Adapting Project Management Practices to Research-Based Projects

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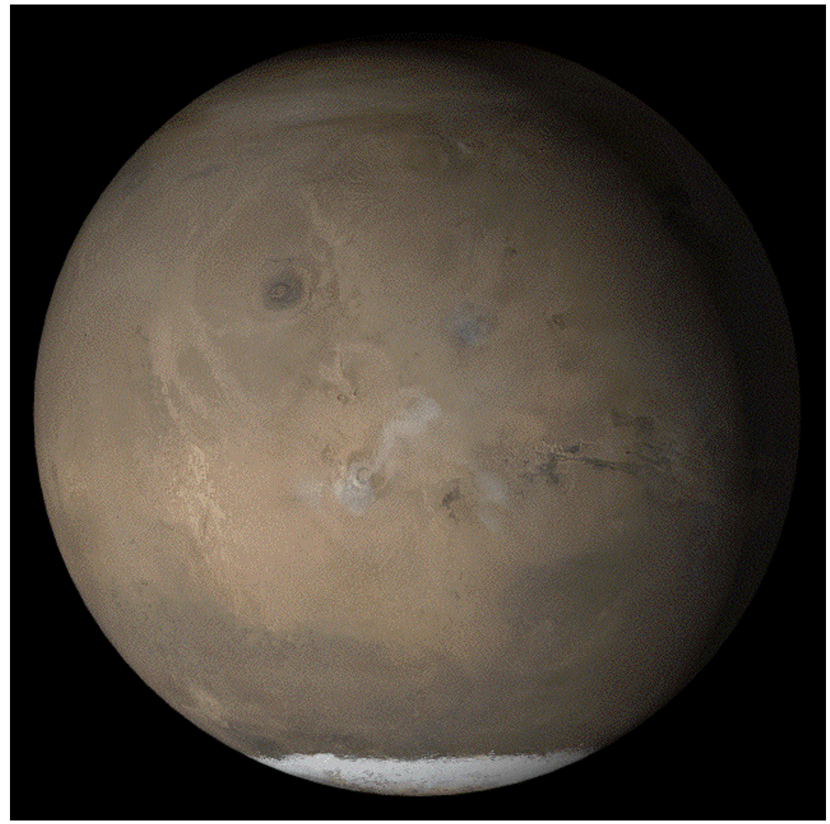
Session outline

- Overview
- Perspective #1 – teaming scientists with project managers
- Perspective #2 – transitioning technical content to applied research with operational relevance
- Conclusion
- Forum questions and discussion



Overview

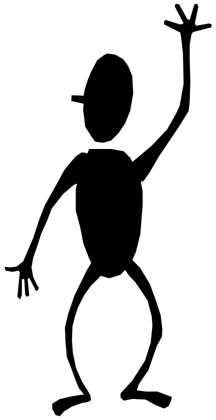
- Background and general information to set the stage

Congratulations – you've been assigned as the project manager for a research-based project!

Edvard Munch's *Scream* detail (1893), National Gallery, Oslo.

- Research-based or research-enabling projects can present unique project management challenges due to:
  - Organization
  - Culture
  - Environment
  - Technical content

So who are we, and why are we here?



- Authors represent several projects in the Human Research Program (HRP)
  - Created in 2005, managed out of JSC, formed to focus research toward enabling the Vision for Space Exploration
    - » HRP’s Critical Path explicitly includes science research
- Biomedical Research and Countermeasures Projects (BRCP) Branch was created after initial formation of the Program / Element / Project structure
  - Goal is to provide consistency in application of project management
    - » Develops and manages project managers and project management core competencies
- We have experienced the normal “growing pains” of starting up a new Program
- The intent of this talk is to:
  - Discuss the specific challenges of managing science research
  - Present some of the actions taken to address these challenges
  - Discuss potential solutions where we have remaining challenges

Projects contained within BRCP and represented by the authors

(In alphabetical order)

- EVA Physiology, Systems and Performance (EPSP) Project
- Exercise Countermeasures Project (ECP)
- Flight Analogs Project (FAP)
- ISS Medical Project (ISSMP)
- Non-Exercise Physiological Countermeasures (NxPCM) Project
- Space Radiation Project (SRP)

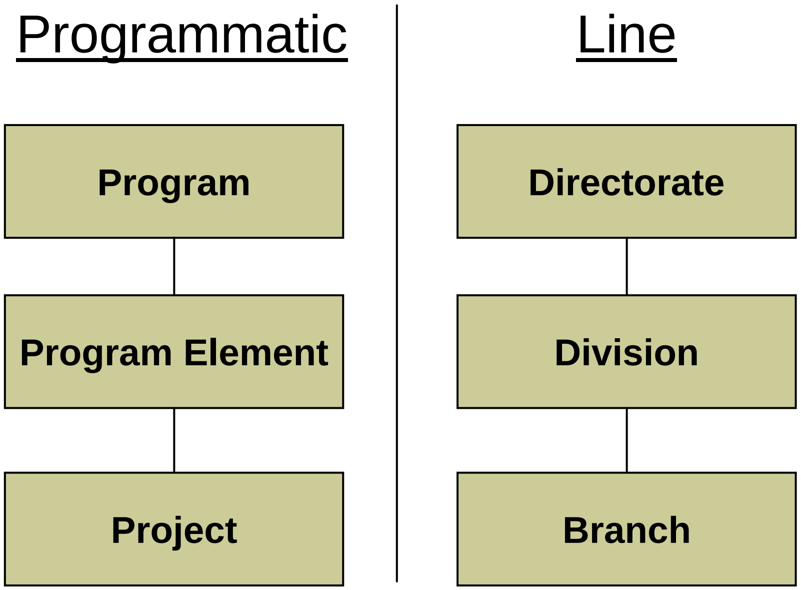
Additional information available at http://sk.jsc.nasa.gov/sk211/

