Space Flight Resource Management for ISS Operations

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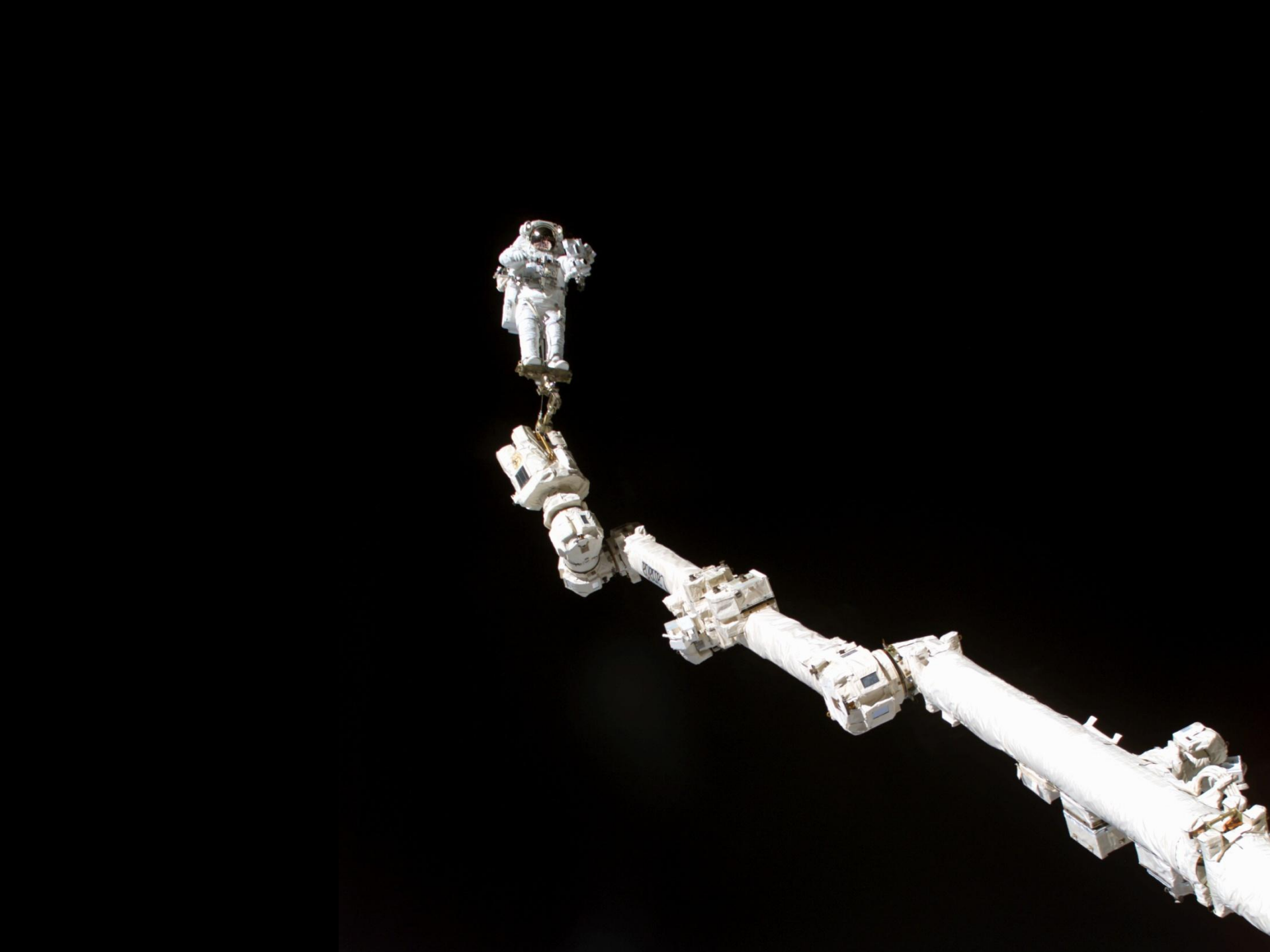
Presented by *One of the Above, whoever is funded to go to ASMA…*


