MISSION OPERATIONS DIRECTORATE
OPERATIONS DIVISION

Inventory and Stowage Officer Lessons Learned

NRC Workshop/Human Destination Systems Roadmap
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Johnson Space Center/Mission Operations
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ISS Flight Control Room

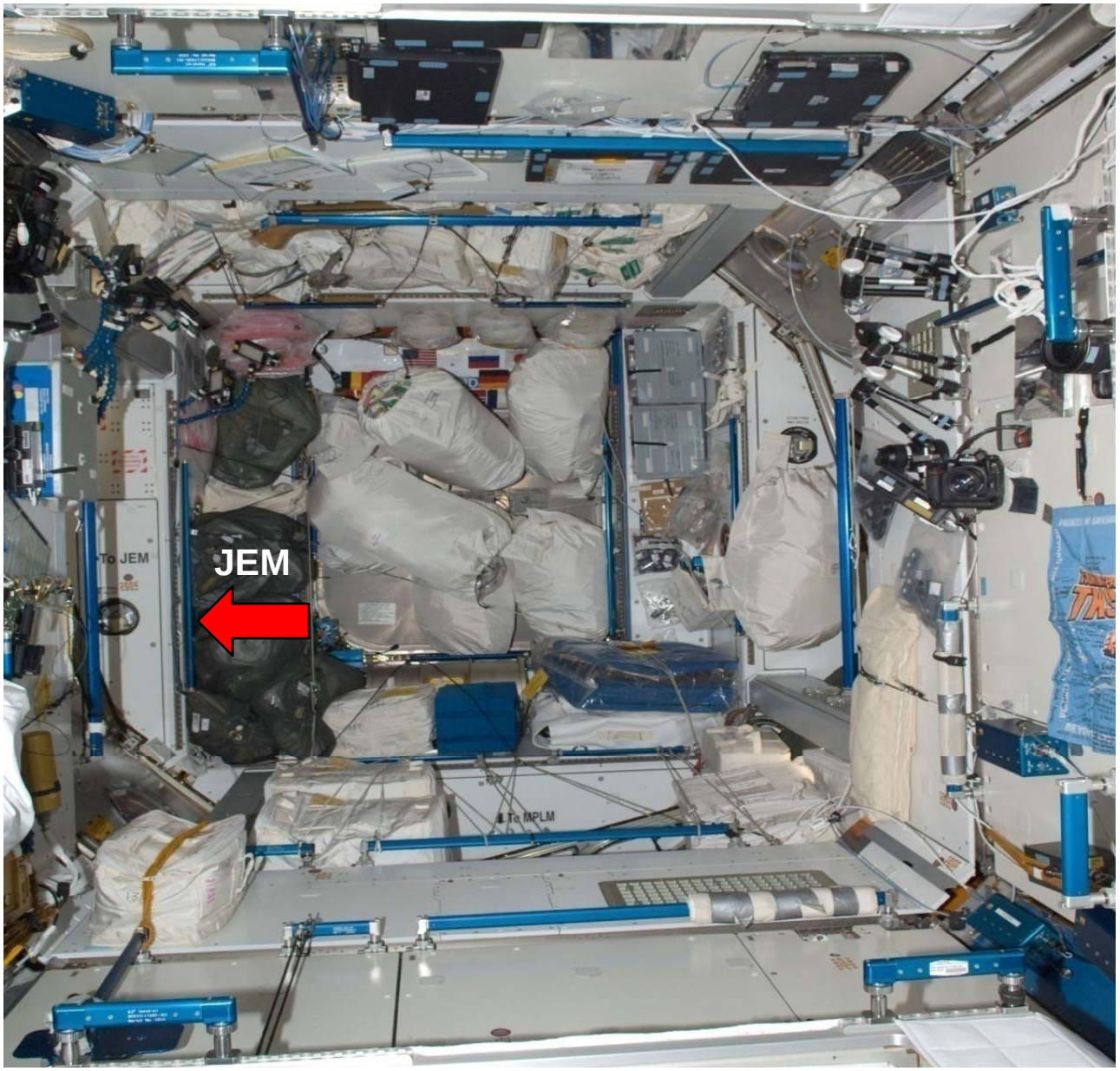
Inventory and Stowage Officer

- Inventory and Stowage Officer (ISO) responsibilities:
  - Keep track of all stowed US cargo items on International Space Station (ISS)
    - » Internal US/NASA cargo only
    - » Maintain Inventory Management System (IMS) on ISS and in MCC-H
      - * Utilizes barcode and scanning system as well as manual reporting
      - * Approximately 36,100 US items are tracked in IMS
      - * Russia, JAXA, ESA all track their items in IMS also
    - » Update database to reflect crew operations
  - Build stowage plans for US cargo on ISS
    - » Determine locations for new cargo arriving at ISS
      - * Approximately 7,358 items arrived at ISS last year
      - * Approximately 6,500 items left ISS last year
  - Provide procedures for crew
    - » To locate needed items for operations
    - » To transfer cargo to ISS from visiting vehicles (Shuttle, SpX, Cygnus, ATV, HTV, Progress, Soyuz)
    - » To transfer cargo/trash from ISS to visiting vehicles
    - » To rearrange cargo on ISS to facilitate crew operations
  - Developing ASIMO tool with JPL to identify empty stowage volumes and generate initial procedures