Why use project management for research-based projects?

Criteria for use of project management[1]	Benefit of project management	Applicable to NASA research?
Unfamiliarity	Allows better planning / coordinating of one-of-a-kind undertakings	✓
Magnitude of effort	Allows management across functional / disciplinary boundaries	✓
Changing environment	Provides flexibility and diversity to deal with changing goals and opportunities	✓
Interrelatedness	Allows better linkage / coordination both within organization and with outside subcontractors, vendors, and customers	✓
Risk to Organization	Provides increased planning and control	✓

[1] Cleland DI, King WR. Systems Analysis and Project Management (3rd Edition). New York: McGraw-Hill College, 1983, pg 259.

Alignment of project and line organizational structures



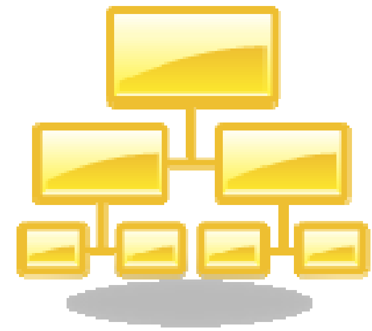
- Full-time NASA Project Manager assigned
  - Reports to Program Element Manager (programmatic) and BRCP Branch Chief (line)
- Project Scientist as technical lead (NASA or contractor)
  - Reports to Program Element Scientist (programmatic) and Biomedical Research & Operations Laboratories Branch Chief (NASA line)
- Contractor support
  - Heavily involved in project life cycle
  - Proportion of overall project labor force varies by project

Strong matrix organization (as defined by PMBOK)[2]

- Programmatic issues handled from Project through Program Element (if applicable) to Program
- Personnel / facilities issues handled through Branch to Division to Directorate
  - » Multi-Center implementation / support
  - » Multiple paths possible
- Organizational overlap: some Program Element Managers are also Division Chiefs

[2] A Guide to the Project Management Body of Knowledge (PMBOK Guide 2000 Edition). Newton Square, PA: Project Management Institute, 2000, pg 20.

Pros and cons of strong matrix organizations



- Advantages of strong matrix organization[3]
  - – Provides needed technical expertise and physical resources
  - – Ensures currency in technical field of specialization
  - – Provides workforce stability in long-term operations
  - – Gives priority to project through dedicated project organization
  - – Allows easier balance of schedule and resource requirements across several projects
- Challenges implementing strong matrix with resource-limited organization[3]
  - – Divided allegiance when setting priorities among projects using same resource
  - – Increased communication needs (functional versus project, lateral versus vertical)
  - – Confusion caused by multiple reporting paths (functional and project)

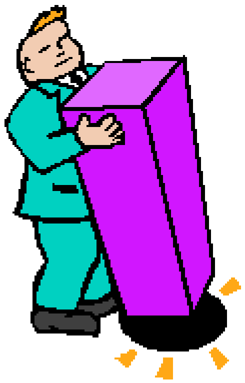
[3] Nicholas JM. Project Management for Business and Engineering: Principles and Practice (Second Edition). San Diego: Elsevier Butterworth-Heinemann, 2004, pg 444-7.

Shift in NASA human research

	Prior to 2004	Current
Available funding	More $$$	Less $$$
Research selection criteria	Science merit	Operational impact and science merit
Where science selected	HQ	Locally
Science managed by	Lab	Element & Project
Driver for science	Science interest	Crew performance decrement
Research focus	Discipline-specific	Multidisciplinary, product-specific
Research goals	Broadly related to space	Narrowly focused on specific objectives or questions
Nature of contractor support	Level of effort	Completion form
Research management	Portfolio-based	Product-based

Challenge: Incorporating legacy research

- Existing NASA research portfolio was reviewed for content and relevance as part of Exploration Systems Architecture Study (ESAS)
  - Selected grants were assigned to an HRP project
- Grants may only partially address project requirements
- Grants have minimal reporting requirements; projects have little leverage to manage technical, cost, and schedule post-award
- Funding for legacy research is part of start-up cost for new program
- NASA scientists seek operationally relevant findings from legacy study results



- *Still need to better understand the research being done, the data available, the nature of ongoing studies, and how to link past and present research with future needs*

