



## Evolution of Training in NASA's Mission Operations Directorate

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### 1. What is the Mission Operations Directorate (MOD)?

NASA's Mission Operations Directorate provides all the mission planning, training, and operations support for NASA's human spaceflight missions including the International Space Station (ISS) and its fleet of supporting vehicles. MOD also develops and maintains the facilities necessary to conduct training and operations for those missions including the Mission Control Center, Space Station Training Facility, Space Vehicle Mockup Facility, and Neutral Buoyancy Laboratory.

### 2. What is the cultural foundation of MOD?

1. To instill within ourselves these qualities essential to professional excellence: Discipline, Competence, Confidence, Responsibility, Toughness, Teamwork, and Vigilance.
2. To always be aware that suddenly and unexpectedly we may find ourselves in a role where our performance has ultimate consequences.
3. To recognize that the greatest error is not to have tried and failed, but that in the trying we do not give it our best effort.

These cultural tenets are instilled in every MOD employee from the day they are hired. All MOD employees attend an initial training course that introduces these concepts.

### 3. Train Like You Fly

MOD's overarching approach to human spaceflight training is to "train like you fly." This approach means not only trying to replicate the operational environment in training but also to approach training with the same mindset as real operations. When in training, this means using the same approach for executing operations, responding to off-nominal situations, and conducting yourself in the operations environment in the same manner as you would for the real vehicle.

### 4. Mission-Specific Training

Mission-specific training has been used since MOD's inception to train the operations needed to successfully complete human spaceflight missions. In mission-specific training, mission controllers and astronauts complete the actual tasks that will be completed during the mission. In the early days, this was MOD's sole approach to training. MOD relied upon a high rate of repetition to ensure the successful completion of mission activities.

### 5. Specialization of Mission Controller and Astronaut Roles & Responsibilities

Due to the complex nature of spaceflight vehicles and associated operations, NASA has always set clear expectations for the roles and responsibilities of every mission controller and astronaut. While the responsibilities for a mission controller do not change from flight to flight, astronaut roles and responsibilities are assigned based on aptitude in specific areas, prior experience, projected availability during a mission, and amount of training required for a given task.

### 6. Generic Training

In the mid-1980's, MOD began using generic training to prepare mission controllers and astronauts for missions. Generic training focuses on the technical, operational, and behavioral skills that remain the same from mission to mission. It is more cost effective to train mission controllers to a generic vehicle configuration and then do comparatively small amounts of mission-specific training than to do all training in a mission-specific environment. Generic training also allows MOD to ensure that trainees possess the capability to be a mission controller prior to assignment to a given mission.

## 7. Cockpit/Spaceflight Resource Management Training (CRM or SFRM)

In the mid-1990's, MOD adapted the airline industry's cockpit resource management model to human spaceflight. CRM/SFRM focuses on the soft skills required for successful team performance including: maintaining situational awareness, communication, decision making, leadership, followership, team care, and conflict management. CRM/SFRM training is most effective when it is embedded within technical training. All MOD students are given some initial training to educate them on these topics and associated best practices. They are then evaluated on these areas throughout their training.

## 8. Crew Training Time Budget

Due to the amount of content needed to train International Space Station (ISS) missions and the number of participants involved, MOD implemented a crew training time budget in 2001. This budget includes an accounting of every hour in the 2.5 year training flow necessary to prepare an astronaut for a mission to ISS. This team is independent from all technical disciplines. As new training requirements are added to the training flow, this team pushes the MOD training community to remove obsolete training requirements thereby keeping ISS training from expanding beyond the 2.5 year training time.

## 9. Curriculum Design

MOD currently uses the ADDIE model – Analyze, Design, Development, Implementation, and Evaluation – to generate all mission controller and astronaut curriculum. MOD uses the Developing A Curriculum (DACUM) approach to perform a functional analysis for all mission controller and astronaut roles and responsibilities. Detailed training needs analyses are then performed on every position to determine training requirements for every position. All training flows are then documented in certification guides. MOD uses a combination of formal and informal training to complete certification including scripted lessons, mentor sessions, on-the-job training, on-line lessons, mini-simulations, and generic simulations.

