

SPACE OPERATIONS SYMPOSIUM (B6)
Human Spaceflight Operations Concepts (1)

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OPTIMAL SIMULATOR USE OVER THE HUMAN SPACE MISSION LIFE CYCLE

Abstract

When designing a new space vehicle with a view to supporting operations over long time frames, the initial reaction tends to use as much of early phase simulators as possible to lower development cost. On the other hand since simulators will be used to support missions from training, procedures development and support for in flight anomaly resolution, there is a need for as much actual flight hardware and software as possible. This second reaction is soon tempered by the realities of cost, schedule, performance, and the need to control complexity of design and operation.

The final design process involves a tradeoff between many different drivers and often leads to simulators made up of subunits with different levels of fidelity. Scheduled need dates for various capabilities are also development drivers and if not met successfully can impact operations schedules. United Space Alliance (USA) has developed several Space Shuttle, International Space Station (ISS) and Crew Exploration Vehicle (CEV) simulators, including the Shuttle Avionics Integration Laboratory, Orbiter in a Box (OIAB), Real Time Simulator for the Shuttle Flight Software, and ISS Procedure Verification Tool (IPVT).

In this paper the design and tradeoffs made in operations support simulations are discussed, and critical design and operations choices are analyzed in light of experience and projected for future space missions. Technology levels are assumed to be those available in COTS tools today or in use at a late Technology Readiness Level by a spaceflight organization. Software design choices for operation support include an assessment of the development, analysis and operations support tools, middle ware functions, and hardware support for data extraction and management in real time simulators.

A scenario is generated to illustrate the early development and use of simulators for test support, ground and flight operations training, and support for mission operations including re-planning and IFA resolution. The optimal use of simulators along the mission life cycle is based on providing the needed capability by as much reuse of early simulations as possible. The reuse includes Use Model Languages, Model Based Simulations, certified COTS products, and adaptable frameworks with appropriate Middleware.