Challenge: Determining future research content

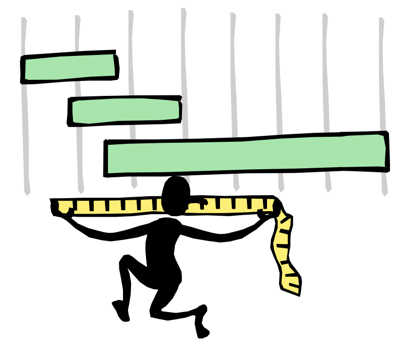
- New studies are more “project-directed”, limited by resource and schedule constraints

Study type	Available expertise	Focus	Timeline
Project-conducted	In-house	Highly operational	Immediate
Intramurally-solicited	In-house unique		Near-term or immediate
Open call	Limited in-house or significant external		Long-term

- HRP technical success depends upon products from research not directly controlled by NASA
  - National Space Biomedical Research Institute (NSBRI)
    - » Cooperative research partner to NASA
    - » Conducts its own research solicitations with separate funding
    - » Independently selects research to fund

- *Process for initiating project-directed studies remains unset*
- *Still need clear, consistent guidelines to ensure research quality of the Program*

Challenge: Concurrent development of documentation



- Science requirements
  - Program effort: science discipline review
    - » Generated physiological risks and knowledge gaps
  - Element effort: Small Assessment Team (SAT)
    - » Prioritized knowledge gaps
  - Project efforts: retreats held after initial gap allocation
    - » Significant outcome of retreats: paths to deliverables
  - *Still need configuration-controlled assignment of gaps to projects*
  - *Still need agreed-upon method for closing gaps*

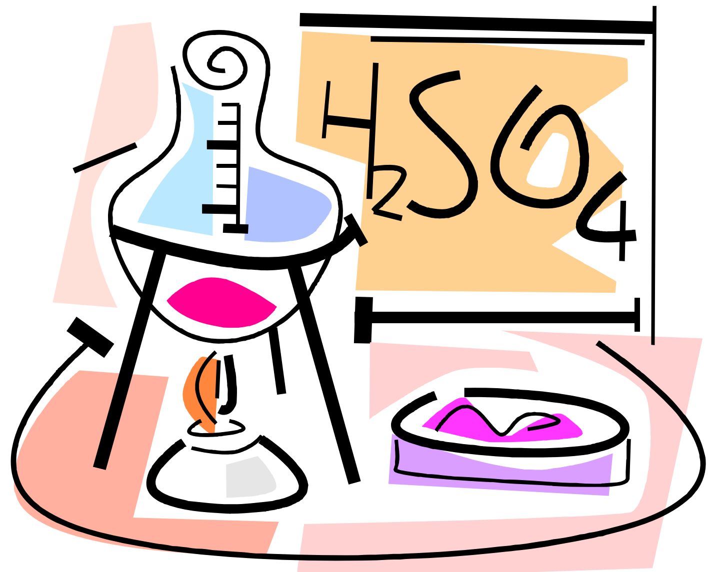
- Current NPR 7120 does not address “hybrid” projects
  - BRCP projects are not all portfolio, or all flight hardware

- Some documentation is still in development
  - *Must update existing documents as new higher-level documentation is baselined*

Two perspectives on implementing project management for research

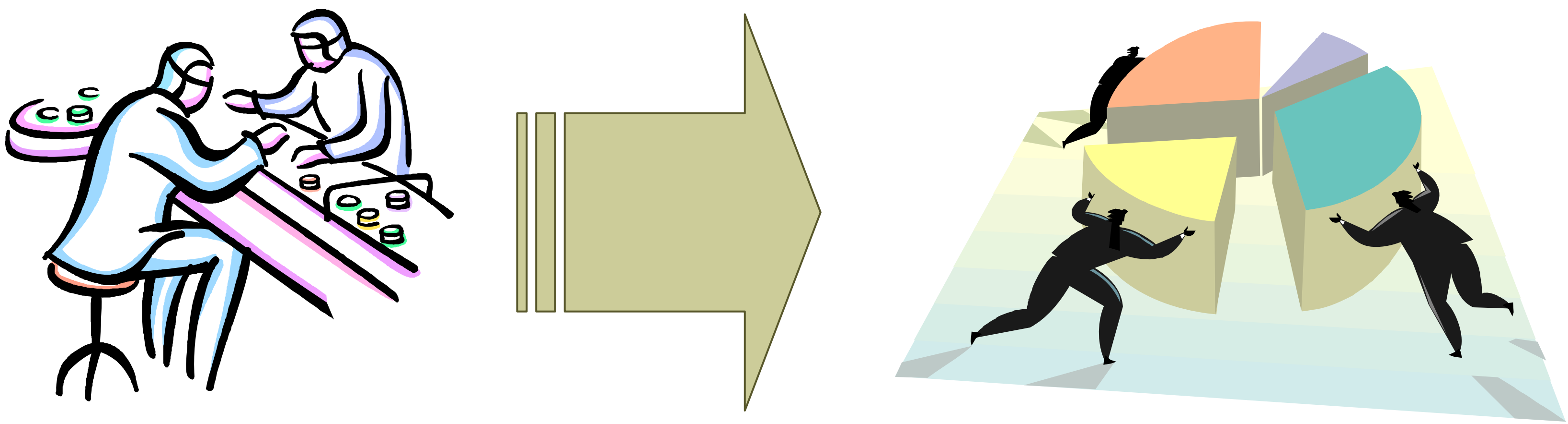
- How it affects the researcher

- How it affects the science

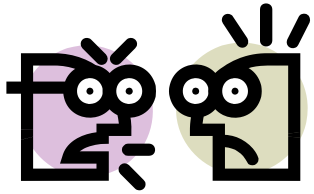


Perspective #1

- Challenges and actions related to teaming science personnel with project managers