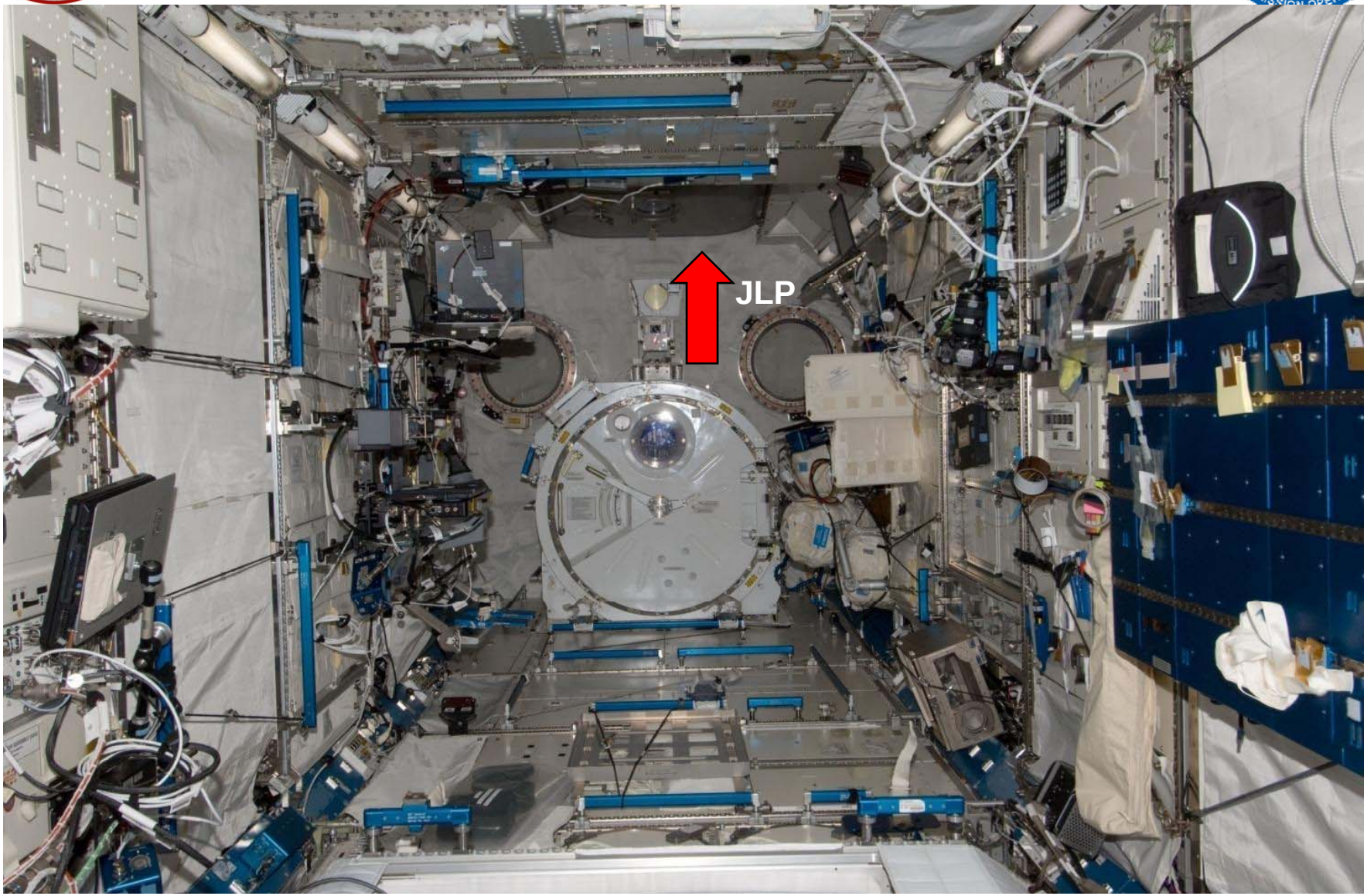
Inventory and Stowage Officer

- Challenges for ISO:
  - Limited crew time available
  - Visiting vehicle weight and center of gravity requirements.
  - Limited space on ISS
    - » Cargo is kept inside and behind racks – these volumes are full
    - » Cargo is also bungeed to panel fronts and in unused hatchways.

