Future space missions will be significantly longer than current shuttle missions and new systems will be more complex than current systems. Increasing communication delays between crews and Earth-based support means that astronauts need to be prepared to handle the unexpected on their own. As crews become more autonomous, their potential span of control and required expertise must grow to match their autonomy. It is not possible to train for every eventuality ahead of time on the ground, or to maintain trained skills across long intervals of disuse. To adequately prepare NASA personnel for these challenges, new training approaches, methodologies, and tools are required. This research project aims at developing these training capabilities. By researching established training principles, examining future needs, and by using current practices in space flight training as test beds, both in Flight Controller and Crew Medical domains, this research project is mitigating program risks and generating templates and requirements to meet future training needs. Training efforts in Fiscal Year 08 (FY08) strongly focused on crew medical training, but also began exploring how Space Flight Resource Management training for Mission Operations Directorate (MOD) Flight Controllers could be integrated with systems training for optimal Mission Control Center (MCC) operations. The Training Task addresses Program risks that lie at the intersection of the following three risks identified by the Project:

- Risk associated with poor task design
- Risk of error due to inadequate information
- Risk associated with reduced safety and efficiency due to poor human factors design

### Flight Controller Training

Based on the understanding of MOD needs, constraints, and current practices, a conceptual framework for Operationally Oriented Training was developed. This framework integrates research on adult learning principles, lessons learned in analog domains, and the results of multiple extensive discussions with MOD training and operations personnel.

To improve performance on Space Flight Resource Management (SFRM) skills, to enable early recognition of SFRM challenges, and to increase the overall effectiveness of Flight Controllers’ training, our framework introduces SFRM early in the training flow, to integrate SFRM skills with the technical skills, and to provide continuous explicit guidance and feedback on SFRM performance throughout training and operations.

### Medical Training

#### Constellation Medical Training Needs Analysis

In FY08, a Constellation medical training needs analysis was performed that examined the most current Constellation Crew Exploration Vehicle (CEV) Medical Operations group’s Concept of Operations and identified expected space medical training needs according to the mission type. This report highlighted areas for further research. In addition to this report, five individual interviews were conducted with ISS long duration crew members regarding space medical training. From both of these activities, specific project related research has been developed and will continue into FY09 and beyond.

#### Demonstration of JIT Training Technique

This product consisted of an investigation and demonstration of just-in-time training techniques. Three components were delivered as a JIT training technique package: a general overview of JIT training, a survey of medical techniques that claim to be JIT training tools and their features and components, and a paper-based concept prototype for a Flight Surgeon’s real-time decision aid/JIT training concept for ISS emergencies.

### Trade Study of Analogue Environments to Conduct Studies for Training

To understand crew performance under the expected conditions of future space flight missions, analogue environments must be used. To assess the value of such environments for evaluating training methods, a comparative study of space-analogue environments was conducted.

### SFRM Generic Training Framework Concept Prototype

The report describes a game which is a generic training tool prototype for multi-agent interactions, and as such can be used to develop the foundational Space Flight Resource Management (SFRM) skills needed by Flight Controllers for effective team work in MCC operations. The game teaches how to identify early signs of increased workload and stress in one’s self and in others, and how to anticipate information needs including pulling information to other team members before they have to request it, and pulling information when necessary. Furthermore, the game teaches and reinforces critical debriefing skills.

### FY08 Deliverables

- Space Human Factors Engineering Training Directed Research Project: 
  - Trade Study of Analogue Environments to Conduct Distributed Team Studies: 
    - Space Human Factors Engineering Training Directed Research Project: 
      - Demonstration of JIT Training Technique: 
        - Space Human Factors Engineering Training Directed Research Project: 
          - Space Human Factors Engineering Training Directed Research Project: 

### Future Research Direction

The Training Continuum

- Pre-Flight
- In-Flight Ops
- In-Flight Refresher
- In-Flight JITT
- Post Flight

#### Skill-Based vs. Task-Based
- Classroom Simulations
- Field Experience

#### Practice Building Experience
- On-Board Equipment
- On-Board drills

#### Little used Critical skills
- CBT On-Board equipment
- Virtual Environment

#### Expected Unexpected
- Virtual Environment
- CBT

#### Daniels & Lessons Learned

### Some Research Questions:

- What are the basic and generalizable skills underlying different tasks?
- What is the optimal distribution of topics across training opportunities?
- What is the optimal delivery method and media for a given training topic?
- How do we assess proficiency?

### Stakeholders:

- Robert Banfield, Chief, Expedition Vehicle Division, JSC/DI
- Dr. Joseph Schmid, Lead, Space Medicine Training, Medical Operations, JCS/SD

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**Human Factors in Training**

Human Research Program - Space Human Factors & Habitability

Space Human Factors Engineering Project

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