## 10. Top Gun Approach

In 2008, MOD instituted a “Top Gun” approach to mission control and instructor personnel. Prior to this, new hires brought into the organization were assigned to do either flight control or instructor disciplines. These new hires then proceeded through a 2-5 year training flow that resulted in a capstone certification as a mission controller or as a full-task simulator instructor. In the new approach, new hires are required to learn a scaled-down set of operational responsibilities within a 12-18 month timeframe. Once that initial certification is achieved, the person proceeds to an advanced flight controller certification, instructor certification, or both. This allows the organization to receive a quicker return-on-investment from the trainee, improves the quality of training by providing instructors with operational experience, and reduces organizational overhead by not having to maintain separate groups of flight controllers and instructors.

## 11. Common Content Training

Through the training needs analysis process, MOD has identified sets of skills and knowledge that are applicable to all flight controllers and instructors. To save directorate resources, a set of common content training has been developed to provide all MOD personnel with a common foundation. This content includes: command training, basic ISS vehicle knowledge, SFRM training, presentation skills, mentor skills, lesson development skills, etc.

## 12. Mini-Sims

Full team simulations using a full task simulator are expensive. To minimize this cost, MOD has developed “mini-sims” to provide team-based training opportunities on specific subjects. Mini-sims focus on a specific nominal or off-nominal scenario and only involve members of the team who are critical players in that scenario. Mini-sims allow trainees to practice soft skills and operational skills prior to participating in generic simulations.

## 13. On-Line Training

MOD has developed a robust on-line training capability that provides a learning environment that is the same quality as a traditional classroom environment. On-line lessons are also being developed that will provide lessons on subjects normally taught in high-use facilities, allowing the student to receive the information when it is appropriate for them. On-line learning is also used to maintain proficiency on topics for experienced personnel.



# Mission Operations Directorate

## *Spaceflight Training Management Office*

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## *Evolution of Training in NASA's Mission Operations Directorate*

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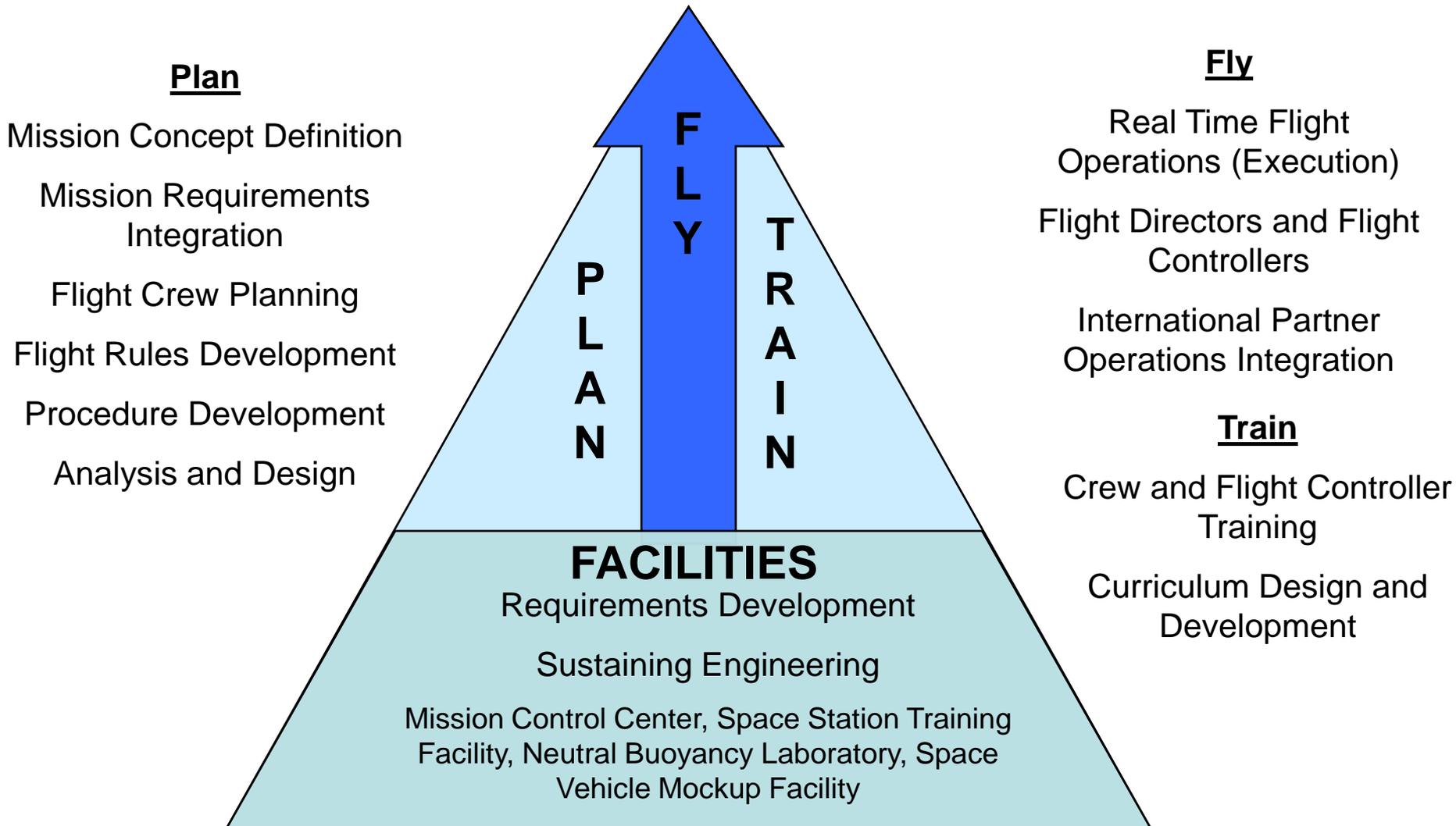


