initial submission
- Revised submission
- Finalization

# RFI OBJECTIVES

- Solicit ideas, discussions, comments, recommendations, user needs and experiences about uncertainty modelling
- Particularly focusing on
  - ✓ identifying use cases
  - ✓ integrating with various OMG standards (e.g., SysML, UML, MARTE, UTP, BPMN).



# RFI RESPONSE

- This RFI seeks information from the industry and academics regarding requirements for uncertainty modelling.
- More specifically, we look for answers to the following questions:
  - ✓ Are you aware of uncertainties that are relevant to your work?
  - ✓ To which extent, do you think you understand these uncertainties?
  - ✓ Is explicit addressing of uncertainties important? If yes, why? If not, why not?

# RFI RESPONSE

- Do you deal with uncertainties when developing your system/software?
  - ✓ If yes, in which phase of the development lifecycle do you deal with uncertainties?
  - ✓ If yes, do you rely on any existing specification/modelling solution, or is it more or less ad-hoc?
  - ✓ If yes, do you perform any uncertainty related analysis or artefact (e.g., test) generation? Is this automated?
- If there were to be a standard for uncertainty modelling,
  - ✓ What kinds of use cases for this can you envisage?
  - ✓ What kinds of integrations with existing standards would be needed?
  - ✓ What would be the preferred implementation format of uncertainty modelling for your use cases? Possible options include a UML profile, MOF-based metamodel or both.

# RFI RESPONSES

- The information of the responses will be ultimately used to:
  - ✓ identify the requirements of the industry in terms of uncertainty modelling,
  - ✓ develop an RFP for an uncertainty modelling specification,
  - ✓ issue the RFP (if possible) in time for the OMG Technical Meeting in December, 2016.

# CALL FOR PARTICIPANTS

- During the phase of TF Issuing RFP (June – Dec. 2016),
  - ✓ On or before the Letter of Intent (LOI) deadline, one or more OMG member companies submit LOIs.
  - ✓ In its LOI, a company states that it intends to submit in response to the RFP named in the letter
  - ✓ Contact: Tao Yue, [tao@simula.no](mailto:tao@simula.no)