

Cost reduction – buzzwords and their real use: mission families, mission planning, mission automation and standardization

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Abstract—For many missions, the European Space Agency ESA has followed a delta approach connected with excessive software reuse for the development of operational ground software for space missions. This approach of mission families is well proven and has already led to enormous cost savings regarding development and maintenance costs. For further cost reductions and to allow for less effort required for the development of ground systems and the definition of exchange formats, ESA is actively moving forward in standardization. Advances in mission planning and mission automation are an example how operational IT can reduce operational costs of space missions.

None of today's space missions are flying without massive use of IT tools. The tools users are in direct contact with are the ground data systems: Mission Control System (MCS) and Operational Simulator (Sim). Although essential, the MCS and Sim are merely supporting the space mission; the lower their cost, the more of the mission budget remains for the actual mission. Additionally, a modern Ground Data System can help reducing operational costs for any space mission by supporting mission operations with automatic controlling facilities. The development and usage of official standards helps to reduce costs for specifying exchange interfaces and allows for easy reuse of existing facilities.

For a long time, ESA is successfully applying a delta approach to reduce development, maintenance and operational costs of the Ground Data Systems. This delta approach isolates layers of software components to be (re-)used as building blocks for any mission specific ground software. The basic building block is the most generic and is reused across all ESA missions. On the MCS side, this basic block provides most of the functions for telemetry reception and processing, telecommand uplink and verification, data archiving, display and retrieval and data distribution. On the Sim side, the basic block supplies the simulator kernel and generic models, including onboard processor emulators, orbit prediction and propagation, selected onboard subsystem models and ground system models. Those basic blocks can then be extended for mission specific needs. One spin-off of the software reuse is high mobility for operators between missions as all systems are fairly similar.

Additionally to reducing the cost for providing the IT infrastructure, ESA is also working on reducing the costs of operations. One way to achieve this goal is to reduce the

necessity of constant human operators presence. Two means are implemented to support this objective: mission planning and mission automation. The Mission Planning System (MPS) allows the generation of advance schedules covering a specific planning period (e.g. one week). Those schedules include payload and spacecraft operations as well as ground activities. They are then autonomously executed on board and on ground (in the control center or the ground station). Together with ESA's Mission Automation System (MATIS), MPS helps to reduce operator presence during routine operations to normal working hours, invalidating the need of shift work and additional workforce. MATIS is able to digest the schedules from MPS to control routine interactions with the mission (e.g. the opening and closing of data links prior to and after passes). Additionally to reducing human errors for repetitive and routine tasks, it also allows operators to concentrate on other aspects of the mission.

The third field to help saving costs for space missions in which ESA is strongly involved in is standardization. By relying on established standards, missions can easily exchange data between each other or between different parties involved in the mission (e.g. spacecraft Prime developer and operational control center). It also allows easy reuse of resources provided by other missions; this can be software or hardware facilities. The XML Telemetric and Command Exchange format XTCE – a CCSDS standard – and the Simulator Modeling Platform standard SMP – an ECSS standard – have been developed by many parties, amongst them ESA.

This paper describes the means taken by ESA to provide IT for low cost missions; those include reducing development costs for the IT systems, reducing the definition work for common interfaces and developing and using systems that allow autonomous operations.

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