# Overview

- **Mission Operations Directorate (MOD) Introduction**
- Early NASA Training
- Space Shuttle Training
- International Space Station (ISS) Training
- Future Concepts



# Scope of “Mission Operations”







# Space Station Training Facility (SSTF)

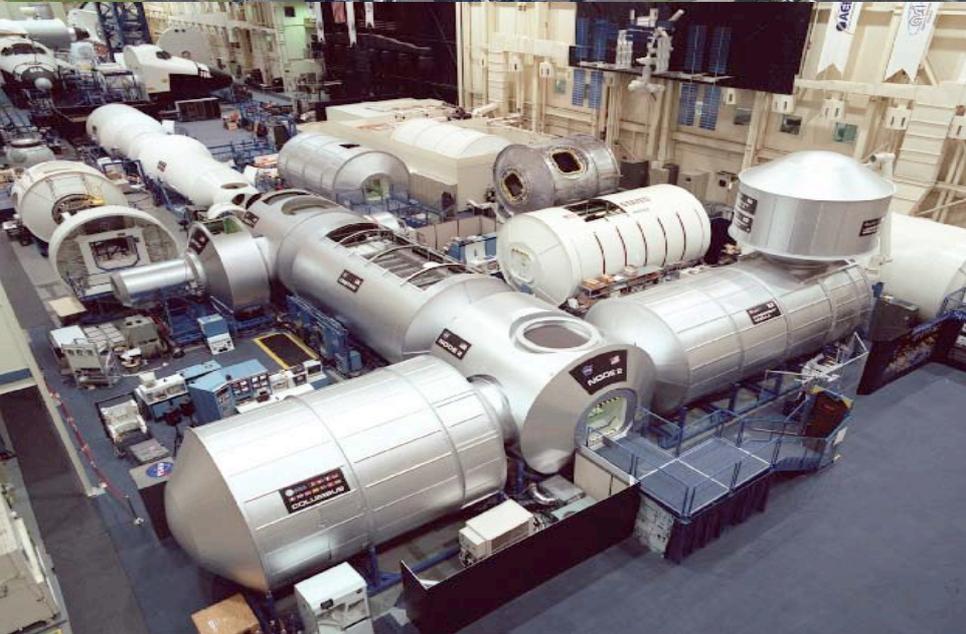
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# Space Vehicle Mockup Facility (SVMF) & Neutral Buoyancy Lab (NBL)

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# Mission Operations 'Culture'

