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TAKING AGILE TO SPACE: MODERNIZED PROCESSES AND ARCHITECTURES FOR AVIONICS DEVELOPMENT

Abstract

Efficient and robust processes are critical in the development of space systems. Without these two qualities, teams are unable to produce adequate results for yearly competitions, funding requests, or even pass design reviews. However, standard practices in rocket teams use year-long iteration cycles, often following archaic *waterfall* management methodologies, and produce single-purpose solutions. This results in having to partially restart design work, while attempting to salvage previous solutions. Development of projects in this manner is highly wasteful of material and human resources, accumulating large technical debt for future iterations.

We first propose a methodology for high efficiency, robust avionics development. It is based on standard technology industry practices such as *Agile methodology* and *rapid prototyping* techniques. Each team follows short, 1 or 2-week iterative cycles called 'sprints' with daily updates where members briefly present progress, blocks, concerns, and plans for the remainder of the sprint. Both software and hardware segments use this in parallel, increasing cross-team communication. Higher level directions are determined by team or product managers through task planning and minor course corrections; however, flexibility is given to engineers to fail-fast and find effective solutions using rapid prototyping. This management style is directly compared with previous waterfall methods, using key performance indicators (KPIs) such as tasks accomplished and systems shipped.

Secondly, we present our technical design of a modular, reusable, and tightly integrated avionics system. Developed within the Avionics team of the University of British Columbia Rocket Student Design Team (UBCR), our system consists of custom ground station software, rocket firmware, and hardware boards. We directly compare against previous UBCR and other publicly accessible university avionics designs, with KPIs such as power consumption, speed, and failure rates.

In this paper, we propose modernized development methodologies and designs for avionics, and quantify their impact on the speed, quality, and scale of development, by directly comparing with previous methods used in several avionics teams across the world. We then outline how these can be integrated into other student, research, or industry teams. We finally describe further modifications in management and design architectures that can improve upon current results. We strongly believe that these methods are crucial for accelerating space systems development in the 21st century and will soon become a mainstay of avionics teams across the world.