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MODEL-BASED CONCEPT FRAMEWORK FOR SUBORBITAL HUMAN SPACEFLIGHT MISSIONS

Abstract

Projects of the New Space economy such as SpaceShipTwo and New Shepard are on their way to shifting the paradigms in space tourism and transportation. Being privately financed, they are also changing the way in which highly complex and formerly government-financed systems are now being developed. Looking to the future, we can envision humanity moving to space, an opportunity that will be available to many more of us as a result of these new paradigms. One of the core issues we encounter when we start the development of complex systems such as the suborbital transportation and space tourism systems is what are the concepts available and how these concepts can be represented using strictly defined ontology and model semantics. In this work we present a model-based concept framework that aims to address this issue. First a concept framework methodology is presented, after which we demonstrate its applicability to suborbital human spaceflight missions such as SpaceShipTwo and New Shepard. The analytical conceptual difference between these concepts is demonstrated. The proposed framework includes: the information that characterizes stakeholders and their needs; the solution-neutral environment (the problem statement) in which we formulate the functional intent; the solution-specific environment (solution statement) in which we see the possible solutions; the decomposition of such solution into internal elements and functions; and the concept of operations. Each one of these entries of the concept framework has a counterpart represented in conceptual modeling languages, such as Object-Process Methodology (OPM) or the System Modeling Language (SysML). Such a model-based concept framework encodes the core information required to define a suborbital tourism concept and represent it in a digital environment. We believe this will become a powerful tool to support the makers of architectural decisions that lead to concept and eventually to architecture.