Research Planning Process

NASA ISS Research Academy and Pre-application Meeting

August 5, 2010

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Space Station Program
Research Planning Office

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• This presentation describes the process used to collect, review, integrate, and assess research requirements desired to be a part of research and payload activities conducted on the ISS.

• The presentation provides a description of:
  - where the requirements originate,
  - to whom they are submitted,
  - how they are integrated into a requirements plan, and
  - how that integrated plan is formulated and approved

• It is hoped that from completing the review of this presentation, one will get an understanding of the planning process that formulates payload requirements into an integrated plan used for specifying research activities to take place on the ISS.
The Research Planning Process is a series of steps used to develop an ISS Increment Research Plan (IRP) which defines the payload requirements requested to be implemented during an ISS increment.

The Research Planning Office is the Space Station Payloads Office organization tasked to develop the IRP and uses the Multilateral Research Planning Working Group (MRPWG) as the technical forum to develop the IRP.

The IRP consists of a list of research investigations, resource allocation specifications, payload manifests for the ISS cargo transportation vehicle flights, and needed on-orbit resource requirements for each payload/investigation.

The flow of development of the IRP is as follows:

- The IRP is used as the basis for development of the Space Station Program Document, IDRD Annex 5: Payload Tactical Plan (PTP). The PTP document is under development control by the Payloads Mission Integration Office and is not described in this presentation.
Sources of Research Requirements

Sponsors of Research on ISS

- Exploration Technology Development & Microgravity (ESMD)
- Human Research Program (ESMD)
- U.S. Commercial Sector
- Education
- Other U.S. Government Agencies (e.g., DOD, NIH...)

- Astrophysics, Heliophysics, Planetary Science, Earth Science (SMD)
- ISS National Laboratory (SOMD Agreements)
- ISS Int'l Barter Commitments (SOMD)
  - ASI
  - CSA
  - ESA
  - JAXA

ESMD: Exploration Systems Mission Directorate
SMD: Space Mission Directorate
SOMD: Space Operations Mission Directorate

Space Station Payloads Office
Multilateral Research Planning Working Group

Roles & Responsibilities

- Tasked to ensure integrated and cohesive research requirements exists for increment operation
- Members are responsible for representing their respective research areas for multiple increments
  - Ensure long-term strategies for their research disciplines are implemented in the tactical and execution planning process
  - Ensure that hardware availability and use strategies are consistent with research plans
- Members are responsible for ensuring that the research priorities of their respective organization are represented
- Produces cross-discipline research plans for increment execution
Where does the IRP fit in the Payload Integration Process?

Payload Integration Timeline

- **Strategic**
  - L-X months
  - Requirements Definition (Design, Development, Test, Safety, and Verification)
    - PDR
    - CDR
    - Manifest Approval

- **Tactical**
  - L-12 months
  - Mission Integration (Detailed Increment Planning)
    - Increment Research Plan Development Period (6 months)

- **Operations**
  - L-0
  - 6 months
  - Real-time Operations
    - ISS Crew Rotation
      - Inc-X Launch
      - Inc-Y Launch
      - Return

- **Post-Increment**
  - Post-Increment Ops (Debriefs, Reports)
    - ISS Crew Rotation

ISS Crew Rotation

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Increment Research Plan Development Process Overview

Research Planning Organizations

Call for Payloads Candidate List and resource needs

Payload-specific Resource Definition and Two-pagers Submittal

Flight & Increment-specific Utilization Allocations (ISS Program Office)

Payload Feasibility Assessments (Payload Mission Integration)

MRPWG

Vehicle Launch Schedules (Shuttle, Russian, ESA, JAXA, ISS Program Office)

Payload Prioritization (Program Scientist, ESA, JAXA, CSA)

