

SPACE SYSTEMS SYMPOSIUM (D1)

Lessons Learned in Space Systems: Achievements, Challenges, Best Practices, Standards. (5)

Author: Dr. Geilson Loureiro
Instituto Nacional de Pesquisas Espaciais (INPE), BrazilLESSONS LEARNED IN 20 YEARS OF APPLICATION OF SYSTEMS CONCURRENT
ENGINEERING (SCE) TO SPACE PRODUCTS**Abstract**

This paper aims to present the lessons learned in 20 years of application of the SCE approach that evolved over the last 20 years being applied to the development of more than 200 complex system solutions. SCE is an approach to the integrated development of complex systems that applies the systems engineering process, simultaneously, to the product elements of a system solution as well as for the service elements of the system solution, recursively, at every layer of the system solution breakdown structure. The approach was born as the application of the requirements, functional and physical analysis processes to the simultaneous development of a product, its life cycle processes and their performing organizations, at every layer of the product breakdown structure. The continuous application of the approach up to 2010, showed the need to include a stakeholder analysis step, to acknowledge that the solution was comprised of product and organization elements (processes were, in fact, the functions of products and organizations), that a mission layer should be added at the top of the product breakdown structure and that the notion of circumstances should be added to the traditional notion of scenarios. With the increasing use of the approach for system of systems conception and development such as those involving multi-spacecraft solutions, the mission layer needed to be extended to include other life cycle processes (besides the operations processes) concept of service and system service architecture. This requires the development of a system solution breakdown structure (SSBS) that will guide the development of the overall solution. For multi-spacecraft solutions, for example, it is necessary to conceive and architect testing, launching and decommissioning services as early as operations. Also, going into more detail in the approach, modes can be derived from circumstances, interface states and internal states of the system and not only from circumstances, as initially established in the approach. These lessons to be presented were learned during the development of: 1) the Brazilian Strategic Program for Space Systems (PESE) and; 2) the TIM Project (Telematics International Mission), a satellite formation with contributions from many regions in the world.