esa
COLUMBUS



Crew Training Flow for ISS

- 2 ½ years plus a 6-month expedition
- 6 crewmembers with overlapping on-orbit schedules
- Primarily trained independently
- Rarely trained as an entire team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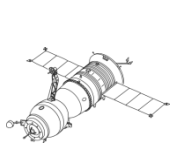
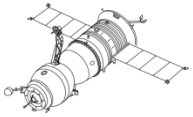
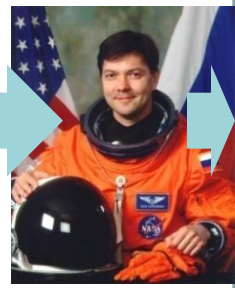














Crew Changes for Expedition 16: A Three-Person Crew

Problem

- How does an ever changing crew quickly become a team that must be:
  - Adaptable
  - Decisive
  - Self-correcting

Space Flight Resource Management
History

- Based on Cockpit Resource Management
- SFRM was developed first for shuttle astronauts
- Focused on managing human errors during time-critical events such as launch and extravehicular activity ("EVA") (Rogers, et al. 2002).

Space Flight Resource Management History

- Human Behavior and Performance Training Working Group
  - Astronauts, Training Experts, and Psychologists
  - NASA, CSA, ESA, JAXA, IBMP, GCTC
  - **What team/psychosocial competencies are required for ISS crews?**
- Completed Document "Human Behaviour and Performance Competency Model Vol 1 and 2" (NASA TM - 2008-214775)
  - Set the first real standards for ISS team training
  - Forms basis for revived SFRM for long-duration crewmembers

Space Flight Resource Management Adapted to ISS

- 2 weeks
- Sprint
- Frequent critical events
- Critical events are largely known and planned

- 6 months
- Marathon
- Less frequent critical events
- Critical events are both planned and unplanned

- **The scope of SFRM for ISS broadened to include teamwork during routine operations (O'Keefe, 2008).**

