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APPLICATION OF A TAILORED MISSION ANALYSIS FRAMEWORK WITHIN A EXTRACURRICULAR CUBESAT PROJECT

Abstract

In this paper we explore the application of Systems Engineering (SysEng) in the early stages of conceptual mission analysis in a CubeSat project implemented for/by Orbit NTNU. Orbit NTNU is a non-profit volunteer student organization at the Norwegian University of Science and Technology (NTNU). STEM students gain hands-on education and training in space engineering through an extracurricular project. Involved students are often inexperienced with engineering, such as system design and team management. For student organizations like Orbit NTNU, we had experienced that members often have new inputs and ideas, where frequent changes to systems caused a lack of system assurance. Therefore, it becomes crucial to reduce risk by assessing pain points through tailored mission analysis frameworks.

The SysEng team in Orbit NTNU began completing the conceptual development of the future satellite project before the launch of the current project. The conceptual development involves selecting a mission, decomposing mission goals to objectives and requirements, and defining the Concept of Operations (ConOps) of NextSat. Previous efforts to apply SysEng on satellite missions in Orbit led to a lack of understanding of the systems view. Artifacts lacked an explanation of synergies and interactions between the contents of other artifacts. This resulted in a disjointed systems view rather than a higher-level description of the mission and system architecture. Hence, the future mission of Orbit NTNU applied SysEng to incorporate a larger context of the existing development processes.

Methodology and frameworks such as systemigrams and tailored mission analysis were applied to integrate SysEng in a wider environment for the next mission. A systemigram aims to translate a system problem into parts and relationships. This applied method of SysEng led to an incremental decomposition of the mission, which increased shared understanding of the system and reduced the loss of design rationale.

We will apply a tailored framework in the following satellite mission of Orbit NTNU. Lessons learned and pain points from SelfieSat were used to define the approach of applying SysEng to the NextSat mission. It is expected that this methodology will increase the transparency of the work of the SysEng team and improve the flow of information. More importantly, applying tailored SysEng tools and frameworks would increase the success rate of the CubeSat mission, as it enhances the quality of assessments and holistic system design.