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A VIRTUAL SYSTEMS ENGINEERING ADVISOR TO IDENTIFY REQUIREMENTS GAPS: APPLICATION TO A TTC TRANSPONDER

Abstract

Requirements have formed the backbone of satellite development. Requirements define the problem boundaries within which contractors try to find acceptable solutions. At the same time, requirements are the criteria by which a customer measures the extent that their contract has been fulfilled by the supplier. In this context, the quality of a requirement set is determined by both its fidelity in capturing the right problem and the level of contractual safety that it yields. Achieving completeness is a necessary target to avoid gaps in the problem formulation. If requirements are missing, satellites that are not fit for purpose may be inadvertently accepted. Similarly, missing requirements may enable a supplier to anchor to a contractually acceptable solution that does not fulfill the needs of the customer. Yet, requirement gaps are common in satellite development. If lucky, those gaps are identified (and costly corrected) before the satellite is deployed into orbit. Otherwise, those gaps reduce the success of the space mission as the satellite becomes operational. Unfortunately, the completeness of a set of requirements cannot be demonstrated. The level of comprehensiveness of a set of requirements that can be attained is heavily driven by the engineer or team put to the task of defining the problem space. In this paper, we present a proof-of-concept of a virtual systems engineering (SE) advisor that supports the actual engineer in identifying gaps in the sets of requirements that he or she is working in. The SE advisor evaluates requirements that are formulated as models and leverages a knowledge repository to reason about the meaning of the model-based requirements. If potential gaps in the set of requirements are identified, these are presented to the engineer, who decides how to address the gaps. In this paper, we show how the virtual SE advisor supported the identification of gaps in an existing set of requirements for a communication's satellite Telemetry, Tracking, and Command (TTC) transponder, which were formulated using the True Model-Based Requirements (TMBR) framework implemented as an extension of the Systems Modeling Language (SysML). The proposed SE advisor advances Model-Based Systems Engineering (MBSE) in requirements engineering by aiding analysis capabilities to otherwise descriptive models.