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OUROBOROS - A CASE STUDY IN DISTRIBUTED AGILE CONCURRENT ENGINEERING (DACE) OF SPACE MISSIONS

Abstract

The growth of the space ecosystem is accelerating exponentially, prompting new actors to join and incumbents to re-evaluate how they engage with the domain. A key aspect of transformation is the changing nature of manufacturing and design practices. The past two decades has seen the increased use of COTS components, followed by the appearance and proliferation of standardised and modularised low-cost systems, such as CubeSats. However, designing, building and testing, deploying and operating satellites, whether for commercial or science purposes is still a prohibitively expensive undertaking, the costs of which mean that many emerging actors—those who could otherwise greatly benefit from the direct access to space—are excluded from the domain. Beyond costs, the other concern is the long design life cycles, which require consistent support, potentially through several years, which again presents a problem to many research or academic institutions, particularly in emerging space nations. This, unfortunately, in many cases also applies to not only full-scale space missions but also payloads and experiments. Launching a microgravity experiment on board the International Space Station can be a project that requires continuous support from a team of 5-10 engineers and funding reaching several tens of thousands of dollars. Present paper discusses a novel approach to the design of space missions incorporating a combination of digital concurrent design and agile aerospace engineering. Through the design of a microgravity experiment, the MIT-based research team created a novel framework to design space missions. Distributed Agile Concurrent Engineering (DACE) relies on constant collaboration between engineers, physically located in different geographic locations, who use various forms of cloud services and collaborative design methods to simultaneously develop and optimise sub-systems. It incorporates an agile approach, which takes into consideration the shortest achievable lead times, optimising it against cost and sacrificing requirements and capabilities where necessary. The paper details the comparison of a microgravity experiment, developed through a traditional waterfal method and the benefits of the flexibility offered by DACE, which allowed the delivery of the experiment in five weeks, and enabled the fast redesign of the system when the research team faced integration issues.