

TESTIMONY TO THE COMMITTEE

ON

SCIENCE, SPACE AND TECHNOLOGY

JULY 25, 2018

A. THOMAS YOUNG
CHAIR, JWST INDEPENDENT REVIEW BOARD

Chairman Smith, Ranking Member Bernice Johnson and Committee members, I am pleased to present the results of the Independent Review Board (IRB) evaluation of the James Webb Space Telescope (JWST) mission.

The IRB charter established by NASA required that we evaluate all factors influencing JWST success. Our report is complete. We believe we have satisfied our charter. Our report contains 32 recommendations. We believe the implementation of all 32 recommendations is required to maximize the probability of JWST success.

Our initial observation is that JWST is an observatory with incredible capability, awesome scientific potential and significant complexity, risk and first-time events.

An overarching recommendation of the IRB is that mission success be the top priority in all future JWST activities. JWST is at the point in its development that every appropriate thing that can be done to maximize mission success should be done.

There are a large number of JWST accomplishments that require recognition. All flight hardware has been delivered. All science instruments have been integrated into the science module which has been combined with the telescope to form the optical telescope and science instrument module (OTIS). OTIS has been successfully tested, the science instruments have met their requirements and it has been delivered to Northrop Grumman for integration with the spacecraft and sunshield. This is but a few of the positive JWST accomplishments.

In our report we cite seven noteworthy JWST Firsts. The most noteworthy being the sunshield which is mandatory for success and has no significant legacy. Two yet to be completed phases of the JWST project represent significant risk. The first is Integration and Test (I & T). To date, there have been human errors and embedded problems that have caused significant problems in I & T resulting in large schedule delays. The IRB has very specific recommendations focused upon human errors and embedded problems. The success in implementing the IRB recommended corrective actions will determine the success of completing JWST development.

Human errors are mistakes made by people working on the flight hardware or developing procedures that dictate how work on the flight hardware is to be conducted. Three examples of human errors that have had a major impact on JWST schedule and cost are:

- Wrong solvent used to clean propulsion valves.
- Test wiring erroneously connected to flight hardware without adequate inspection.
- Sunshield cover fasteners improperly installed.

The capability of the I & T workforce and the quality of procedures must be such that human errors are minimized and when they occur their impact is negligible.

Embedded problems are problems in the as-built hardware that are undetected until a major test many months in the future after the problem is introduced or even worse not detected until the Observatory is in space. The valve solvent problem and sunshield fastener problem are examples of embedded problems that have had a major impact on schedule.

An in-depth audit by NASA and Northrop Grumman of the flight hardware including drawings, procedures, etc. is required to identify any additional embedded problems that may exist.

The second JWST phase with high risk is spacecraft and sunshield deployments that occur during Observatory Commissioning. Approximately 307 single point failure items must work to have successful deployments. This phase of JWST is similar to the entry-decent-landing (EDL) phase of a Mars Science Laboratory mission, which for comparison had 75 single point failures when it landed on Mars in 2012. Both are high risk missions with no ability to test-as-you-fly. A "World Class" systems engineer assigned as EDL manager has been critical to the success of Mars landers. The IRB recommends the position of Commissioning Manager staffed by a "World Class" engineer be established for JWST.

There are several additional important technical and management recommendations from the IRB. If fully implemented, such recommendations as NASA certification of the launch vehicle and management reporting and communication increase the probability of mission success.

The IRB recommended launch date for JWST is March, 2021. This is a 29-month delay from the October, 2018 date established in 2011 with a cost of approximately 1B\$. Five factors have caused this delay:

- Human errors.
- Embedded problems.
- Lack of experience in areas such as the sunshield.
- Excessive optimism.
- Systems complexity.

The JWST complexity and risk cannot be overstated. The IRB recommended March, 2021 launch date assumes the successful implementation of the recommendations in our report. No allowance has been made for:

- Additional I & T errors or imbedded problems with multi-month impacts.
- Additional sunshield deployments during I & T beyond the currently planned two.
- Removal of a spacecraft subsystem or science instrument.

With all factors considered, the members of the IRB are unanimous in recommending that JWST continue based on its extraordinary scientific potential and critical role in maintaining U.S. leadership in astronomy and astrophysics.

Thank you, I will be pleased to respond to any questions you may have.