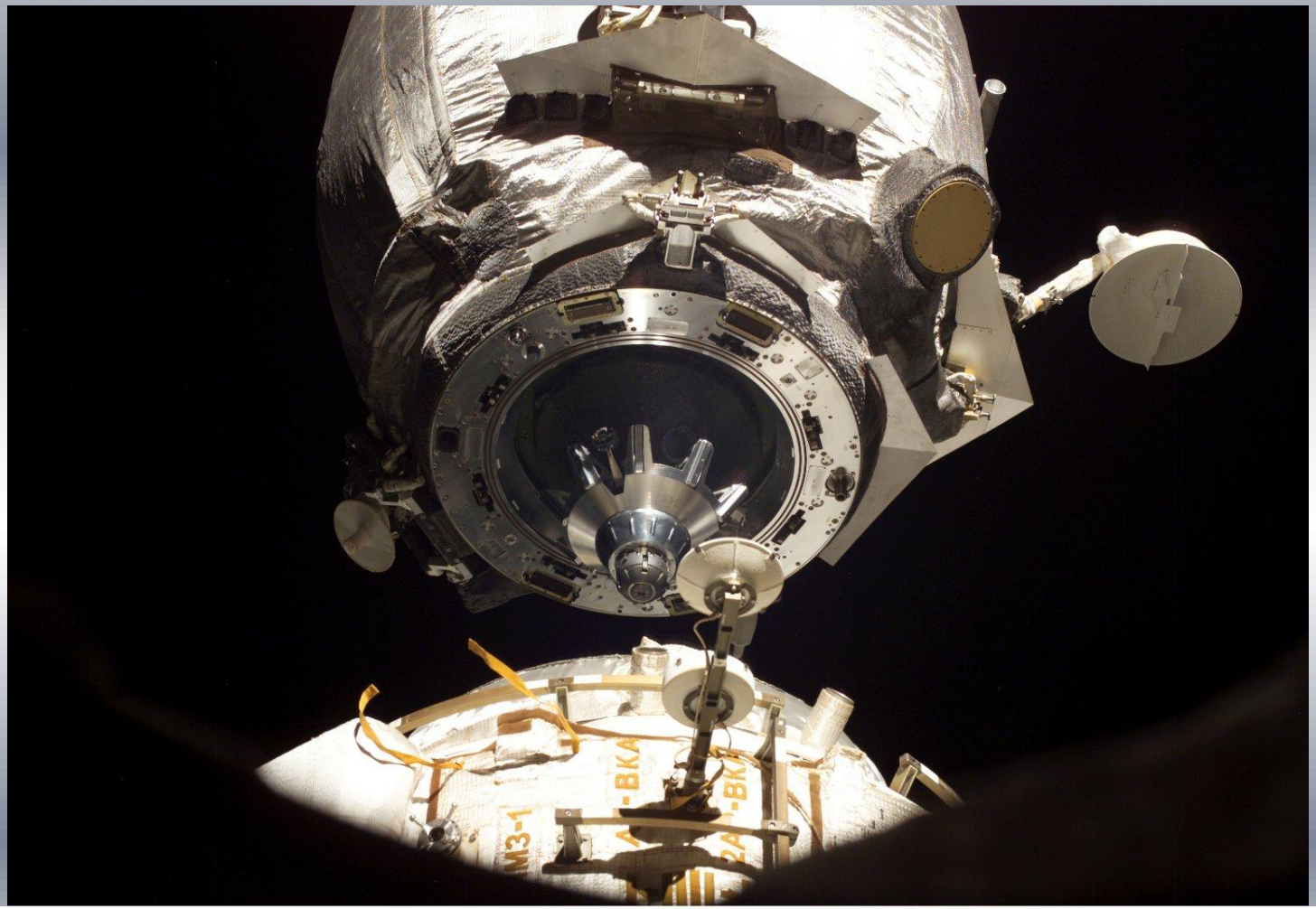
SFRM Adapted to ISS

Time Critical Events

Astronaut Ken Cockrell activating air systems, fire extinguishers, alarm systems, computers and internal communications in the newly attached Destiny laboratory on board ISS.

