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NAVIGATING THE ADOPTION OF MBSE ACROSS THE SPACE INDUSTRY: AN ORGANIZATIONAL AND SUPPLY CHAIN PERSPECTIVE

Abstract

The aerospace industry is constantly growing and changing, and as a result, it needs more efficient and interconnected approaches to designing and developing space systems. To meet these evolving needs, Model-Based Systems Engineering (MBSE) has been proposed as a way to facilitate more effective communication and better manage system complexity. Nevertheless, its adoption across the space sector has not been a smooth transition due to several non-technical challenges, such as insufficient stakeholder engagement, perceived complexity of the approach, and questioned return on investment (ROI). To bridge this gap, this research focused on exploring the diverse challenges of adopting MBSE, focusing on organizational and operational issues.

Integrating a year-long collaborative effort from aerospace professionals supported by Young Professionals International Project/Programme Management Committee (IPMC) Workshop, this paper showcases the results of MBSE implementation efforts across diverse organizations, hypothesizing evidence of the benefits of using MBSE in terms of time and cost savings. Moreover, this work also analyzed relevant differences in the strategies used by space agencies, private companies, start-ups, and research entities to handle the cultural and procedural changes necessary for successful MBSE adoption, including workforce training, workflow restructuring, and the selection and standardization of modeling tools and languages.

The research approach included an extensive literature review and a series of surveys and interviews, highlighting key challenges encountered and lessons learned, especially by managers and teams responsible for facilitating the use of MBSE within their organization. Our results also emphasized the role of international collaborations in facilitating the exchange of practical knowledge and experience in deploying

and implementing MBSE to stimulate broader adoption within the industry. Furthermore, this study analyzed how MBSE facilitates collaboration and information sharing among stakeholders and characterized potential ways to address supply chain issues, such as tool compatibility disparities, data exchange standards, and the distinct readiness levels of different organizations to adopt this approach. To conclude, this work included several reflections on the future trajectory of MBSE in the aerospace industry, exploring potential advancements such as Digital Twin Development through MBSE and the integration of Artificial Intelligence (AI) and Machine Learning (ML).

Considering the potential to enhance the efficiency, reliability, and success of space missions through MBSE, the aim of this research is to serve as a roadmap for space actors to navigate the complexities of MBSE deployment and implementation, providing actionable recommendations to make MBSE adoption a reality across the global space industry.