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2. To always be aware that suddenly and unexpectedly we may find ourselves in a role where our performance has ultimate consequences.
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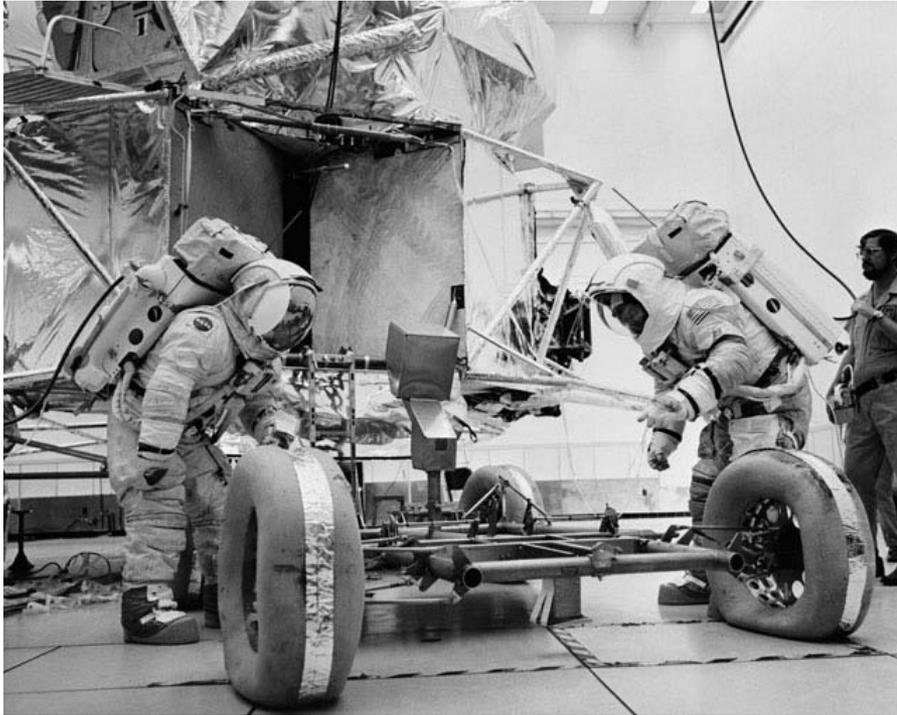
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# Early Training Approach

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**Train Like You Fly**

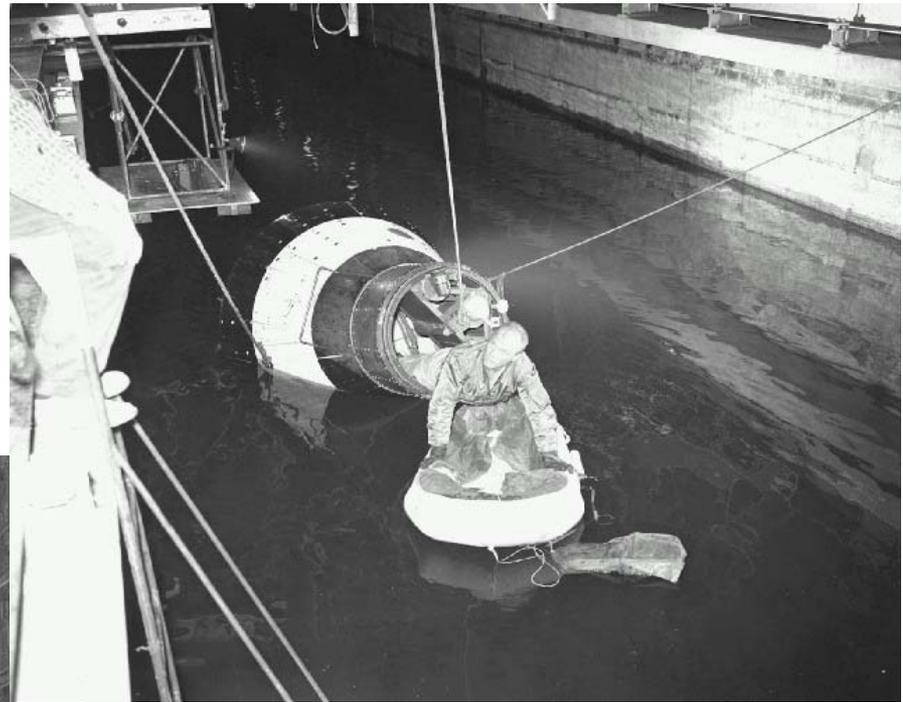
**Mission-Specific Training**





# Early Training Approach

- Full task training
- Part task training





# Specialized Crew & Mission Controller Roles

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- All crewmembers & mission controllers are not trained on all tasks.
- Allowed training to focus on tasks pertinent to a particular crewmember or mission controller.
- Training requirements documented in certification guides.