SFRM Adapted to ISS

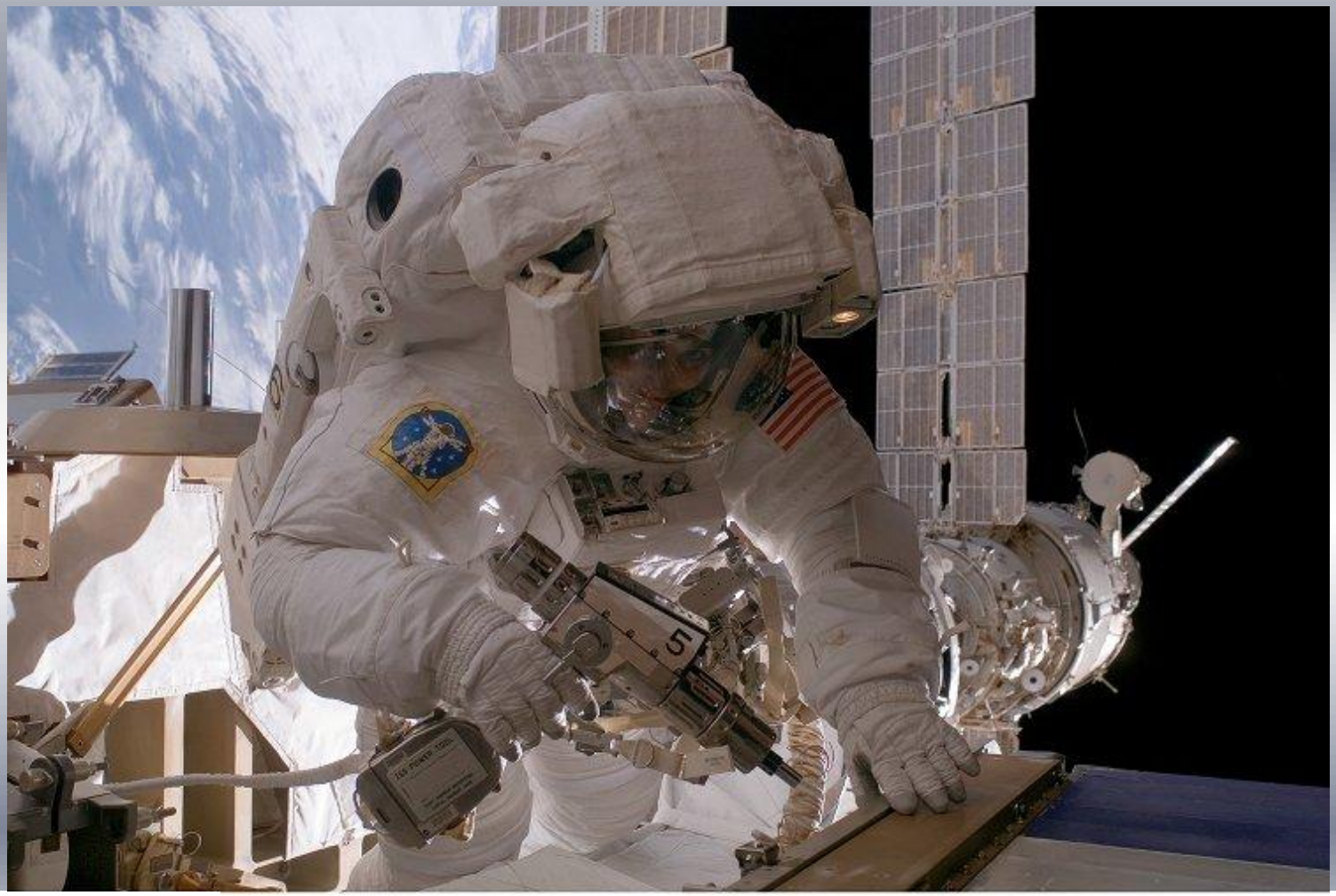
Time Critical Events



Unmanned Progress undocking before burning up in atmosphere.

SFRM Adapted to ISS

Time Critical Events



Astronaut Sunita Williams, Expedition-14 flight engineer, uses a pistol grip tool.

