

SPACE SYSTEMS SYMPOSIUM (D1)  
System Engineering - Methods, Processes and Tools (1) (3)

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WHEN CONCURRENT TURNS COLLABORATIVE: ADDING FLEXIBILITY TO THE  
CONCURRENT ENGINEERING FACILITY

**Abstract**

The Concurrent Engineering Facility (CEF) is DLR's systems analysis laboratory where feasibility studies and early stage designs (*e.g.* Phase 0/A) are undertaken. Whilst the Concurrent Engineering (CE) process is a well-proven methodology that optimizes engineering design for many systems (*e.g.* satellites and other spacecraft) and has been very successful in dozens of studies performed at DLR, in the particular case of space launch vehicle design it has proven not to be implemented as effectively.

The development of Expendable and Reusable Launch Vehicles (ELV's and RLV's) is an iterative, multi-disciplinary process involving complex domain models even at early-definition level. The inherent sensitivity of these systems, the strong interdependencies of the design domains, the necessity to iterate design sub-cycles until convergence, and the need for a parametric analysis to optimize designs do not allow for efficient adaptations of the classic CE tools and processes, and have led DLR to revise current ELV/RLV design processes and infrastructures.

Through a recently initiated project, DLR aims to develop the Collaborative Launch Vehicle Analysis (CLaVA) tool, an in-house collaborative software for space transportation vehicle design specifically focused on ELV and RLV Phase 0 design studies, which will support a new design process chain, CE study process and centralized data model.

The study of a ELV/RLV design process based on a mixed approach of sequential sub-cycles –parallelized by cascading a multiple-step work distribution– has yielded constraints and requirements for both CLaVA and the CE study process. The three main changes to the CE study process for the implementation of this semi-concurrent method are: the inherent differences in the study-preparation phase; the adaptation of the in-study work sequence; and the in-study personnel distribution.

The present paper introduces CLaVA's software concept and how it was formulated, and describes how the CE study process must be adapted to this new paradigm for launcher studies through a specifically conceived Collaborative Engineering philosophy that aims to maximize the efficacy and versatility of the CEF as a system-design facility.