Examples of Feedback from Science Colleagues About Traditional Project Management Techniques



- Technical: *Until I know the outcome of one study, I cannot tell you what the next step will be.*
- Schedule*: How can I give you an accurate schedule when I don't know how quickly test subjects will be recruited or how many will drop out before the study is done?*
- Cost: *I cannot give you an accurate labor cost because I'm not sure who will complete the data collection, my senior scientist of 10 years or my new hire out of college – it depends on who is available!*

- OVERALL: *Science is not like building a widget – you cannot develop requirements for a project or research study and then track progress, budget or schedule without a large margin of error.* ***Project management cannot be applied to research-based activities.***

Project teams need to find a middle ground. Project management techniques must be adapted to the unique environment of research.

The cultural challenge: different viewpoints

	Scientists	Project Managers	Flight Surgeons (Ops)
Motivation	Driven by questions	Driven by requirements	Driven by current best practice
View of change	Change is good – follow the path where the science leads	Change is bad – it adds risk to budget and schedule	Change is good only if proven to decrease a known hazard to acceptable risk levels
Approach to problem solving	Investigate specific pieces of the problem (to enhance power of research)	Need an integrated answer to solve the problem	Prevent or treat medical or occupational hazards
Measure of success	Number of publications, amount of research funding	Delivery of quality product within schedule and budget	Crew health and performance, reduced incidence and severity of hazards, mission success
Perceptions of others	Perceive Project Manager as obstacle to scientific success Perceive Flight Surgeon as unscientific	Perceive Scientist as required for project technical success Perceive Flight Surgeon as needed to provide concurrence on ops relevance	Perceive most research as having poor ops relevance Perceive research should only address uncontrolled operational hazards with unacceptable risk

The Challenge

How do you effectively implement project management techniques and tools in a technical environment previously unfamiliar with project management practices?

Requires:

1. Consistent and active management support across the matrix organization
2. Demonstration to scientific colleagues of the “value added” when adopting project management practices
3. Scientist buy-in of their critical role in project success
4. Clear communication of project needs and research expectations from Project Manager / Project Scientist teams

Examples: Bridging the Gap Between Project Management Practices and Scientific Cultures