Node 2



Japanese Experiment Module



Japanese Logistics Module

- Example of nominal cargo configuration

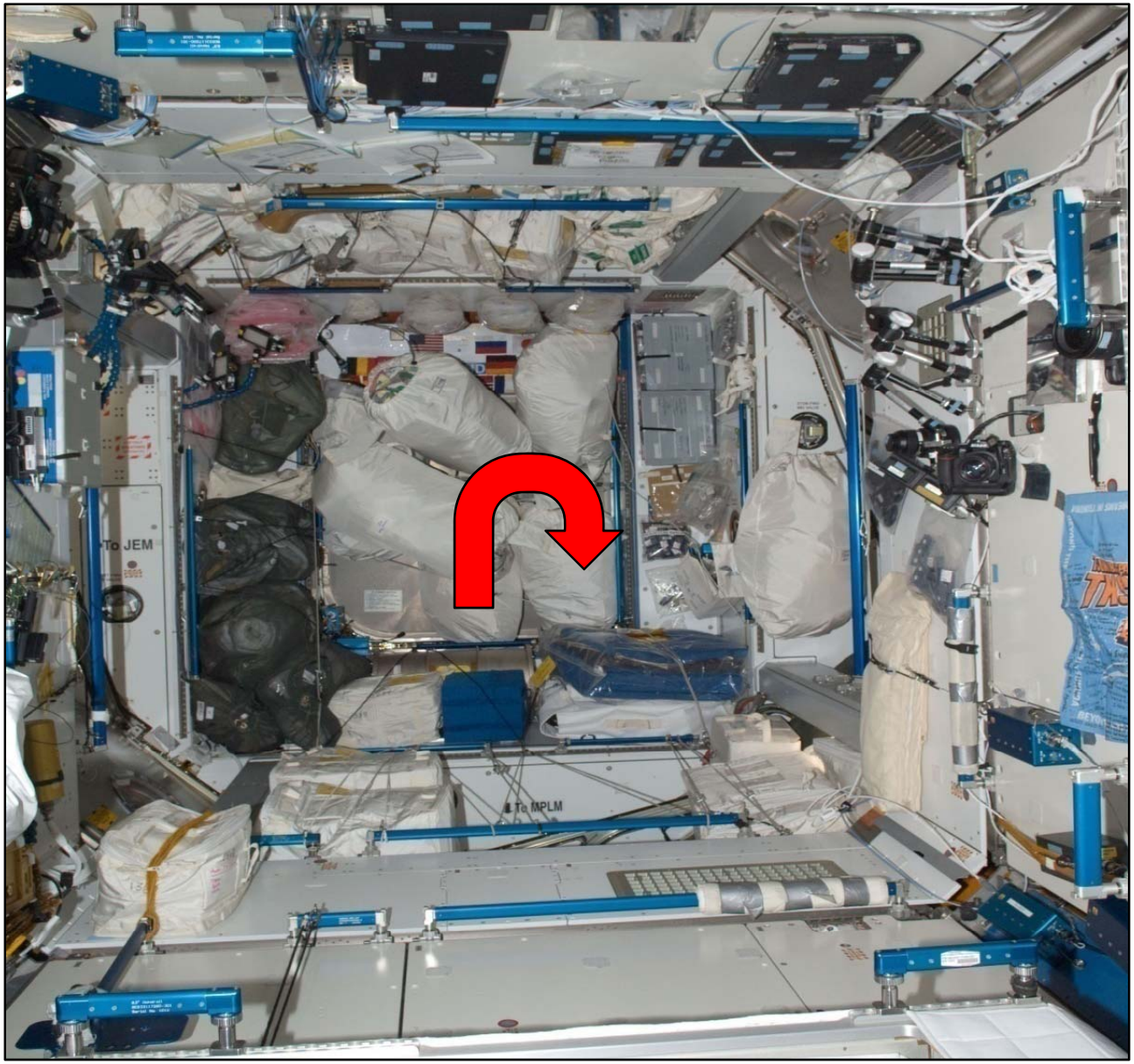
Japanese Logistics Module

- Example of off-nominal cargo configuration

Node 2

Columbus Module

Node 2



Node 2

US Laboratory Module

Node 1

Node 3

Node 3 Port Endcone

Node 1

ISS027E013095

Permanent Multipurpose Module

Node 1

Functional Cargo Block (FGB)

Inventory & Stowage Officer Lessons Learned

- Packing cargo for ascent
  - Pack like items together - minimize need to reconfigure stowage on board
    - » Same system
    - » Same procedure
    - » Sometimes not possible because visiting vehicle center of gravity has to be maintained.
  - Understand packed bag configurations
    - » Can better prepare procedures and answer crew questions
    - » Helps to anticipate any foam/layers of containment for trash
  - Unique identifiers on hardware
    - » Part number and serial number
    - » IMS Barcode
  - Write bag serial numbers on all sides of bags in large text
    - Bag labels are only on one side and in small text
    - Enables crew to easily locate a particular bag

Node 1 Deck 2 hatchway

- Example of need for serial numbers on all sides

Inventory & Stowage Officer Lessons Learned

- On-orbit cargo operations
  - Learn all you can about hardware/packing on the ground - crew time is expensive!
  - Review procedures with crew prior to performing them
  - Be consistent with procedure format
    - » Tell crew why they are being asked to do something.
    - » Procedures should answer all anticipated questions - minimize space/ground calls
    - » Give crew photos and diagrams as reference
  - When crew calls, immediately follow up with any clarifying questions
  - If crew can't find an item in its last known location, suggest other locations it has been.
    - » If run out of alternatives, send them back to initial suggestion
    - » Often it's hard to find an particular item among other items in that location.