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# Shuttle Training



ISS020E021319

- Short duration missions (<2 weeks)
- 4-7 crewmembers
- Vehicle primarily operated by crew
- Well-defined mission objectives



# Training Concepts Introduced

- MOD Cultural Training
- Generic Training
- Cockpit Resource Management Training





# MOD Cultural Training



Initial training program for all new hires or transfers.

Instills MOD values and expectations.

Provides overview for human spaceflight operations.



# Generic Training

Introduced post-Challenger accident

Used to train and certify mission controllers on skill sets common across missions.

Mission-specific training still required.





# Cockpit Resource Management (CRM)

- From 1996-1998, MOD developed soft skill training adapted from airline industry.
- Focuses on:
  - Teamwork
  - Communication
  - Leadership/Followership
  - Problem Solving
  - Situational Awareness





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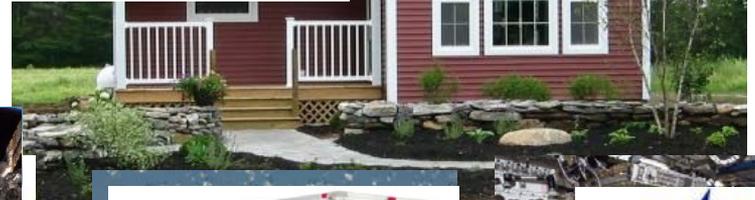
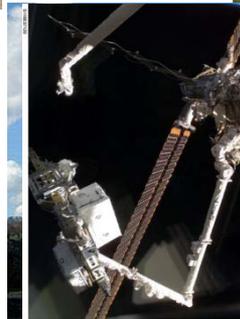
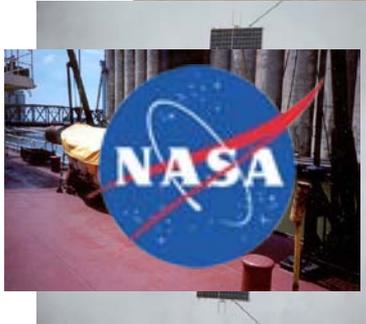
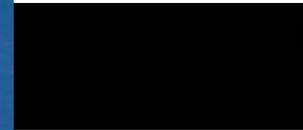


# ISS: A New Training Challenge

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# Operating ISS



MCC-Houston



POIC-Huntsville



MCC-Moscow



CSA-MCC



SSIPC(JAXA)



Columbus-CC  
(ESA)



# ISS Training Challenge

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Long duration mission (6 months).

Mixed international crews.

Primarily controlled remotely by MCC.

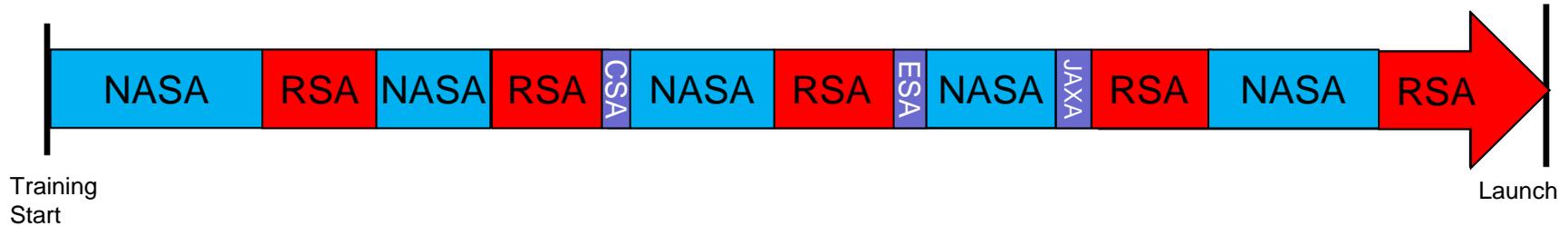
Crew focused on utilization.





# Long Duration Crew Training

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- Currently a 2.5 year training flow for an inexperienced crewmember.
- First 2 years of training are focused on generic skills training. Final 6 months of training focuses on mission specific skills.
- Crewmembers may spend up to 55-65% of the 2.5 year training period in Russia, Germany, Japan and Canada.