Increment Research Plan Formulation And Review

IRP Approval

Space Station Payloads Office
Increment Research Plan Development

Step 1

RP Development Data Package Release

- At I-18 months, MRPWG Chairman issues a call for investigations and payloads desired to be flown and/or performed during the new increment being planned.
- RP Development Data Package goes out with the call and consists of:
  - A Research Plan Requirements Definition Planning Schedule
  - An Increment specific vehicle flight sequence schedule
  - Payload Candidate List Submittal Template (includes flight vehicle assignment request)
  - Payload 2-Pager Development Format (investigation description and basic ops)
  - Payload Tactical Plan data entry workbook address (computer based)
  - Experiment Summary request form
  - Target Milestone Chart for experiments requiring human subjects
PROPOSAL NUMBERS
CSA: ILSRA-04-0198-0106

SCIENCE TEAM
Laurence R. Harris, Ph.D., R. T. Dyde, Ph.D.
M. R. Jenkin, Ph.D., H. L. Jenkin, Ph.D., J. E. Zacher
York University

RESEARCH OBJECTIVES
The specific objective of the present project is to conduct experiments during long-duration microgravity conditions to better understand how humans first adapt to microgravity and then re-adapt to normal gravity conditions upon return to earth. This experiment involves comparisons of pre-flight, flight, and post-flight perceptions and mental imagery, with special reference to spaceflight-related decreases in the vertical component of percepts.

OPERATIONS
Astronauts will conducted two OCHART Protocol sessions, once around flight day 10 and again around 2 weeks before return. Floating aligned with the laptop display, the astronaut will view the laptop screen through the COGNI tunnel. On the laptop display, the astronaut will view a rotated character ('p' or 'd') superimposed over a highly polarized visual background. The background will be presented in different orientations. Via COGNI tunnel interface, the subject will indicate if the shape is recognized as a 'p' or a 'd'.

POINTS OF CONTACT
CSA Project Manager: Luc Lefebvre
Luc.Lefebre@space.gc.ca; (XXX) XXX-XXXX

Export Control Classification (NASA only): N/A
## Increment Research Plan Development

### BISE – Increment 19/20 Scenario

#### Pre Flight

**BDC:**
- Establish a perceptual up model (3 protocols)
  - OCHART protocol
  - Luminous line protocol
  - Shading protocol
- Testing protocols in the second posture

#### Activity Table – Session 1

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**TOTAL:** 105 minutes

**TOTAL:** 1.75 hrs

#### Activity Table – Session 2

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<td>Subject 1</td>
</tr>
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**TOTAL:** 105 minutes

**TOTAL:** 1.75 hrs

#### Note:
If more than one subject per session, add 35 minutes for each additional subject.

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### Russian segment:

#### US module:
- FD10 (5) Session 1
- FD10 (5) Session 1
- R-15 (10) Session 2
- R-15 (10) Session 2

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### Columbus:

#### Increment 18
- 18S March 09
- 19S May 09

#### Increment 19
- 19S Nov 09

#### Increment 20
- ULF 3 Oct 09
- 19S Nov 09

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**Up: 16S**
- ESA COGNI tunnel
- Interface between COGNI and laptop (ESA)

**Up:**
- Upload OCHART (software)

**Down:**
- NA

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**Mass up:** 0.0 kg

**Mass down:** 0.0 kg

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Increment Research Plan Development

Step 2

P/L Candidate List Submittal by Research Planning Organizations

- At approximately 17.5 months, research planning offices and/or payload developers submit their list of candidate payloads and payload resource requirements and activities desired to be performed during the increment being planned.

- Required resource specifications include the requested resupply vehicle flights (both ascent and descent) to be used, whether human subjects are needed for any investigations, and conditioned stowage/transport needs of investigation samples.
Step 3

P/L Requirements Submittal by Research Planning Organizations

- At approximately 1-17 months, research planning offices and/or payload developers submit 2-Pager forms, PTP table development data, and narratives describing candidate research if new and updates to existing investigations descriptions if previously submitted for an earlier increment planning period.

