Fostering Support for Flagships

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Building Community Consensus

- Importance of a compelling science case
  - ➡ Broad science community
    - ➡ Exoplanets and general astrophysics
  - ➡ General public
  - ➡ Decisions makers

- Mission provides a significant technical advance

- Observatory offers broad involvement for the whole science community e.g. GO program

Programmatics

- Early cost estimates are subject to large uncertainty during concept development phase
- Focus initially on cost control:
  - Identification of key technologies
  - Science requirement traceability
  - Robust performance margins
  - Infrastructure and logistics
  - Implementing lessons learned

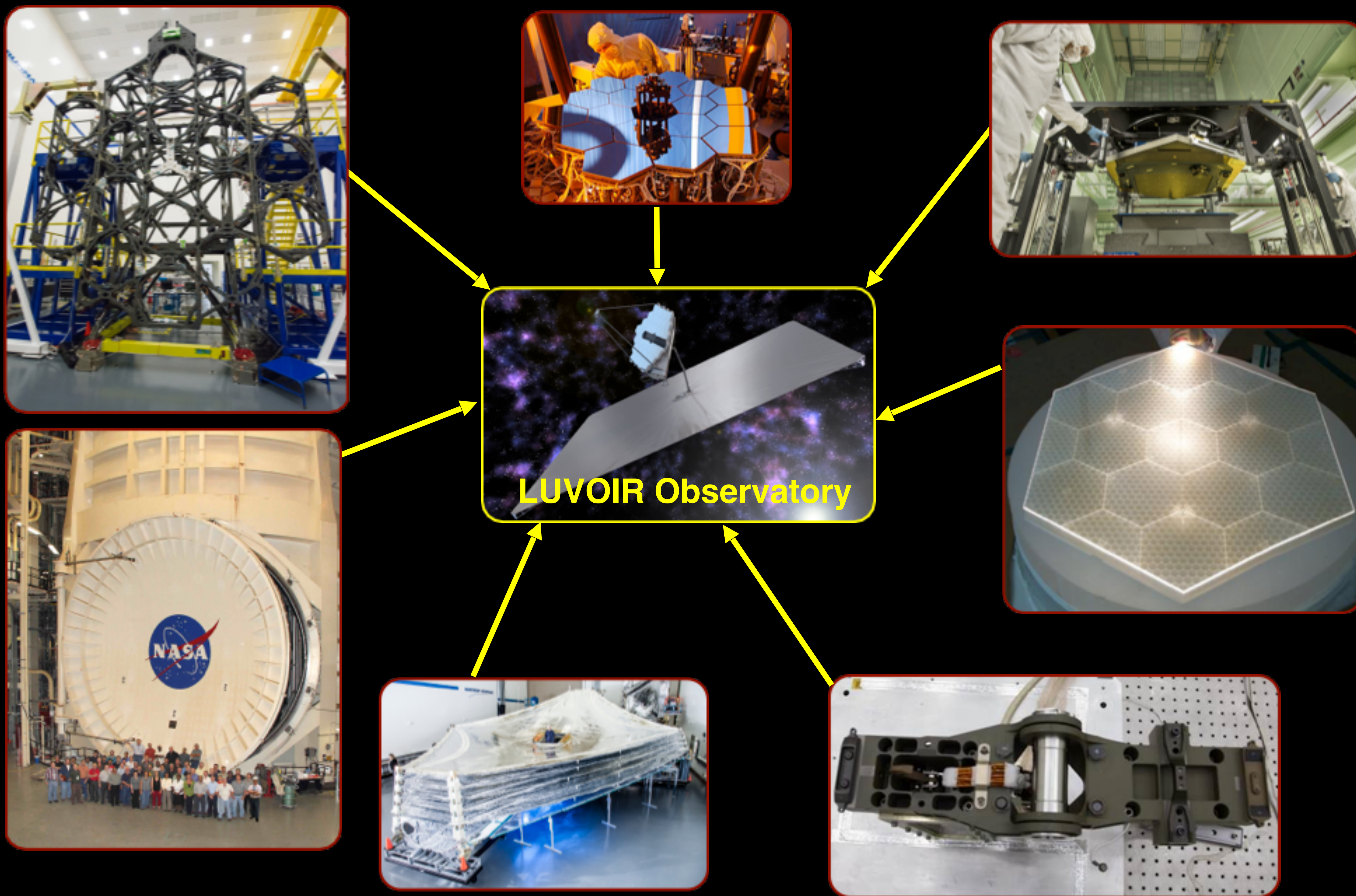
Technology Development: I

- **Invest early in technology**
  - ➡ JWST invested early and this paid off
- **Technologies development to TRL-5**
  - ➡ Competitive down-selects
    - ➡ JWST mirror development is a good example
  - ➡ TRL-6 requires:
    - ➡ Flight-like system (engineering unit)
    - ➡ Technology must be manufactured per flight
    - ➡ TRL-6 requires defined mission with launcher
    - ➡ Independent review process

Technology Development: II

- **For large missions, complexity >> ∑ technologies**
  - ➡ Missing technology is System Engineering (SE)
  - ➡ Require early attention to SE of the requirements
- **Technology transition to TRL 6 has to include assessment for system level dependency e.g.**
  - ➡ A detector requiring a cryocooler can induce jitter which impacts image quality and optical stability
- Yield has to be a key TRL consideration, for sensors
- Technology doesn't always transfer ground ➠ space
- Leverage technology investments

Leveraging JWST Technology Investments



Leveraging JWST Technology Investments

Mirror Backplanes

Composite, primary mirror backplane structures scaleable to ≥ 10 meter apertures

Control System

Wavefront Sensing and control for large, segmented optical systems

Integration and Test

Precision high-speed interferometric testing of mirror segments with ≤ SFE precision

Segmented Mirrors

MMSD mirror program demonstrates lightweight ULE segments capable of ~pm stability with active thermal control @ 300K

TV Test Facilities

Thermal vacuum test chamber facility, optimized for large aperture telescopes

Sunshield

Large deployable, sunshield structures

Deployment Mechanisms

Mechanisms and latches employed in deployment of large structures and sunshields

Operating Temperature

- **Do not compare cost of cryogenic (JWST) to room temperature (HST) observatories**
  - ➡ Cryogenic observatory requires much more time to build e.g. cryo-polishing of optics
  - ➡ I&T has to be incremental and is more costly
  - ➡ Cryogenic observatories not suited to modular designs, due to thermal packaging requirements
  - ➡ Structures have to be designed for safe margins over very large temperature ranges
  - ➡ Passive and active cooling systems place large overhead on observatory design and performance

Requirements

- **Requirements have to be clearly written**
  - ➡ e.g. Define zodi-limited performance by stating the wavelength range and definition
- Start out with a clear set of definitions for ACS (pointing) and define their linkage to image quality prior to developing error budgets
- Early assessment of stray light requirements on the observatory design is mandatory
- Include I&T specialists early in design phase to ensure that design can be assembled & tested

Requirements

- Do not add capabilities without systems assessment
- Observatory level descopes can incur significant cost due to unforeseen impacts
- Keep designs simple, fully integrated and carefully assess complexity
    - ➡ For exoplanet imaging simplest designs are often more complex because they are not “integrated solutions” and require significant additional instrumentation
- Effective costing requires post phase-A understanding of requirements

Instruments

- Insist on common instrument architectures
  - ➡ Optical bench & mount materials
  - ➡ Mechanical, electrical & data interfaces
- Provide alignment adjustment in each instrument
- Avoid embedding engineering functions in science instruments i.e. dual-role instruments