# Training Governance

- Multi-National Control Board
  - Co-chaired by NASA & Roskosmos



- Spaceflight Training Management Office





# Training Concepts Introduced & Refined

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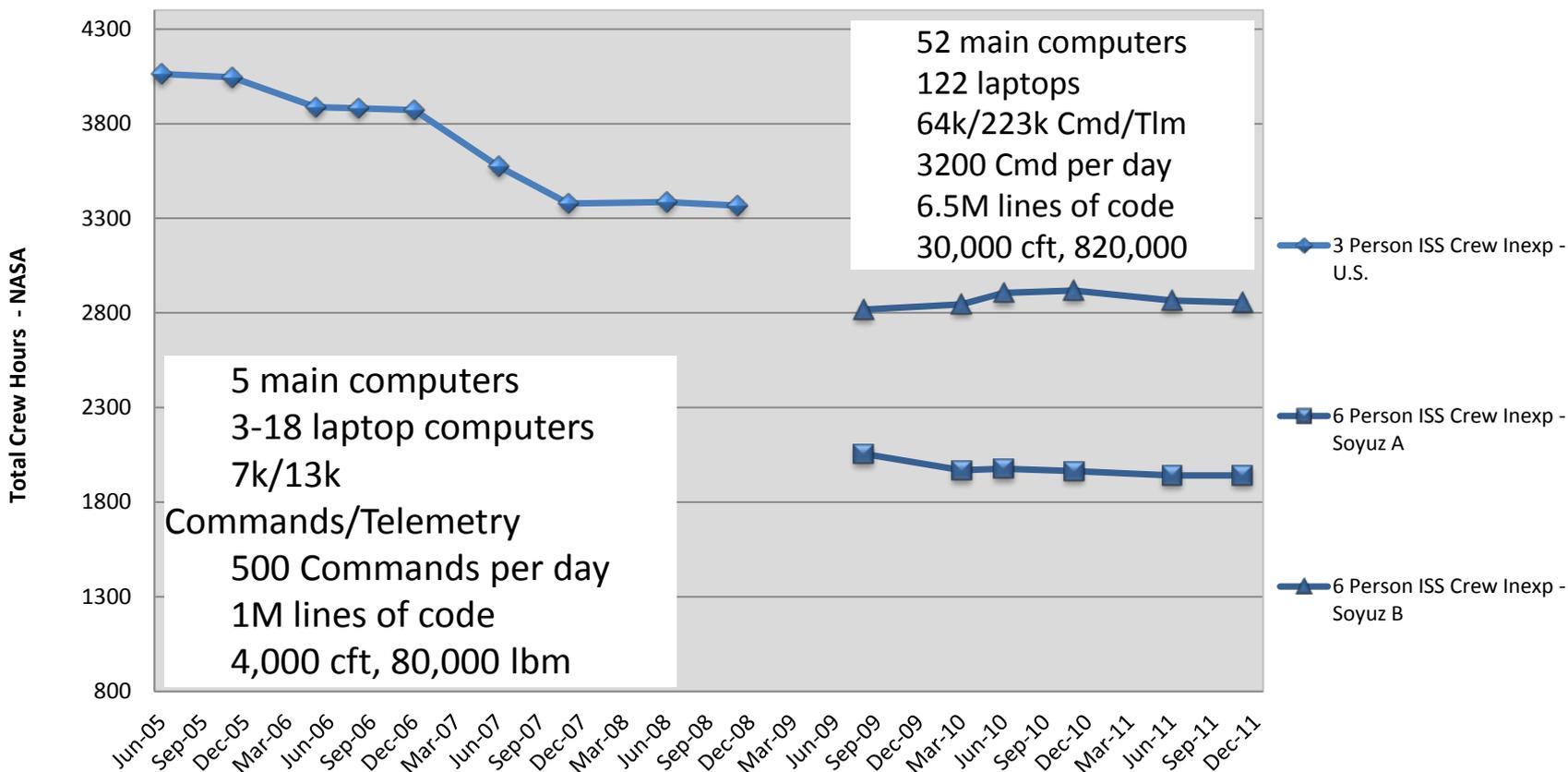


- Crew Training Time Budget
- Training Needs Analysis
- Top Gun Approach
- Common Content Training
- Spaceflight Resource Management Training
- Mini-sims
- On-Line Learning



