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THE HARDWARE DEVELOPMENT TOOL STACK FOR FUTURE SPACE EXPLORATION

Abstract

In modern software development, companies pick a number of programming languages, tools and frameworks for every project; the "stack". The benefits and usefulness of each individual framework are analyzed for power and suitability, but also the integration of these tools is evaluated, to ensure a powerful low-friction development environment. This involves the complete chain of team communication, bug tracking, requirements management, development, configuration management, deployment, customer support and maintenance.

Analogously, in "New Space" hardware development, lean and collaborative engineering approaches are necessary to cope with the rising demands towards disruptive reduction of costs and increase in speed of space projects. A radically new approach is necessary, breaking with classical processes and tools, which have grown as a patchwork in most companies over decades. Instead, new tools and most importantly their interactions and interfaces need to be analyzed to fundamentally improve the efficiency of hardware development. This is all the more relevant for an international collaborative space exploration effort.

In a first step, this paper identifies the landscape of functionalities, needed by space companies and agencies for their technical operations: requirements management, CAD design, engineering data management, simulation, reporting, software development, testing, verification management, internal and external communication, task management, etc. Then the identified functions are put into relation, identifying the different interfaces and relationships among them. As a second step "Old Space" tools are mapped to these functionalities: PDM/PLM systems, Document Management software, issue trackers, CAD software and requirements software. These are then compared to a mapping of modern tools to the requested functionalities: collaborative browser based 3D software, Kanban tracking tools, concurrent engineering data management systems, chat-based communication channels, etc.

As a result of the comparison of "Old Space" and "New Space" tool stacks, it will be made apparent, how startups today are already able to design highly complex spacecraft with significantly less manpower than established companies. The direct comparison will also make apparent in which areas and at which interfaces modern tools have the highest impact, to paint a roadmap also for major "Old Space" players of how to transform their engineering processes in a way that will enable cost effective development of ever more complex spacecraft in the future, allowing for space exploration without breaking the bank.