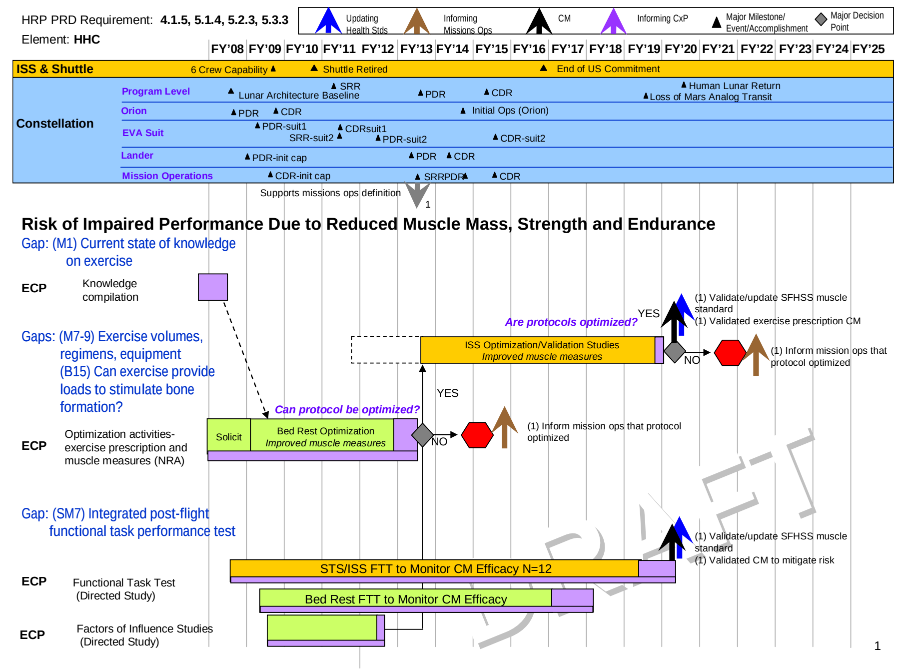
Organizational

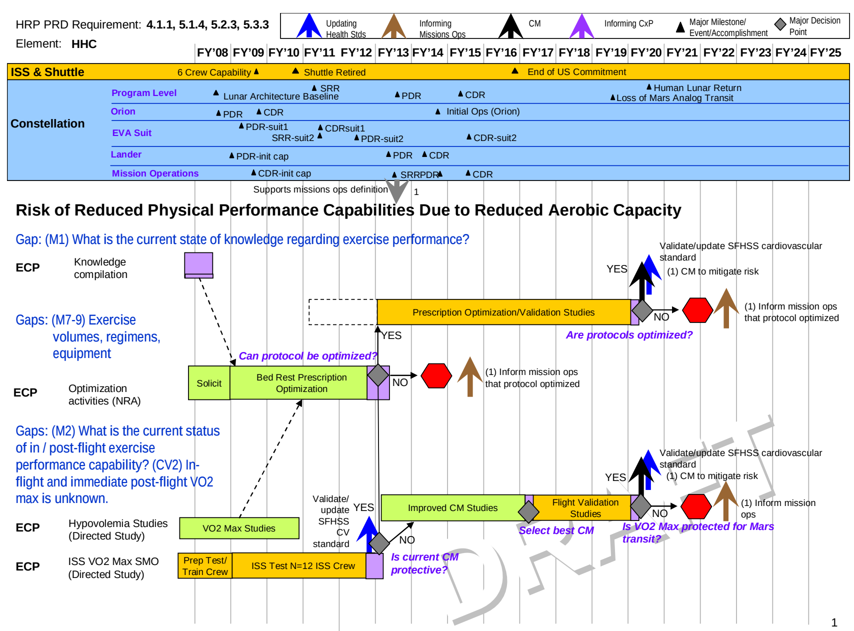
- Project Managers, Project Scientists, and intramural research scientists share common management structure
  - BRCP Branch and Lab Branch personnel report to same Division management
- Project Manager and Project Scientist comprise the leadership team assigned to each project
  - Project Manager: authorized and responsible for project execution
  - Project Scientist: responsible for research content and direction of the project
    - » May also perform active research (conflict of interest safeguards)

Examples: Bridging the Gap Between Project Management Practices and Scientific Cultures

Technical

- BRCP Branch led research requirements development and flow-down
  - Performance risks = Program Element requirements = Project objectives
  - Knowledge gaps = Project requirements
- BRCP Branch played an integral role in the development of Program Element research plans
  - Summarizes deliverables from research activities
  - Shows how findings from one study will inform subsequent research
  - Specifies research platforms needed to answer knowledge gaps
  - Has buy-in from projects and scientific lab personnel



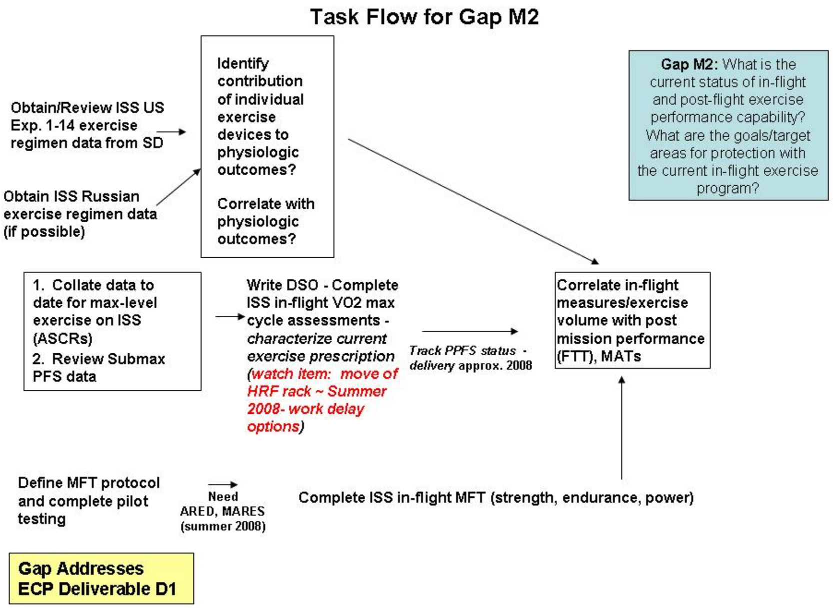


Sample excerpts

Examples: Bridging the Gap Between Project Management Practices and Scientific Cultures

Communication

- Barriers between Research Labs and Projects have been reduced due to:
  - Weekly science meetings to discuss ongoing Program, Project, and laboratory studies / findings / processes
  - Generation of "Discipline Teams" comprised of Project, Lab, and Ops personnel to summarize evidence base in a given scientific discipline (e.g., muscle) and advise on forward work
  - Common line reporting structure through Division from both Lab and Project Branches
- HRP has baselined a Science Management Plan and Integrated Research Plan. These have been vetted with the JSC science community.
- Projects each sponsored a retreat to identify a research path to deliver answers to the knowledge gaps posed in the SAT Report findings (engage labs as stakeholders)



Examples: Bridging the Gap Between Project Management Practices and Scientific Cultures

