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BUILDING A LIGHTWEIGHT DATA MANAGEMENT TOOL FOR SMALL SATELLITE MISSIONS

Abstract

Model-Based Systems Engineering (MBSE) has received widespread adoption in the space industry, allowing engineers to develop, design and validate their activities through formal models. MBSE's perceived benefits include enhanced communication, complexity management, knowledge transfer, and improved verification capabilities through traceability. However, generic or tailored MBSE tools have not yet found such widespread adoption in small satellite missions, such as CubeSats. Drawing from a review of previous and current missions, we postulate that many MBSE tools and processes add a considerable overhead in terms of time, cost and effort to establish and maintain models. On the other hand, Document-Based Systems Engineering, often used on such projects, may suffer from inconsistency, lack of detail, and difficulty in accessing reliable and up-to-date engineering data. In this paper, we propose a concept and design for a new software tool for small spacecraft engineering, focused on engineering parameter management and sharing. This design is based on modern design and user experience principles, with a basic requirement of allowing users to access any engineering parameter within 20 seconds of having access to a web browser. The tool uses a standard block-based structure to describe the hierarchy of a space system, with modifiable parameters and content assigned to each block. This structure is stored under a version-controlled database (such as *git* or *dolt*), allowing history tracking, merging, auditing and real-time collaboration. Ready-made templates can also be used to produce aggregate values, such as mass or cost budgets. A REST API allows integration with different external tools, such as MS Excel Power Query, and an integration with an AI-based copilot is envisioned. To complement the design concept of our tool, we additionally provide User Interface mockups of key actions, as well as an early functional proof-of-concept developed with a Python backend. We use data from the POQUITO mission from the University of Luxembourg to emulate a use case in our proof-of-concept. This implementation is also released as free software to allow future users to modify and extend our tool. We conclude with a roadmap for the potential future development of the tool, with an aim of improving the engineering data management workflow for small satellite missions and surpass the limits of document-based information tracking, without the added burden of industrial modelling processes.