Miniature Seeker Technology Integration Spacecraft

Lead Authors: *Heidi Davidz, Art Pyster, Deva Henry,*
Contributing Authors: *Dave Olwell*

The Miniature Seeker Technology Integration (MSTI) spacecraft was the first of its kind: a rapid development spacecraft, designed and launched in one year. As an aerospace example for a satellite application, the case study, "M.S.T.I.: Optimizing the Whole System" (Grenville, Kleiner, and Newcomb 2004), describes the project's systems engineering approach. Driven by an aggressive schedule, MSTI optimized over the whole project, rather than allowing sub-optimizations at the component level. As a partnership with Phillips Laboratories, the Jet Propulsion Laboratory (JPL), and Spectrum Astro, MSTI went into orbit on November 21, 1992. The MSTI-1 succeeded in meeting all primary mission objectives, surpassing the 6-day data collection mission requirement.

Contents

Additional References

Domain Background

There are many case study examples for aerospace systems. This case is of particular interest because it highlights mechanisms which enabled successful performance following an aggressive schedule. Since this rapid development spacecraft was designed and launched in one year, new ways of structuring the project were necessary. Within this domain, the MSTI project used an innovative approach. Practices from this project led to the Mission Design Center and the System Test Bed at JPL.

Case Study Background

This case study was developed in support of the National Aeronautics and Space Administration (NASA) Program and Project Management Initiative by authors at the Virginia Polytechnic Institute and State University and Scientific Management, Inc. The case study was developed in the interest of continuously improving program and project management at NASA (NASA 2010). Research for this case included comprehensive literature review and detailed interviews. The project was selected based on the potential for providing lessons learned.

Case Study Description

The MSTI case study illustrates many principles described in the Systems Engineering Body of Knowledge (SEBoK). The MSTI team had to make adjustments to the traditional approach to spacecraft development in order to stay within budget and to meet the aggressive timeline of bringing a spacecraft from conception to launch within one year. The team realized that they were "building Porsches not Formula 1s"(Grenville, Kleiner, Newcomb 2004). Meeting the schedule was a crucial factor that affected all decisions. The SEBoK knowledge area on life cycle models describes life cycle design in more detail.

The team took advantage of existing hardware architectures for their architectural design to expedite the project. In addition, at each design phase, the whole system was optimized instead of optimizing subsystems, and the level of optimization at the subsystem level was

reduced. A hardware-in-the-loop test bed was used throughout the project, which expedited system integration.

The schedule was maintained only at a high level in the project management office, and the costs were managed using a cost reporting technique for "cost to completion." Rather than report on past spending, the Responsible Engineering Authorities (REAs) were expected to continually evaluate their ability to complete their tasks within projected costs. Faster procurement was achieved using the Hardware Acquisition Team, where a technical team member was matched with a procurement representative for each design function. This pair wrote the specifications together and initiated the purchase requisitions.

From the organizational perspective, increased responsibility and accountability were given to each team member. Individuals took ownership of their work and the decision process was streamlined. The team made more "good decisions," rather than optimal decisions. The team was collocated, and daily meetings were used to assign daily tasks and keep the team focused on the launch. The standard Problem Failure Report (PFR) was streamlined and electronic reports provided snapshots of the resolved and outstanding PFRs. The report helped REAs stay on top of potential problem areas. REAs were responsible for looking forward on the project horizon and notifying the team of any potential problem areas.

The first satellite in the MSTI series, MSTI-1, was launched on November 21, 1992. The spacecraft weighed 150 kg and was built for $19M in less than 12 months. Over 200,000 photographs were returned from the spacecraft. From a project management standpoint, all mission objectives were completed.

In addition, MSTI had a lasting legacy. Faster procurement developed into an approach JPL now calls "Fast Track Procurement." Hardware acquisition teams are used often in JPL projects. The hardware-in-the-loop test bed was the precursor to the Flight System Test Bed at JPL. Team members moved up quickly in JPL due to the increased responsibility and authority they were given on the MSTI project.

Summary

MSTI demonstrated that an aggressive schedule can be used to design low earth-orbiting spacecraft to optimize

the full system. The MSTI experience changed JPL's culture and their approach to spacecraft development and mission management. The insights from this case study example can help both students and practitioners better understand principles described in the SEBoK.

References

Works Cited

Grenville, D., B.M. Kleiner, and J.F. Newcomb. 2004. *M.S.T.I., Optimizing the Whole System.* Blacksburg, VA: Virginia Polytechnic Institute, case study developed in support of the NASA Program and Project Management Initiative. 1-27. Accessed June 3, 2011. Available at http://www.nasa.gov/pdf/293212main_58529main_msti_casestudy_042604.pdf.

NASA. 2010. *A Catalog of NASA-Related Case Studies,* version 1.6. Compiled by the Office of the Chief Knowledge Officer, Goddard Space Flight Center, MD, USA: National Aeronautics and Space Administration (NASA). Accessed June 3, 2011. Available at http://www.nasa.gov/centers/goddard/pdf/450420main_NASA_Case_Study_Catalog.pdf.

Primary References

None.

Additional References

None.

< Previous Article | Parent Article | Next Article >
SEBoK v. 2.10, released 06 May 2024
