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Insuring Quality and Safety in a Cost Constrained Environment: Which Trade-Off? (1)

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A RELIABILITY ASSURANCE FRAMEWORK FOR COTS COMPONENTS USED IN SPACE
SCIENTIFIC PAYLOADS

Abstract

Many space agencies (such as NASA, ESA, JAXA) focus on the Commercial Off-The-Shelf (COTS) components used in space mission in recent years mainly due to the budget, and this focus should be enhanced especially in the economic recession times. On the other hand, as the requirements of space scientific payloads are increasing dramatically, more and more high-precision and high-performance COTS components have to be used in space scientific payloads. To ensure the reliability and optimize the cost of a space scientific mission, a mission-oriented framework of reliability assurance solution based on Hall's methodology of systems engineering is studied.

The framework consists of technical flow, cost estimation & optimization model, and decision tree. Elements of the technical flow include Reliability Mission Analysis (RMA), reliability analysis, COTS Reliability Assurance Test (CRAT), COTS Reliability Assurance Design (CRAD), reliability and environmental adaptability test, and reliability assessment. According to our space project experiences and systems engineering theory, RMA is put forward as an important project implementation part. The result of RMA includes mission-oriented reliability assurance strategy and reliability plan, which is the trigger of the framework. The CRAT includes Component level CRAT (C-CRAT) and Assembly level CRAT (A-CRAT). C-CRAT is based on High Accelerated Life Testing (HALT) technique and A-CRAT is based on Accelerated Degradation Testing (ADT) technique. Finally, the cost drivers of COTS components used in space scientific mission are identified, and optimization model with reliability & cost is built.

The framework has already been applied in manned space scientific missions successfully, and is proved an innovational exploration for systematically solving the conflicts of performance, reliability and cost.