ISS Science : Status of Implementation Constraints

C. Sams - NASA


This is your science platform
How can you best use it?

Science Implementation Constraints

- Implementation of science during space flight is limited by various resource constraints
  - Crew time
  - Up and down mass
  - Power
  - Others
- Manage science within these constraints by experiment design, training, & ops procedures
- Limitations evolve as the mission architecture changes

Current ISS constraints

- Major tasks to date are to complete assembly and outfit ISS
  - Crew time dominated by assembly, maintenance and configuration activity
  - Limited crew size due to vehicle constraints
  - Periodic limitations to manifest (large heavy items dominate manifest priority)
- For science to date, the major limitation is available in-flight crew time and this has dominated both experiment design and ops planning

6 crew ops

- How will current situation change when we go to 6 crew ops and assembly complete?
- Good news…
  - Large working volume
  - Good on orbit facility assets (pwr, racks, etc)
  - Multi-national, complimentary equip assets
  - More available crew time for science
  - Good communication & video assets
- Not so good news…
  - Severely limited up & down mass after Shuttle retires
    - Experiment and crew re-supply
    - Equipment repair & reconfig
    - Major vehicle system repairs and upgrades
  - Limited training and preflight BDC time available
  - Severely limited post-flight BDC time

Preflight BDC and Training

- Training flow is very full and leaves limited openings for BDC
  - Ops training is in multiple locations with extensive travel required
    - US
    - Russia
    - Europe
    - Japan
- Limited equipment & significant circadian disruption limits timing of some data takes
- Limits ability to train for science and perform BDC

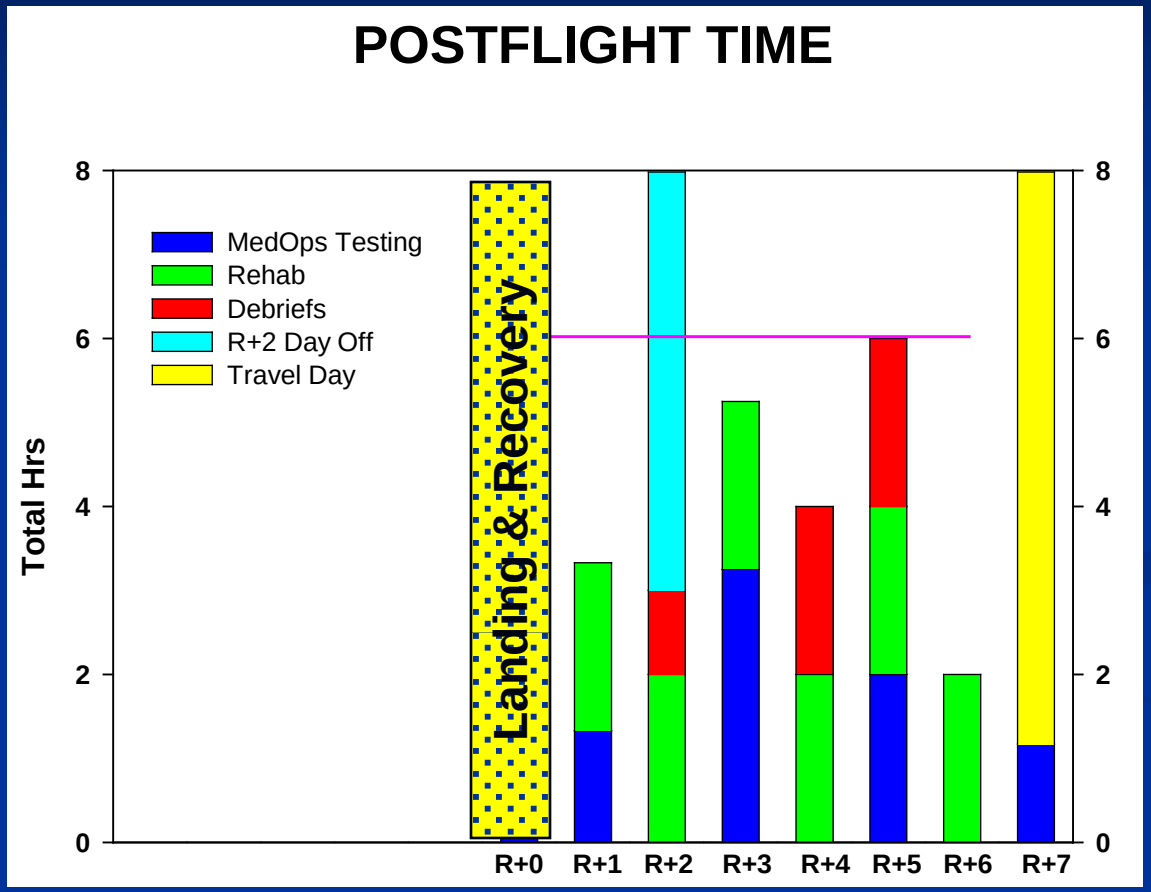
Postflight BDC

- Crew duty day is six hours with 2 hours required for rehab activity
- Four hours remain each day for other activity (MedOps, science, PAO, debriefs, etc.)
- Time on one day can be greater than 6 hrs if “overage” is given back the next day.
- Only limited testing possible on R+0 (typically “non-active” sessions) due to recovery ops.
- R+2 is crew day off; however, limited BDC time has been allowed on that day in the past
- Crew is to get another day off in the R+6 timeframe.
- US crew will nominally depart Russia in R+7 to R+14 day timeframe

Post-flight constraints

- Why are these constraints so limiting?
  - Priority task to rehab the crew from the flight and return them to safe terrestrial function
  - Crews may look good at any point but may be generally fatigued and vulnerable to injury
  - Crew may have significant circadian disruption
  - Frequent testing can bias test results

Example Post-flight Timeline



Post-flight available hrs = 36 hrs (R+1-6)
6 hrs/day = 4 hrs crew testing + 2 hrs Rehab
6 days at 6 hrs/day with R+2 crew day off

Total hrs:	Med Ops	6.33
	Rehab	12
	Debriefs	5
	Total Non-BDC	23.33
BDC available hrs		12.67 hrs

Crewmember day off on R+2 - 3 hours

travel prep day on R+6 - 4 hrs

So as little as 5-6 hrs may be available in week 1

R+0 day is not really available with landing in Russia – maybe 1 hr for minimally invasive testing

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How do we manage?

- Deal to strengths
  - Timeline more flexible – test and adjust
  - Crew more interactive – talk to them
  - Train skills and guide tasks – EVA model
  - Use real time measure if possible
- Plan for reality and not an idealized picture
  - Implementation may look very different than original design (renal example)
  - Evaluate must haves vs. nice to haves for your science

Summary

- ISS assembly complete will create opportunities and impose constraints
- Move to 6 crew operations will provide more available in-flight crew time
- Time available for training and BDC will become limiting constraints
- Immediate post-flight BDC time is particularly constraining
- Program scientists and PIs need to understand and consider these factors in science design and increment planning
  - If post-flight data take is not needed for science objectives, omit it
  - If possible have data take later than R+7
- Adequate planning and thoughtful experiment design will minimize the impact of these timeline constraints