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IAF SPACE SYSTEMS SYMPOSIUM (D1)
Systems Engineering Approaches, Processes and Methods (6)

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BUILDING AN EMPIRE: INSTANTIATING LOGICALLY CONSISTENT SYSTEM MODELS USING ONTOLOGICAL ARCHITECTURE AND PROCESS FRAMEWORKS

Abstract

Systems engineers utilize Model-Based Systems Engineering (MBSE) platforms to characterize integrated systems interacting with enabling systems in a given operational environment, but a lack of semantic consistency limits ultimate platform utility and therefore the utility of applied MBSE. Systems Modeling Language (SysML)-based projects are instantiated in these platforms as blank slates, meaning disparate systems engineers modeling an integrated system may define system architecture, requirements, verification, integration, and reliability information with unique mental models of what the system should be and do. These projects may be instantiated with inconsistent system description information because neither SysML nor SysML v2 feature semantics in the sense of meaning, so logical consistency between disparate information sets is not ensured. The intended interdisciplinarity of collaborative SysML models is therefore subverted by construction and will not be improved by the advent of SysML v2. Toward the goal of generating self-consistent integrated system models using less time and resources than is currently required, the Engineering Management Platform for Integration, Realization, and Execution (EMPIRE) ensures logical consistency between object-oriented systems engineering and project management information through a database-supported ontology written using first order logic. Both an Architecture Framework (AF) defining all work products that could be instantiated to ensure project completion and a Process Framework (PF) defining the life cycle and maturation philosophy of instantiated AF content are codified within a set of ontologies called the Unified Ontologies Suite. By defining the AF and PF in a math-based ontology, filtering project context through the AF and PF to generate risk posture-specific project information, and representing that information in EMPIRE, Integrated Project Models (IPM) describing the interrelated enterprise system, integrated system, enabling systems, and operational environment can be instantiated consistently from early concept development rather than reconciled subsequently. IPMs can then be exported to SysML-based platforms, and semantic utility limitations of applied MBSE are avoided. EMPIRE Alpha will be provided to the Jet Propulsion Lab's F' Working Group in May 2024 and will be available open-source as EMPIRE Beta in May 2025 through the United Nations Office of Outer Space Affairs.