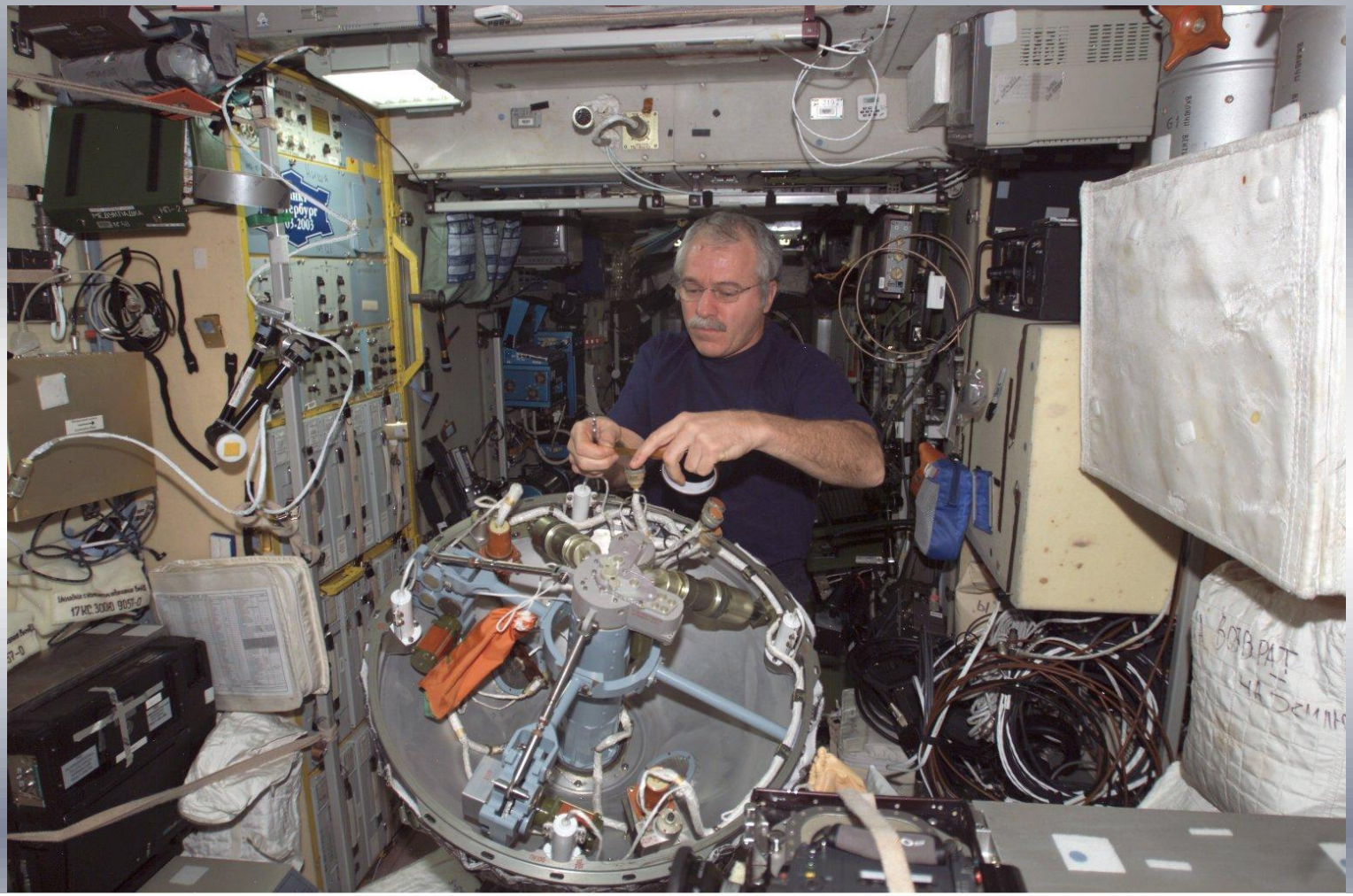
SFRM Adapted to ISS

Routine Operations

Astronaut Michael Foale, Expedition 8, uses a digital still camera to photograph a Slow Growth Sample Module (SGSM).

