PI-Team Composition
Principal Investigator

Pat McCormick
Hampton University
PI Outline

- PI Qualities
- PI Responsibilities
- Mission organization
- Mission schedule
- Science and mission traceability matrices
- Descope principles
- Example PI Challenges
PI Leadership Qualities

- Inspire and motivate
- Develop ownership*
- Foster cooperation and communication
- Stimulate creativity (empower the team)
- Develop trust
- Recognize talent
- Communicate mutual goals and objectives effectively
- Know what and when to delegate
- Be willing to pay the price – sacrifice your time – burn your bed*
- Engender loyalty
- Listen
- Be a problem solver
- Anticipate problems*
- Encourage
- Acknowledge performance well done
PI Responsibilities

- Leader
- Team organizer
- Team builder
- Establish a ‘whole team’ approach*
- Team Communicator---do not isolate yourself*
- The one person who feels the total responsibility to make the mission succeed*
- The one who has the mission big picture always in mind
- Make sacrifices of time and effort
- Manager of all team elements from hardware to scientific journal article publications
- Ultimate decision maker after debates
- Final cost authority at the project level
Mission Organization
NASA Program Executive, NASA Mission Manager and the PI
Relationships with the Project Scientist

NASA Program Executive

NASA Mission Manager

Principal Investigator

NASA Program Scientist

NASA Project Scientist
Principal Investigator and Project Manager Relationships

-Principal Investigator
  -Project Manager
    -NASA Mission Manager
      -NASA Program Executive
        -NASA Program Scientist
        -NASA Project Scientist
Selecting and working with the Project Manager

- Second to the PI, a strong PM is the most important member of your team
- There must be chemistry between you and the PM. If not, you must make it so
- The PM must be well respected and have a great relationship with the implementing organization
- If PM is not at the PI’s institution, a signed agreement must be put in place stating that the PM works for the PI.
- The two of you will ensure that the mission meets its objectives within the resources proposed
• Delegate most of the day-to-day decision making authority to the PM

• You must not build in a mentality of new/more money will come as problems arise

• Make it known that you will hold the line on cost

• Decide on thresholds for PM to have authority to decide and expend resources

• Develop reporting vehicles for your use, e.g., planned vs. actual key milestones, manpower and cost
The Executive Advisory Council Role

Executive Advisory Council

- NASA Program Executive
  - NASA Mission Manager
    - Principal Investigator
      - Project Manager
  - NASA Program Scientist
  - NASA Project Scientist
Executive Advisory Council Considerations

What are the key considerations in forming an Executive Advisory Council? How is this council used to help in the development?

- A key council to help control costs
- Members must be in a position to control organization physical, fiscal and people resources
- Keep them in the information flow --- good and bad
Science Team Considerations

- Organization rationale
- Instrument(s)
- Algorithm team
- Cost awareness
- Validation team — e.g., leader can be experimentalist or modeler
- EPO – science team member oversight will maximize return
Mission Systems Engineer

- Key translator of science-to-technical requirements
- The MSE understands all technical parts of the mission and how they come together
- These documents become the underpinnings for the mission. Here is where you stop mission creep. The MRD becomes sacrosanct! *
- Implements requirements tracking system, e.g. DOORS
### Example Science Traceability Matrix

<table>
<thead>
<tr>
<th>Science Goals</th>
<th>Science Objectives</th>
<th>Scientific Measurement Requirements</th>
<th>Instrument Functional Requirements</th>
<th>Projected Performance</th>
<th>Mission Functional Requirements (Top Level)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>How does the presence of waves affect the atmospheric structure of planet X</td>
<td>Geophysical parameters</td>
<td>Alt. Range</td>
<td>5 – 40 km</td>
<td>1 - 60 km</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Vert. Resol.</td>
<td>3 km</td>
<td>1.5 km</td>
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<td></td>
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<td></td>
<td>Horiz. Resol.</td>
<td>10 deg x 24 lat x lon</td>
<td>5 deg x 24 lat x lon</td>
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<td></td>
<td></td>
<td>Temp. Resol.</td>
<td>10 min</td>
<td>5 min.</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Precision</td>
<td>3 K</td>
<td>1 K</td>
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<td></td>
<td></td>
<td>Accuracy</td>
<td>8 K</td>
<td>5 K</td>
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<tr>
<td>Objectives 2 to n</td>
<td></td>
<td>Repeat above categories</td>
<td></td>
<td></td>
<td>Four different observing strategies: Solar, limb, nadir, zenith; requires yaw and elevation maneuvers Launch window: 6 minutes to meet nadir and limb overlap requirement. Window applies day to day Need 2 seasons to see planetary wave activity transition Need 8 months of observation</td>
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<tr>
<td>Mission Requirements</td>
<td>Spacecraft Requirements</td>
<td>Ground System Requirements</td>
<td>Operations Requirements</td>
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<tr>
<td>Rocket type</td>
<td>Spinning, stabilized</td>
<td>Passes per day and duration</td>
<td>General spacecraft maneuver requirements and frequency</td>
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<td>Launch date:</td>
<td>Mass</td>
<td>Assumed antenna size</td>
<td>Special maneuvers requirements</td>
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<td>Mission length</td>
<td>Power</td>
<td>Data volume per day</td>
<td>Rationale for maneuvers</td>
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<tr>
<td>Orbit altitude</td>
<td>Volume</td>
<td>Real time data transmission requirements</td>
<td>Ephemeris requirements</td>
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<td>requirement and</td>
<td>Data Rate</td>
<td>Transmit frequency</td>
<td>Changes in viewing modes and directions per orbit, per day or over longer time periods. Rationale for these changes</td>
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<td>Pointing: Control:</td>
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<td>Number of data dumps per day</td>
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<tr>
<td>Other</td>
<td>Other</td>
<td></td>
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</tbody>
</table>

Example Mission Traceability Matrix
Education and Public Outreach (EPO)

- NASA Program Executive
- NASA Mission Manager
- Principal Investigator
- Project Manager
- EPO
- Mission Systems Engineer
- Executive Advisory Council
- NASA Program Scientist
- NASA Project Scientist
- Science Team
- Algorithm Devel.

Executive Advisory Council
Mission Systems Engineer
The total integrated team must work together
Descope Principles
Descope Considerations

- Clear baseline science goals, objectives and baseline mission
- Measurements identified that lead to clear closure
- Carefully thought out minimum (floor) mission objectives
- An allowable degradation plan should be formulated, i.e. which descopes should be taken and in what order
- Descopes that unambiguously show the connection with baseline science objectives and the science “hit”
- Science descope “hit” should be quantified, i.e. relate back to baseline and loss of science
- The point in development when descope decision must occur should be clearly stated
- The cost, mass and schedule saving for the descope must be delineated
- Is a shortened mission a reasonable descope to propose?