# Crew Training Time Budget

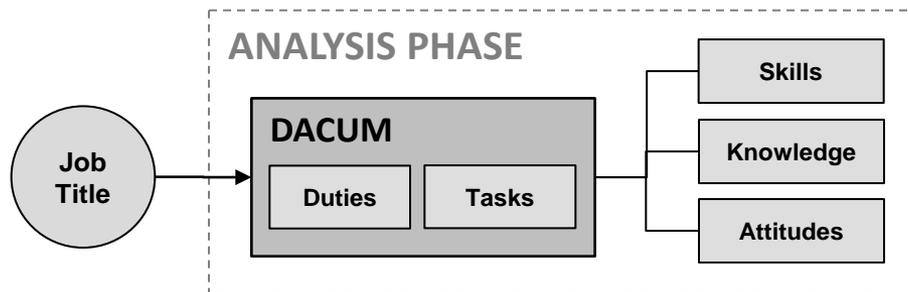
- Captures time associated with all training requirements from all international partners.





# Develop A Curriculum (DACUM)

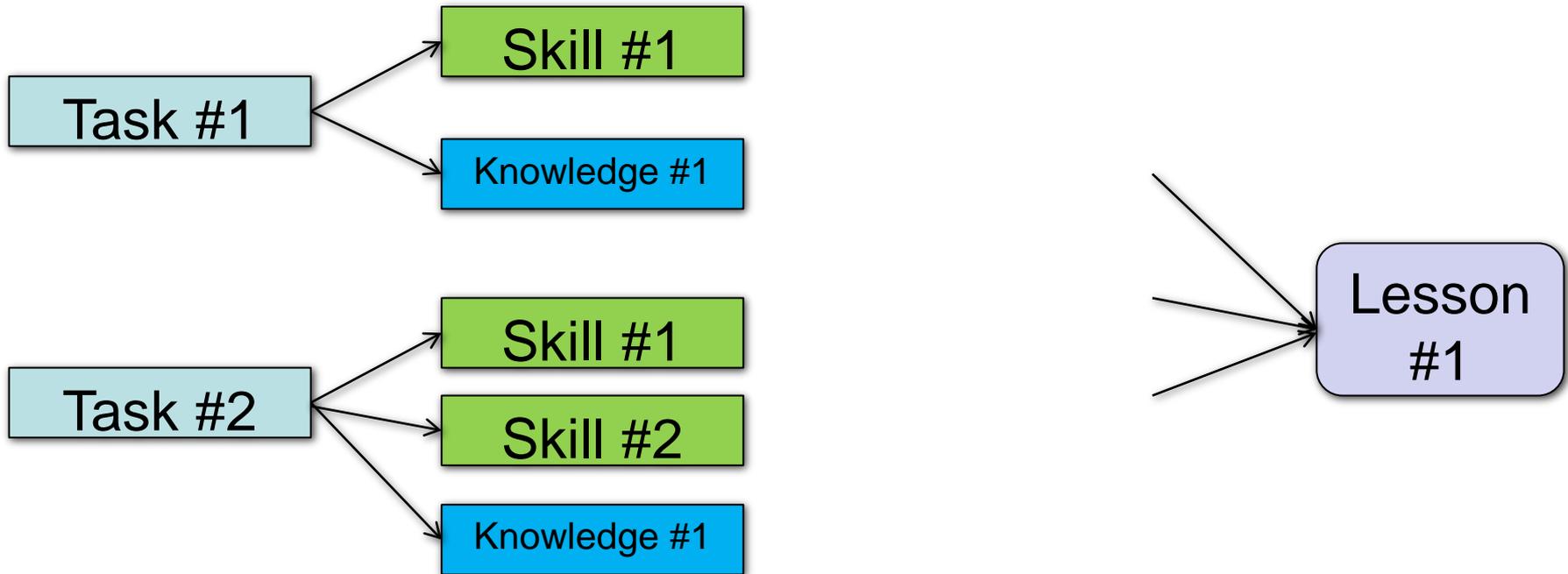
- First used in MOD in mid-90s
- Functional Analysis used to define roles and responsibilities of every mission control position or crewmember role.





# Training Needs Analysis

- Training shifted from being task-based to being skills-based.