SFRM Adapted to ISS

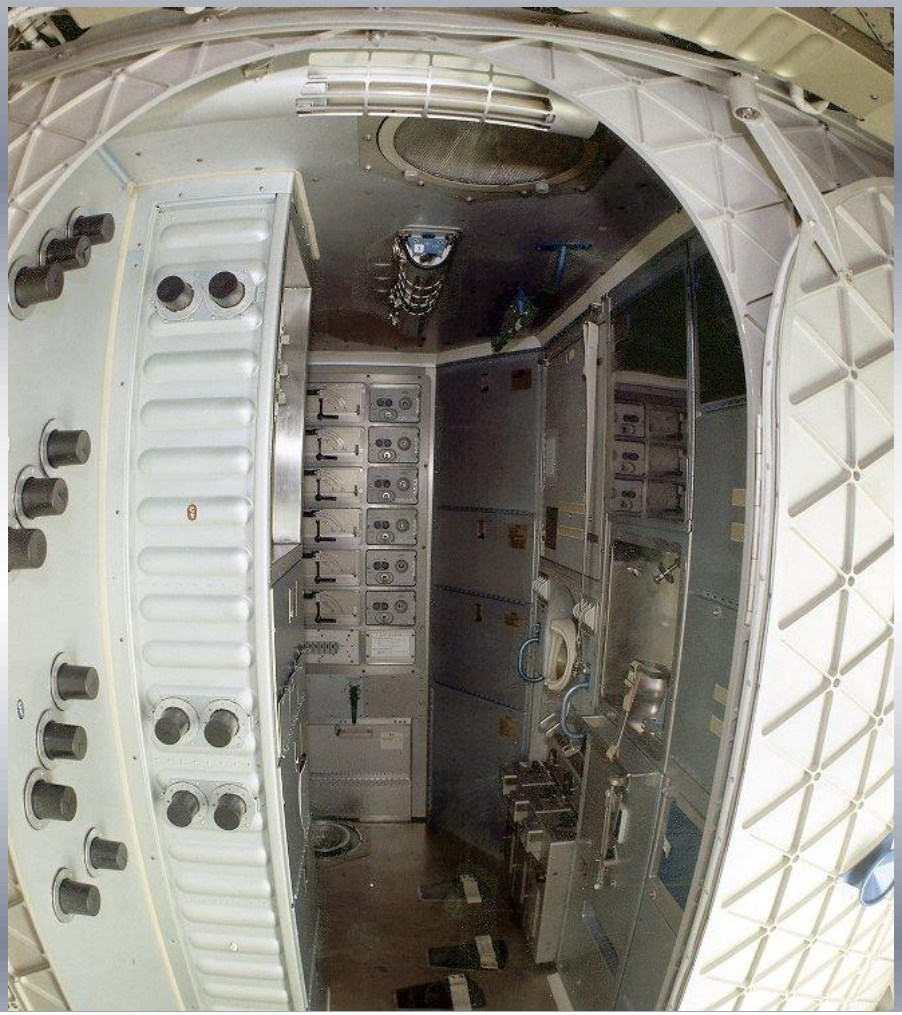
Routine Operations



Astronaut John Phillips, Expedition 11, works on the dismantled probe-and-cone docking mechanism from the Progress 18 spacecraft in the Zvezda Service Module of the ISS.

SFRM Adapted to ISS

Routine Operations



Waste management compartment

SFRM Training Flow Overview

- Stand-alone classes taught by SFRM experts
  - Additional Human Behavior and Performance courses offered to ASCANs (Cross-cultural, Stress Management and Conflict Management) at this time
- Low-fidelity simulations
- Expeditionary workshop led by flown astronauts
- Field experience—NOLS
- Technical simulations with SFRM incorporated

SFRM Training Flow
Formal Classes

- **ISS SFRM Skills**
  - Learn the eight interrelated SFRM skills and how to apply them to ISS operations
  - Describe how effective SFRM skills will break the error chain

- **ISS SFRM Human Performance**
  - Identify ISS mission conditions that adversely affect human performance
  - Develop a personal plan to mitigate adverse human performance conditions
  - Define the STAR acronym and explain how the process can help to mitigate errors
  - Practice using the STAR process

- **ISS SFRM Case Studies**

  Given an accident scenario, perform the following:
  - Identify the error chain that caused the accident
  - Identify how heightened SFRM skills would have helped break the error chain

SFRM Behavior Elements

The goal of the SFRM program is to reduce human errors in Space Flight Operations.

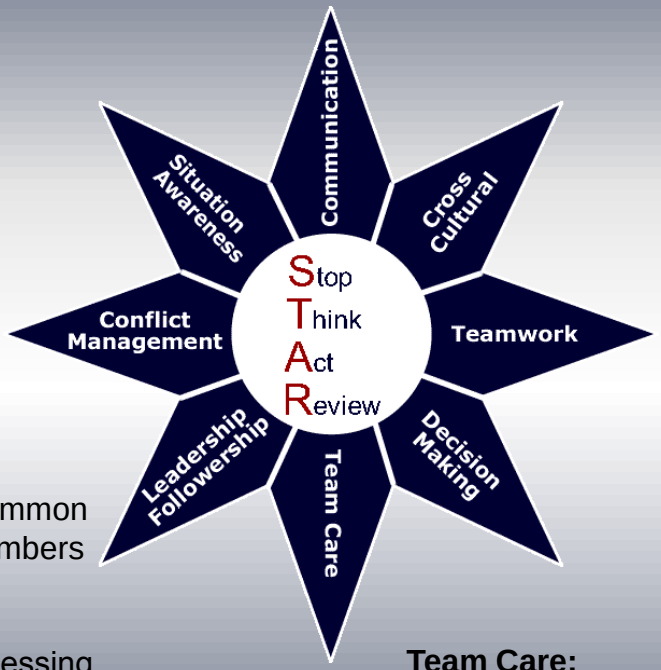
Situation Awareness:
The capability to identify, process, and comprehend the critical information regarding what is happening with the team and situation with regards to mission success. Simply put, *sensing what is going on around you (including identifying disconfirming info and predicting effects.)*

Conflict management:
The ways individuals and teams identify and manage differences in opinion, perception, technical knowledge, personality, etc. to complete a task or mission.

Leadership:
Directing a team or individual toward a common goal, developing and motivating team members as appropriate to tasks.