    - » RFID applications could help this problem; just beginning to utilize this capability.

Inventory & Stowage Officer Lessons Learned

- Stowage planning
  - Try to think from crew's perspective.
  - Be flexible in planning; ask crew for input
  - Stow items where they will be used - minimize crew time retrieving items
  - Keep items that crew needs daily easily accessible (food, water, clothing, laptops)
  - Only track items you need to track
  - Establish usage rates to determine when to resupply items
  - Discard/return unnecessary/excess items
    - » Extra crew provisions (toothpaste, clothing, food)
    - » Duplicate items (tools, laptops)
    - » Used items (payload experiments)
  - Reuse resources (bags, labels, ziplocks) as appropriate
  - Know what hardware is used for and when it will be needed – necessary to determine how deep to bury an item

Cargo behind a panel in Japanese Logistics Module

Inventory & Stowage Officer Lessons Learned

- Packing for return
  - Minimize need to touch items twice
    - » Don't pack item for return unless certain it is no longer needed for operations
    - » When item is last used, stow for return during task
  - Put all return items for a vehicle in same location
    - » Makes return packing of a visiting vehicle (Progress, HII-B Transfer Vehicle, Shuttle) more efficient
- Others:
  - Use different color labels to provide visual cue for crew: yellow (to orbit) , green (to earth), purple, brown (to trash vehicles)
  - Consider unplanned options:
    - » Coordinate early with International Partners to discuss unidentified stowage volumes, both in ISS modules and on visiting vehicles (HII-B Transport Vehicle (HTV) or Automated Transport Vehicle (ATV))
    - » Coordinate early with commercial vendors (SpaceX and Orbital) to discuss unidentified stowage volumes
    - » May not seem necessary, but often provides solutions to stowage challenges

HTV1 Closeout

HTV2 Closeout

Backup

ISS configuration
post STS-133/ULF5