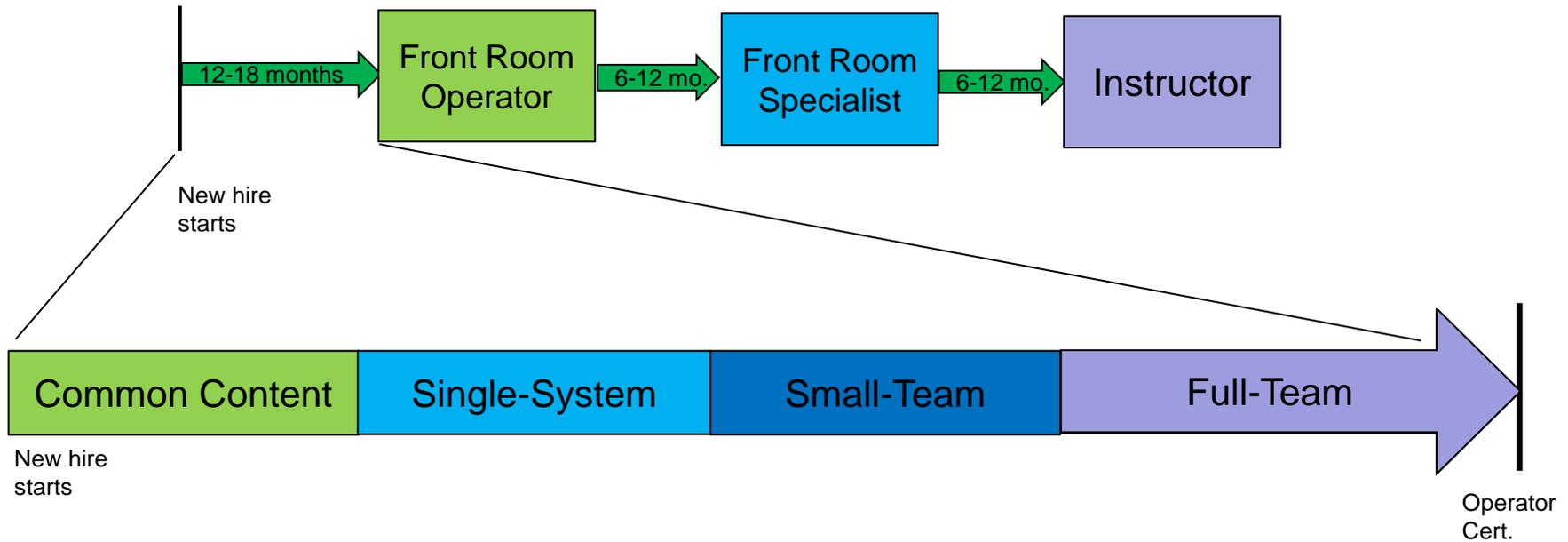


- ADDIE model now basis for all crew and mission controller training.
- Task-based training still used for select critical, safety-related or time-sensitive tasks.



# Top Gun Approach

- Adopted in 2007





# Common Content Training

- Provides common foundation for all MOD personnel.
- Cover basic flight controller skills, advanced flight controller skills, and instructional skills.





# Spaceflight Resource Management (SFRM) Training

- Applies Cockpit Resource Management training concepts to mission control team and instructor teams.





# Mini-sims



- Partial team simulation
- Practice specific scenarios
- Gateway prior to entering generic simulations



 MOD e-Lessons

Toxic Atmosphere - Strategy and Hardware

Zoom Video Swap Video & Slide Thumbnails Zoom Slide

## Breathing Protection

- Two types of oxygen masks are available:

PBA ИПК-1М



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Index Info Resources Email Quiz Help

- Automatic Software Response
- Toxic Strategy
- Identification of Toxic Materials
- Toxic Strategy
- Personal Protective Equipment
- Breathing Protection
- Quick Don Mask (QDM)
- PBA Bottle
- PBA Ops
- PBA Extension Hose + Tee

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How To Navigate



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# Just-in-Time Training

- Use electronic training aids to deliver training content when it is needed.
- Potentially allow for decrease in pre-flight training.
- Goal is to introduce this content without adding time to operations.





# Benchmarking

MOD continues to look at industry and other areas of government to identify best practices that can be used to improve MOD spaceflight training.



# Mission Operations Directorate

## *Spaceflight Training Management Office*

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*Thank you!*