Training

- Most BRCP Project Managers previously worked in a science field and were trained in project management skills
  - BRCP Branch underwrote project management training classes held on-site at JSC
  - Contractor project staff are required to take Kepner-Tregoe* project management training.
  - Many contractor and civil servant project managers are PMP-certified by the Project Management Institute
  - Enables tailoring of project management techniques to specific research environment
- BRCP participated in the development of the NASA competency model for project management

*recognized by the Project Management Institute

Examples: Bridging the Gap Between Project Management Practices and Scientific Cultures

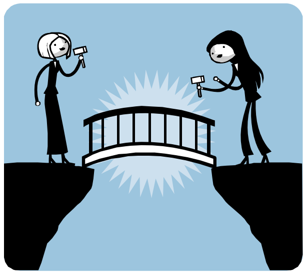
Processes

- BRCP Branch led efforts to identify needed Program processes that will facilitate application of project management practices / tools to research studies
- Processes will ensure a standardized approach for implementation of project management and research activities
- Project Managers and scientists had significant input to science-related processes (e.g., PR-5)
- Scientists and Project Managers had significant input to management processes

ID	Process Description
PR-1	Process for HRP/Element management approval/"go ahead" to implement recommendations from the Programmatic Review Small Assessment Team by Projects (and impact to current Project activities)
PR-2	Flight experiment selection/approval process
PR-3	Process for obtaining and documenting official SLSD/HRP Position on Constellation inputs (CxP requirements, Tiger Team findings, etc.)
PR-4	Process for request, review and approval of changes in funded investigation PI, CO-I, funding level, period of performance.
PR-5	Process and criteria for determining if and what level of peer review/NAR is needed for Project sponsored activities
PR-6	Directed study proposal review process (sequence of panel reviews: Project CB, Element CB, CPHS, SMP, NAR, etc.) - board order and criteria for going to each?
PR-7	Processes for procurement of research information (studies, tests, investigations, etc.) and guideline criteria for selection of procurement vehicle (AO, NRA, RFP, RFQ).
PR-8	Criteria/process for using Wyle/BCC, Directed, and/or solicited routes to answer Project science needs (assumed to be at the discretion of the Project team, yet will HRP management be upset if we are heavily using non-competitive processes?)
PR-9	Project NAR Selection Process and NAR Operating Procedures
PR-10	Criteria for raising decision to next higher level (Project, element, program)
PR-11	Process for preparing, reviewing and selecting study proposals or concepts received (from any source) that were not solicited by the project
PR-12	Process for obtaining SD buy-in to SK Project findings and recommendations for flight countermeasures (e.g., after CM flight validation, how is an idea handed over to Ops. for implementation and what does this package need to contain to for SD to review?)
PR-13	Process for updating OCHMO Standards: Human Health & Performance Fitness for Duty/Permissible Exposure Limits Standards
PR-14	Process for updating OCHMO Standards/Habitability standards
PR-15	Criteria/process to document lessons learned within the Element/Program.
PR-16	Process and criteria for preparing a BCD to move funding
PR-17	Process to identify and obtain inputs from stakeholders (outside HRP)
PR-18	Process to issue "Select for Flight" Directive to allow ISSMP implementation

Processes impacting science

Progress and Forward Work



Accomplishments:

