

Addressing Human Error in International Space Station Flight Control Teams:

Advances in Ground Training for Science Operators

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In flight control, as with any human in the loop system, operator error is an inevitable reality. On the International Space Station (ISS) where crew time and physical resources are precious and often irreplaceable, operator errors can result in significant, irreversible consequences. Flight controllers at the Payload Operations Integration Center (POIC) located at NASA's Marshall Space Flight Center (MSFC) in Huntsville, Alabama know this reality well. At the POIC, operator errors can be caused by a variety of factors, from poor hardware or software design to environmental factors such as time pressure or fatigue. The most difficult errors to address, however, are those which result from ineffective teamwork.

Academic research in teamwork has resulted in the identification of many factors which make cross-functional teaming difficult, including leadership, trust building, and communication challenges. These factors, especially when combined with the challenging environmental factors flight control teams must contend with daily, make the goal of minimizing operator errors in payload operations challenging to achieve. To address such teamwork errors, trainers at the POIC have drawn best practices from high reliability industries such as commercial aviation, healthcare, and nuclear power plants, as well as from our sister ISS control center in Houston, Texas, to develop and institute a new training program focused specifically on teamwork skills.

This training program, called the Team Skills Curriculum, is based on the concept of Crew Resource Management (CRM) which was developed by NASA in the 1970s for the commercial aviation industry in response to a series of aviation disasters resulting from ineffective teamwork. CRM was later tailored by the Johnson Space Center (JSC) for use in astronaut and flight control training. The result, called Space Flight Resource Management (SFRM) was formally introduced into manned spaceflight training in the late 90s. SFRM has evolved over the years, but the focus has remained on helping operators develop the skills needed to work as part of an effective team. Using these concepts as well as the latest research in cross-functional teaming and data on specific errors occurring at the POIC, trainers in the integrated flight control training branch created a custom training program for both new and certified payload operations specialists.

The resulting Team Skills Curriculum focuses on specific team skills identified as important for payload operators including team dynamics, situational awareness, communication skills, critical thinking, human factors and error reporting, giving and receiving feedback, conflict resolution, and leadership. Classes are composed of a diverse mix of flight controllers representing many technical disciplines, and are facilitated using a variety of innovative teaching methods including review of video clips, group discussions, and interactive activities such as building rockets out of Lego blocks, which are designed to encourage collaboration and learning between participants. Instructors are drawn from a pool of currently certified and active flight controllers representing multiple flight control disciplines, and are chosen based on technical competence and instructional skills. To address the common training challenge of translating classroom lessons in team skills into measurable results on the job, students develop action plans which consist of concrete goals for changes they will make in their daily work as a result of what they learned in the course. Accountability for these goals can be achieved through meetings with peers, mentors, or managers. For trainees, course content is presented over a period of months, which allows time to digest information and meet action plan goals before adding additional skill areas.

This paper will go into more detail about the challenges faced by cross-functional teams in general and, specifically, challenges faced by the flight control team at the POIC. It will also provide additional details about flight control teamwork errors at the POIC, development and implementation of the Team Skills Curriculum as a tool to address these errors, early feedback on the training program, and recommended areas for future research and advancement in flight control team training and error prevention. Minimizing operator errors in flight control is an endeavor which requires constant vigilance and continuous improvement. At the POIC, the Team Skills Curriculum is an important step in this journey.

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