- 2-Pager forms describe in a summary fashion the investigation/payload major parameters and requirements
  - First page gives investigation name, sponsoring organization, research team members, investigation objectives and operations, list major payload hardware, and crew member usage requirements
  - Page 2 gives in graphical form the investigation operation scenario, depicting when payload hardware is desired to be transported to the ISS and results via samples, data cards, downlink data, etc. are brought to the ground from the station. Additionally, crew training, Baseline Data Collection requirements, and investigation session activities to be conducted on-board are given.
Step 4

P/L Requirements Review and Assessment by MRPWG

- At approximately I-17 months, review of submitted 2-Pager data and Payload Tactical Plan inputs begins. Review of the data occurs at special RPWG meetings some of which are MRPWG meetings with International Partners.

- The goal of these reviews is to get an in-depth understanding of each payload's requirements and constraints.

- Assessments involve comparison of the submitted payload requirements to the ISS Program specified resource allocations, principally up and down-mass, transport vehicle volume capability, and crew-time needs for on-orbit payload operations. Reviews focus on developing and evaluating changes to payload requirements that ensure the best IRP is formulated given the resource allocations.
Increment Research Plan Formulation and Approval

- The MRPWG reviews the research plan which has been formulated into a presentation report put together by the Chairman of the MRPWG. This presentation includes listing and description of the proposed investigations and payloads, specification of the resource allocations, payload transportation requirements, manifest, and on-orbit crew time needs. Consensus is achieved on the recommendation to proceed forward to management reviews of the proposed IRP.

- Typically, at no later than 1-12 months, the Chairman of the MRPWG presents the IRP to the Payloads Control Board (NASA internal) and to the Multilateral Payloads Control Board (MPCB) for review and approval.
Increment Research Plan Elements

Research Investigation Lists

Investigation List

Investigation Description New Prime Activity Reserve Activity

Space Ops

ALTEA Dosi Will capture radiation particle flux data within the ISS - Yes -

Disruptive Tolerant Network (DTN) Investigated communication between intermittently connected comm. nodes - Yes -

Space Comm And Navigation Will investigate reconfigurable Software Defined Radio technology Yes Yes -

Human Research Program

Bisphosphonates Test whether antiresorptive agents help reduce bone loss - Yes -

Integrated Cardiovascular Determines the magnitude of left and right ventricular atrophy - Yes Yes -

Integrated Immune Monitor immune function of crew (both long duration and short duration) - Yes Yes -

PROK (Protection against bone loss) Test hypothesis that decrease in protein to potassium ration will decrease bone loss - Yes -

VO2 Max Measure maximal oxygen uptake during and following space flight - Yes -

IRATS Integrated Resistance and Aerobic Training Study to evaluate efficacy Yes Yes -

Nutrition Designed to gain better understanding of nutrition-related changes - Yes -

Reaction SelfTest Evaluates extent ... samples for archiving for future research - Yes -

Silicon Radiation Skin response of crew on long duration missions - Yes -

Human Life Sciences

22.7%

Fluid Physics/Materials & Combustion Sciences

15.5%

Biological Sciences

13.6%

Educational Activities

7.3%

Monitoring Space Environment

3.6%

Technology Development

2.7%

Earth Observation

11.0%

Commercial Venture

23.6%
Increment Research Plan Elements

Up-mass Requirements versus Allocation Graph

Program Stipulated Allocation
Research Requirement

Flights

26S  Orbital D1  42P  SpX-1  27S  43P  HTV3  SpX-2  44P

(kg)
## Increment Research Plan Elements

### Transportation Traffic Plan and Manifest - Launch

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<tr>
<th>MAR</th>
<th>APR</th>
<th>MAY</th>
<th>JUN</th>
<th>JUL</th>
<th>AUG</th>
<th>SEP</th>
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<td>3/30</td>
<td>Apr 2</td>
<td>4/28</td>
<td>5/1</td>
<td>5/31</td>
<td>6/21</td>
<td>7/1</td>
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<tr>
<td>26S</td>
<td>25S</td>
<td>42P</td>
<td>SpaceX-1</td>
<td>27S</td>
<td>43P</td>
<td>HTV-3</td>
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#### Increment 27
- **CSA**
  - None
- **ESA**
  - CARD Items
  - ESA EPO
  - GRAVI-2 Items
  - SOLO Items
  - ESA Cold Stowage Boxes, ECCO Bags
- **JAXA**
  - Onboard Diagnostic Kit
  - TEM for CRS-1
  - Commercial for Inc 27 & 28
  - JAXA EPO (Try Z-a)
- **NASA**
  - Cube Lab Resupply-8, 10, 11 & 12
  - HRP Sample Collection Kits
  - HRF Pantry Items
  - Seed Growth-2
  - Micro4
  - NIH-1 & 2 GAPs
  - NLP Cells-7

