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The Emerging SysML 2.0 Standard: Will It Enable Multi-Party Digital Design Collaboration?

AD PAG Insight

Key takeaways:

- *There are no Commercial Off-The-Shelf (COTS) Model-Based Systems Engineering (MBSE) tools utilizing data exchange standards that support the bi-directional exchange of digital system architecture models across the aerospace industry. This complicates the task of integrating the aerospace Original Equipment Manufacturers (OEMs) and supplier design activities starting with conceptual systems design and progressing through detailed design/Verification & Validation (V&V).*
- *The SysML 2.0 standard, to be formally released during 2024, aims to address several of these issues by introducing new system modelling notation along with an open API.*
- *The Aerospace & Defense PLM Action Group (AD PAG) has sponsored a project team of MBSE domain experts to provide an appraisal of the standard, within the context of interoperability, and to identify where SysML 2.0 solves challenges facing the industry and where gaps remain.*
- *The AD PAG MBSE project team will report the results of their assessment in a series of position papers over the course of 2024.*

Introduction

Currently, there are no digital systems design tools utilizing data exchange standards that support the bi-directional exchange of digital system architecture models across the aerospace and defense (A&D) industry. Consequently, aerospace Original Equipment Manufacturers (OEMs) must rely on a combination of technical documentation, internally developed solutions, consulting services, and/or third-party software solutions to incorporate those capabilities into an effective system design collaboration process.

To address this issue, the Aerospace & Defense PLM Action Group (AD PAG) member companies sponsored a team of systems engineering domain experts to evaluate current data interoperability standards intended to enable a Model-Based Systems Engineering (MBSE) conceptual design process. The activity has focused on defining key lifecycle application use cases and assessing the feasibility of exchanging digital models, instead of documents, between A&D OEMs and their supply chain partners.

The Opportunity and the Challenge

SysML 2.0 is not just an incremental update but a significant overhaul of the modelling language, addressing many of the limitations and challenges encountered with using the SysML language over the past two decades. As a result, the transition to SysML 2.0 can offer substantial benefits for organizations engaged in complex systems engineering, but it also requires adaptation and learning to leverage these new capabilities effectively.

Release of SysML 2.0 is imminent. Without a clear and unified message of urgency and priorities from industry, PLM solution providers will set their own solution strategies and timelines for incorporating SysML 2.0 into their software, based on the default assumption that the industry is fragmented and will be looking to them for direction.

The Response

The AD PAG MBSE project team of industry domain experts from Airbus, Boeing, GE Aviation, Gulfstream, Rolls-Royce, Safran, and CIMdata met in a two-and-a-half-day workshop in Toulouse, France in October 2023 to chart their future course of action. The goals they adopted are to:

- Provide an appraisal of the SysML 2.0 standard, within the context of interoperability, and identify where SysML 2.0 solves challenges facing the industry and where gaps still remain
- Define and communicate a clear and unified message from industry to the PLM/MBSE solution providers regarding the requirements and foreseen gaps in interoperability capability
- Collaborate with other industry working groups and standards bodies, such as International Council on Systems Engineering (INCOSE) and PDES, Inc. – International Industry Consortium
- Communicate industry needs/priorities as the MBSE solution providers begin implementing the SysML 2.0 standard in their next generation of software solutions

The Plan

The team adopted a pragmatic approach in working to assess this impact and identified five key topics to both explore and structure the discussion and future work: 1) Notation, 2) Application Programming Interface (API) scope, 3) Tools, 4) Pros and Cons, and 5) External Considerations. The team documented a set of questions about each topic and then agreed on a list of deliverables to answer those questions in calendar year 2024:

- A high-level explanation and evaluation of the new textual and graphical notation capabilities of SysML 2.0 with respect to A&D industry needs
- Generation of A&D workflows as test cases for the new SysML 2.0 API
- Analysis and mapping of the MBSE use case requirements to SysML 2.0 API capabilities
- AD PAG member requirements and MBSE priorities (e.g., for configuration management, model interoperability management)
- Overall pros and cons of the SysML 2.0 language standard as released during 2024
- Identification of needs and topics beyond SysML 2.0 that need additional attention in the future (e.g., MBSE best practices, the need for organizational/process changes)

This cannot be a unilateral or all-encompassing effort. The project team will pursue discussions with the software solution providers about exact coverage they will provide with respect to the standard and embracing an open API and sharing best practices within the team and with similar interest working groups across the aerospace industry.

Beyond SysML

The project team cautions that data exchange standards and a new system modelling language cannot solve all of the challenges in MBSE data and model interoperability which include:

- Clear identification and prioritization of A&D use cases
- Need for meta-models in bi-directional model-based exchange processes
- Need for common taxonomy and ontologies
- Identifying industry best practices to enable a multi-partner collaboration environment
- Having a roadmap plan in place during the transition from SysML 1.x to SysML 2.0

The specific issue of migration from SysML 1.6 to 2.0 and supporting multiple levels of information sharing is a thorny one and requires significant investigation before engineering organizations can move ahead with complete adoption of SysML 2.0.

The Deliverables Timeline

The project team's intention is to deliver several white papers over the course of the next 12 months to report results related to the planned deliverables and share the knowledge gained during the process. The AD PAG welcomes participation in this MBSE data interoperability project by other industry organizations that share an interest in this topic.

SysML 2.0 Syntax/Notation Evaluation: Internal Report Q1, Whitepaper Q4

- Document position statement on Syntax/Notation (utility/gaps)
- Mapping of SysML 2.0 Syntax/Notation Implementations to:
    - Boeing Collaboration Levels
    - Airbus Collaboration Schemes
    - ADPAG Phase 4 Use Cases
- Syntax/Notation In-Tool Evaluations (pre-release versions)
    - Cameo, Obeo, OMG Pilot Tool, Rhapsody (as able)
- Summary of SysML 2.0 Vendor Engagements
    - Targets: MathWorks System Composer, Dassault Cameo, IBM Rhapsody

About the Aerospace & Defense PLM Action Group

Since its founding in 2014, the AD PAG, administered by CIMdata, has sponsored research and jointly staffed projects on a diverse set of prioritized PLM-related industry and technology topics. These topics include Model-Based Definition, Multiple-View Bill of Materials, PLM Technology Obsolescence Management, Global Collaboration, Model-Based Systems Engineering, and Digital Twin/Digital Thread. As an outcome of these investments, the AD PAG has released a series of direction statements, research reports, position papers, and most recently AD PAG Insights, All are freely available for downloading from its website at http://www.ad-pag.com. Making these materials available is consistent with the Group's mission to engage proactively within the PLM ecosystem and advocate for common direction and positions within the aerospace and defense industry on PLM-related topics of importance to the members.

For more information about the A&D PLM Action Group, please contact CIMdata at info@cimdata.com.

About CIMdata

CIMdata, an independent worldwide firm, provides strategic management consulting to maximize an enterprise's ability to design and deliver innovative products and services through the application of Product Lifecycle Management (PLM). CIMdata provides world-class knowledge, expertise, and best-practice methods on PLM. CIMdata also offers research, subscription services, publications, and education through international conferences. To learn more about CIMdata's services, visit our website at http://www.CIMdata.com or contact CIMdata at: 3909 Research Park Drive, Ann Arbor, MI 48108, USA. Tel: +1 734.668.9922. Fax: +1 734.668.1957; or at Oogststraat 20, 6004 CV Weert, The Netherlands. Tel: +31 (0) 495.533.666.