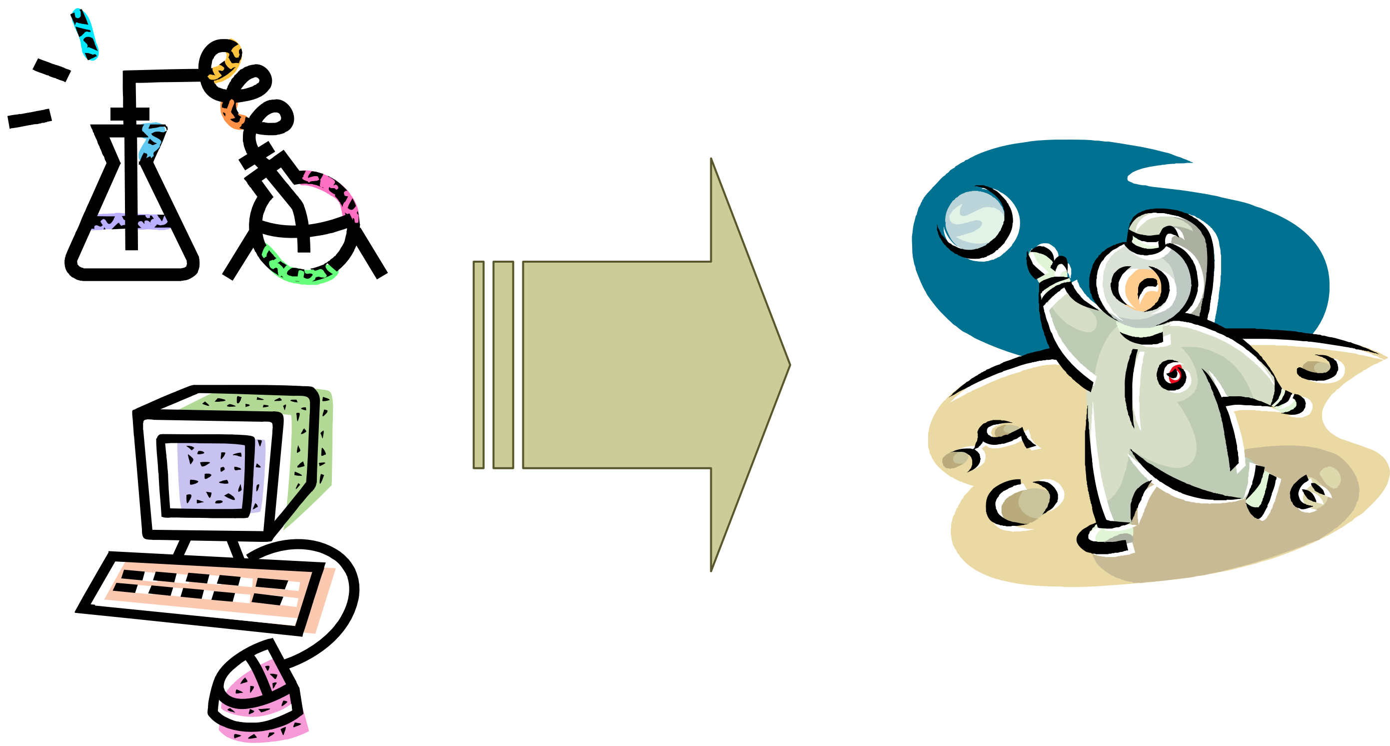
- Acknowledged challenges with managing research activities and differences in doing business
- Established an integrated Project Manager / Project Scientist leadership team for each BRCP Project
- Engaged scientific colleagues as stakeholders in project needs
  - Identified forums to improve communication of project needs with the NASA science community
  - Generated and implemented science documentation and tools, created jointly with inputs from science and project management personnel

Ongoing challenges:

- Applying risk management to scientific activities (risks that we can control and manage)
- Laying out project science activities in a schedule that clearly identifies a critical path
- Using project management techniques / tools and agreements with the greater research community
- Defining results reporting strategies to maximize project use of science findings

Perspective #2

- Challenges and actions related to transitioning programmatic technical content to applied research with high operational relevance

