

IAF SPACE SYSTEMS SYMPOSIUM (D1)
Space Systems Engineering - Methods, Processes and Tools (2) (4B)

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MODEL-BASED MISSION PLANNING: REDUCING MISSION PLANNING COSTS BY
GENERATING MISSION-UNIQUE ARCHITECTURE AND PROCESS FRAMEWORKS

Abstract

The effort spent during early mission planning often has the greatest impact on cost and schedule performance, with rigorous planning reducing execution uncertainty and development rework as the life cycle progresses. For a given mission, project leadership must identify and understand relevant stakeholders, their effects on the mission's life cycle approach, any required stage-gate reviews, and the products to be generated at each phase and progression event. With the release of the Object Management Group's Unified Architecture Framework in 2020 and the National Aeronautics and Space Administration's (NASA) Space Mission Architecture Framework (SMAF) in 2021, products to be created throughout a mission life cycle have gained rigorous organization under Architecture Frameworks (AF) that identify stakeholders, define mission-specific products, and allocate products to views and viewpoints that represent individual stakeholder concerns. The definition of mission life cycles, stage-gate reviews, product maturation philosophies, and the allocation of products at a given maturity to reviews can be defined similarly using a Process Framework (PF), with NASA considering its procedural requirement NPR 7123.1C to be its PF. In a Model-Based Systems Engineering (MBSE) development paradigm, document-based AFs such as the SMAF and PFs such as NPR 7123.1C fail to enable modern mission planners because the SMAF and NPR 7123.1C are not cohesively integrated with MBSE-centric work products in mind. In this work, a Mission Planning Ontology (MPO) is defined with strong semantic relationships for all concepts inherent to mission planning. The MPO may be queried based on factors such as mission program type, destination, payload, and risk posture to generate a specific Mission Ontology (MO) as a subset of the MPO. The MO then simultaneously generates a Mission Architecture Framework (MAF) and Mission Process Framework (MPF). The MAF defines relevant mission stakeholders, the products needed by the mission, the views and viewpoints that those products are organized within, and the allocation of products to stakeholder concerns. The MPF defines the relevant mission life cycle, stage-gate reviews, review entry and exit criteria, product maturation philosophy, and allocation of products at a given maturity to reviews. MPO query results can autogenerate mission-specific SysML diagrams forming the structure of a project model. By applying the MAF and MPF, mission planners have access to a fully tailored

organizational template for their mission, reducing early workload in project formation and providing authoritative program planning basis.