#### Increment 28
- **CSA**
  - Vascular Blood Collection Kit
- **ESA**
  - SOLO Blood & Urine Kits
  - Vessel Imaging Ultrasound Kit
  - FASTER Experiment Unit
  - FASTER Facility Controller & EDR Drawer
  - Portable PFS ORU
  - ENERGY Hardware
  - ESA Cold Stowage Boxes
- **JAXA**
  - JAXA EPO7
  - Myco (inc 27-28)
  - Onboard Diagnostic Kit
  - Alloy Semiconductor Items
  - Aquatic Habitat and Fixation Tubes
  - Ice Crystal 2
  - Nano Step
  - Dynamic Surf
  - Microbe-III
  - Eval of Onboard Diagnostic Kit
  - MCE Attached Payload
- **NASA**
  - Cube Lab Resupply-4
  - Cube Lab Resupply-13
  - Cube Lab Resupply-15
  - Cube Lab Resupply-16
  - HRP Sample Collection Kits
  - HRF Pantry Items
  - Integrated Immune Kits
  - Re-entry Breakup Recorder
  - MSL Batch 2a SCAs
  - PFS Gas Cylinders
  - VO2max Resupply Kit
  - SpaceDRUMS Carousels, Debris Traps
  - NIH-3 ADF
  - USDA-1 ADVASC
  - NLP Cells-8
  - NLP Cells-9
  - NLP Vaccine-18
  - NLP Vaccine-19
  - CSI-06 Ecosystem Habitat
  - Scan (CoNeCt)
  - Seed Growth-1
  - GLACIER, Cold bags

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Space Station Payloads Office

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### Crew time Needs - Research Activity Table

#### Allocation versus Requirements Summary

<table>
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<tr>
<th></th>
<th>Program Allocations (hrs)</th>
<th>Planning Allocations Prime (hrs)</th>
<th>Planning Prime (hrs)</th>
<th>Planning Reserve (hrs)</th>
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<td>346.7</td>
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<td>NASA</td>
<td>-</td>
<td>691.3</td>
<td>675.4</td>
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<td>17.5</td>
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The Research Planning Process involves the development of an Increment Research Plan which identifies integrated research investigation and payload requirements desired to be implemented as part of ISS on-orbit increment activities. These requirements are specified by the various research planning organizations across NASA, other US Governmental agencies, ISS International Partners, and the private sector.

The Increment Research Plan is developed over a 6 month period by the Multilateral Research Planning Working Group and is composed of investigation lists, ISS resource allocation specifications, payload manifests, and tables of on-orbit resource needs.

Upon approval of the Increment Research Plan by the Multilateral Payloads Control Board, the IRP is used as the basis for development of the IDRD Annex 5: Payloads Tactical Plan document which is used to formally document all of the Utilization requirements (science, training, support equipment, etc.) for particular increments.
<table>
<thead>
<tr>
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<th>Description</th>
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<td>Ames Research Center</td>
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<td>Baseline Data Collection</td>
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<td>Exploration Systems Mission Directorate</td>
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<td>GRC</td>
<td>Glenn Research Center</td>
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<tr>
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<td>Human Research Program</td>
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<tr>
<td>HTV</td>
<td>H-II Transfer Vehicle</td>
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<tr>
<td>IDRD</td>
<td>Increment Definition and Requirements Document</td>
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<td>IP</td>
<td>International Partner</td>
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<td>Increment Research Plan</td>
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<td>Lead Increment Scientist</td>
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<td>NLO</td>
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<td>Principal Investigator/Project Scientist</td>
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