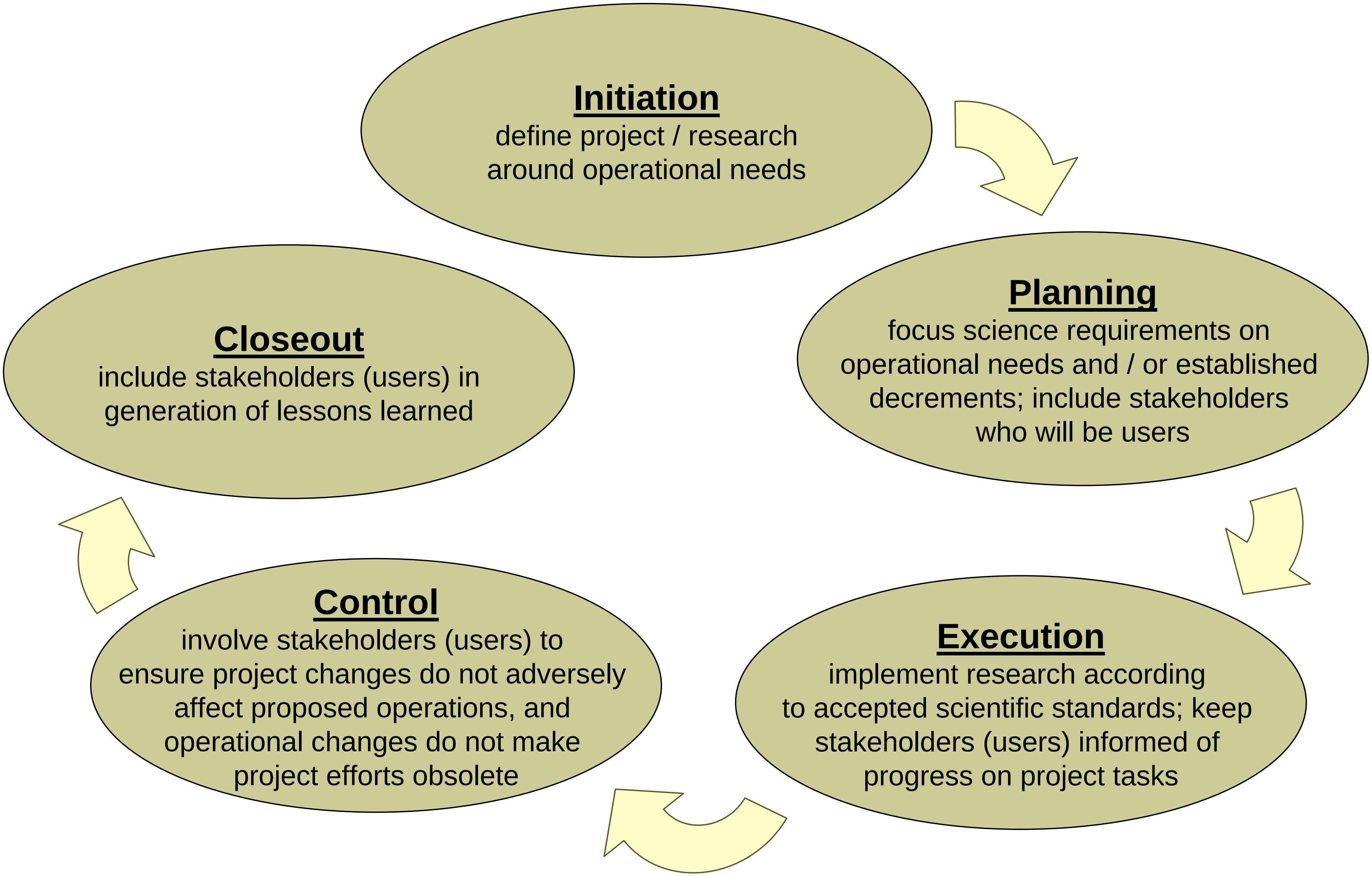


Bridging the Gap
An Operationally-Driven Approach to Science

- Project management is a way of thinking and behaving, rather than just a way of analyzing and presenting data
- The key is to apply scientific methods to <u>operational</u> problems. Applied research is very relevant when tied in via an operationally-driven approach.
- An operationally-driven approach:

1. Independently understand the operations and the science before bringing them together
2. Identify how the operations need to be improved and establish your stakeholders
3. *Then*, define the products you will deliver to your stakeholders that meet their needs
4. *Finally*, determine what science is needed to reach those products
5. Conduct the science using project management as a tool to deliver your product on-budget and on-time

Keep Operations involved in all phases of the project management life cycle



Maintaining scientific validity despite an emphasis shift to operational relevance

- HRP undergoing Institute of Medicine (IOM) review of program-level physiological risks and evidence base (early 2008)
- Projects undergo annual technical review
- Projects can use technical subject matter experts (science discipline teams, external merit review) to establish scientific validity of research studies
- Peer-reviewed publication of study results further validates the scientific methods used for data collection and analysis
- HRP documenting scientific merit review process for new procurements
  - Establishes necessary review for each study type

Example #1: EPSP
EVA Physiology, Systems, and Performance Project

Customer: Constellation Program EVA Office, Level IV, Suits

Physiological / Performance Risk
Risk of compromised EVA performance and crew health due to inadequate EVA suit systems

⇩

Requirement / Gap: (EPSP1)
What parameters of EVA suit design affect human performance?

⇩

Tasks:
Series of studies in analogue environments to evaluate suit weight, mass, center of gravity (CG), pressure, biomechanics and mobility

⇩

Deliverables:
Recommendations for suit mobility requirements, optimal suit weight, pressure, CG and kinematics

Example #2: ECP

Exercise Countermeasures Project: Critical Mission Task Assessments

Customer: Constellation Program

Physiological / Performance Risk

Risk of impaired performance due to reduced muscle mass, strength and endurance; Risk of reduced physical performance capabilities due to reduced aerobic capacity

⇩

Requirement / Gap: (M4)

What is the physiologic cost to complete Lunar Sortie and Lunar Outpost tasks?

⇩

Tasks:

Assessment of strength and aerobic demands of physically-challenging lunar tasks such as vehicle egress, suit ingress/egress, 10 kilometer suited ambulation, etc.

⇩

Deliverables:

Requirements for lunar exercise countermeasures that meet crew performance needs within the constraints of the vehicle and habitat

Progress and Forward Work

Accomplishments:

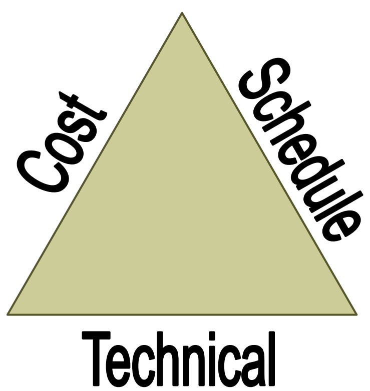
- Identifying stakeholders
- Recognizing different perspectives of stakeholders
- Defining operational needs

Ongoing challenge:

- Engaging operations personnel in program / project planning and activities

Conclusion

- Project management is a valuable tool for managing research based projects
  - A structured approach to managing research projects protects scientific creativity
  - Common language encourages communication and team effectiveness
  - Ambiguity does not inhibit good project management, but lack of project management ensures ambiguity
- We have made a number of successful investments with regard to project management
  - But more work is required



Forum questions and discussion

- Any questions? Thoughts? Suggestions?

- Recap of ongoing challenges:
  - Making the most of legacy studies
  - Establishing process to start new project-directed studies
  - Handling concurrent document development
  - Applying risk management to scientific activities
  - Laying out schedules that yield clear critical path for project science activities
  - Using project management techniques with the greater research community
  - Defining results reporting strategies
  - Engaging operations personnel in planning and activities

NASA