Abstract for SpaceOps 2018, Topic 4: Planning and Scheduling

Innovative Development of a Cross-Center Timeline Planning Tool

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The Payload Operations Integration Center (POIC) at Marshall Space Flight Center (MSFC) is the United States focal point to support operations controllers and payload developers conducting payload science operations for the National Aeronautics and Space Administration (NASA) aboard the International Space Station (ISS). Some of the key functions are planning, coordination and scheduling of science activities. This effort occurs in coordination with other NASA centers, international partners, and payload developers. The ability to efficiently plan and re-plan in response to change is critical to the flight planning teams. Additionally, in Fall 2017, NASA will increase its ability to perform payload science operations aboard the ISS with a fourth crew member. In order to support this, there will be an increasing need to quickly plan and schedule more activities. In the past, it was cumbersome and time-consuming to consolidate copious amounts of planning and change request data from various sources. Planners would summarize information from the Johnson Space Center (JSC) Operations Planning Timeline Integration System (OPTIMIS) and manually integrate it with other data in order to produce a Timeline Planning Summary (TPS). This lengthy process of updating static documents while planning and re-planning was cumbersome, introduced human error, and was inflexible to last minute changes. There was a need for a dynamic, more efficient, less erroneous, and more concise way of building a report that could be readily updated as fast as payload science plans change.

The Timeline Integration Product Summary (TIPS) software tool has been developed to deliver customer-driven value. TIPS creates an automated consolidated summary of payload science activities for easy consumption by many different operating disciplines. TIPS summarizes activity information in daily, weekly, and monthly views. TIPS requests and integrates data from multiple sources, and includes note information stored in a local database. TIPS allows notes to be associated with individual activities, or groups of activities called containers. Some notes and requested changes may require approval by a Payload Operations Director, which TIPS permits via its user interface. The software is also able to customize a report to display activities originating from any one or more accessible ISS research partners. TIPS has optimizations that dramatically increase the speed of generating reports. TIPS is flexible; reports are newly generated on demand with the latest published plan information and associated notes. Combined, these various features eliminate the need for the manual generation and maintenance of TIPS reports, dramatically increasing the amount of time planners have to focus on planning instead of updating documents manually when payload science activity plans change.

The requirements for the TIPS tool were loosely defined and anticipated to change across the software development lifecycle, thus an Agile Software Development (ASD) paradigm was deemed most appropriate. TIPS became the POIC's first Agile project, and needed to find the balance between responsiveness to deadlines, inherent to any operational environment, while at the same time becoming flexible to changing customer needs. For the first time, flight operations support personnel collaborated closely with the developers building the software. The ASD process facilitated successful collaboration through periodic tag-ups, hands-on user evaluations, and structured feedback mechanisms that minimized paperwork and turn-around time. Through these strategically timed user evaluations, the customers provided ongoing, frequent feedback to developers, such that unanticipated changes and requests were identified earlier than they normally would have been. These were prioritized alongside addressing software bugs that were discovered at the same time by testers, and implemented as often as possible within the development timeframe, long before an official software release. ASD retrospectives, team-building activities, and socials were employed to ascertain how well the team was operating and how it could improve. Obstacles to success were removed, management was kept informed, and metrics were collected, analyzed and disseminated.

The forward-thinking software architecture combined with the ASD collaborative process has resulted in the fast completion of a tool that delivers customer value. Not only does TIPS fulfill functional requirements, but its

implementation directly reflects the evolving needs of the customer. The customer finds the reports intuitive and easy to understand, and reports are free of human error while continuously staying up to date with the latest planning information. TIPS provides efficient visibility into a timeline, and provides console operators with a clear summary for execution which will become more complex with the additional fourth crew member payload science activities. It assists teams with planning judicious resource allocation. After just the first Phase, efficiency metrics revealed a reduction in average time to complete the summarization of a timeline plan, from 40 hours with a manual TPS report, to 40 minutes with a TIPS Report (60 times faster). Through the unique collaborative process the team developed a synergy that allowed for a free flow of ideas. This resulted in the desire for additional capabilities, previously not identified, which the customer requested in a subsequent phase. Upon seeing the first phase of TIPS used operationally in flight, JSC began requesting their own instantiation of TIPS for JSC planning and operations. The flexible TIPS architecture can accommodate a JSC instance with relatively few changes.

This paper will address software architecture considerations in the successful cross-center development of an automated planning tool with multiple data sources. It will also discuss the practical application of a time-boxed Agile Software Development paradigm to deliver customer-driven value despite changing requirements with respect to low-Earth orbit operational planning activities. The goal of this paper is to open discussion with members of the international community and trade effective strategies for cross-center architectural and customer-developer driven collaborations, to support increasing utilization of planning and conducting science activities in space.