Followership:
Following the leader's direction, while assessing individual and team behavior elements and providing input to best support the leader to reach the common goal.

Communications:
To express oneself in such a way that one is readily and clearly understood. This is accomplished by active listening and allowing for non-verbal actions.



Cross-Cultural:
Considering the effects of various cultures (nationalities, professions, heritage) on the workplace and people's actions.

Teamwork:
How individuals cooperate with each other to achieve a shared goal, including accepting accountability and responsibility for actions.

Decision Making:
The cognitive process leading to selecting a course of action, including an assessment of options and risks.

Team Care:
How healthy the person or team is on a psychological level. This can be influenced by various personal factors such as: stress, fatigue, boredom, training, sickness, etc.

SFRM Training Flow

Low-Fidelity Simulation—Moon Base

- Nontechnical, low-fidelity tabletop simulation
- Players practice
  - planning, implementing, and debriefing SFRM skills as a team, and
  - self-correction techniques.
- 4-5 students, 1 acts as mission control
- Students are physically separated and use walkie-talkies to communicate
- Planning session before start of simulation
- Facilitated debrief follows the simulation
- Simulation is conducted twice in one day
- Scenarios can be tailored to meet needs of student or team

SFRM Training Flow

Low Fidelity Simulation—Moon Base

- Primary simulation objective—To have each crewmember travel to moon base and back and then launch successfully within the mission window
- Three versions of the simulation with increasing complexity and difficulty
  - Version 1—Basic; meet primary objective
  - Version 2—Intermediate; adds unexpected emergency and risk management scenarios
  - Version 3—Advanced; adds assigned mission roles and individual as well as team objectives

SFRM Training Flow

Low-Fidelity Simulation—Moon Base

- Each student monitored and coached by SFRM instructor
- Individual feedback given at end of day
- Feedback based on SFRM Behaviorally Anchored Rating Scales
- 2 SFRM skill strengths
- 2 goals for improving weakest SFRM skills
- Narrative summary of this feedback discussion provided to ASCAN and to ASCAN Review Board (and International Partners for international ASCANs)

SFRM Training Flow
Expeditionary Workshop

- Led by flown astronauts
- Presented the competencies as they apply to long-duration expeditions
- Reviewed real ISS critical incidents, experiences, and effective behaviors and coping strategies for living on the ISS
- Most valued for the personal accounts of experienced/flow ISS crew members



SFRM Training Flow
National Outdoor Leadership School

- Field-based training in wilderness environment
- Specially designed 12-day course to meet the needs of NASA
- Competencies
  - Leadership/followership
  - Decision making and problem solving
  - Communication
  - Group living
  - Self care

SFRM Training Flow
Technical Sims

- Malfunction Fundamentals
  - 3 hours in ISS Flight Control Mockup
  - Instructors trigger different system malfunctions
  - ASCANs are actively questioned during sim
  - SFRM Instructor provides a written narrative
- Moderate Temperature Loop (MTL) Loss
  - 1 hour in class room reviewing, and 2 hours in ISS Mockup
  - Instructor sets off 1 overall failure involving thermal loops
  - ASCANs work to identify and eliminate failure signatures
  - SFRM Instructor provides a written narrative
- EPS Bus Loss
  - Similar to MTL

Evidence

"SFRM and STAR gives people the impression that I did something that is beyond my scope. Instead it's the training that I received that is above and beyond the ordinary."

- Ground support crewmember

Evidence

- Transfer of training
  - From classroom to mountaintop
  - From work to family
- "It's a good story, since we made it back to tell it!" - ASCAN

Evidence

- Two and a half foot tear in a $5.6 million solar panel
- “This repair was the type of activity that would take over a year to design and would typically require over a year of crew training—and we did it with three days of procedure development and zero crew training.” - NASA astronaut Dan Tani

SFRM Training Flow
Future Hopes

- Adding components to training
- Extending from ASCANs to Assigned Flight Crew
- Standardizing what is Trained
  - Across entire flight team (controllers, directors, instructors, crews, etc.)
  - International partners
- Sharing knowledge gained
  - Other industries with similar operational challenges
  - Research on teams and training