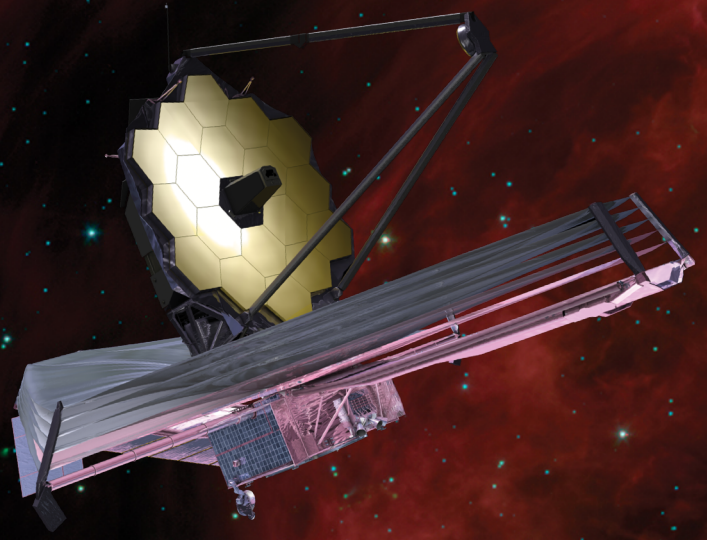


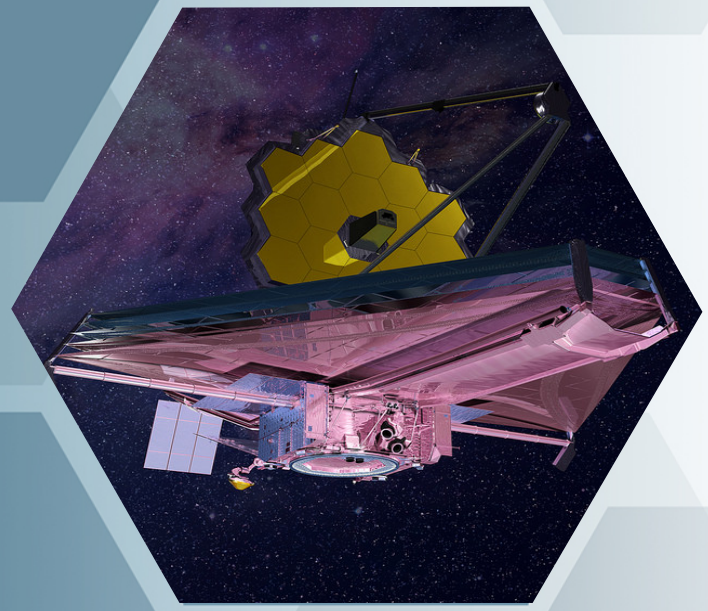
James Webb Space Telescope

Independent Review Board

Assessment Report

February 8, 2019

Table of Contents



Webb IRB* Charter

Assess the implementation of the IRB recommendations.

* *Independent Review Board (IRB)*

Webb IRB Members

Thomas Young, (Chair)
William F. Ballhaus
Steven Battel
Orlando Figueroa
Fiona Harrison
Michele King
Paul McConnaughey
Dorothy Perkins
Peter Theisinger
Maria Zuber

Dan Woods (Review Manager)
John Karcz (Executive Secretary)

Review Methodology

Structured Reviews

Informal Sessions

Personal Interviews

Formal Cost/Schedule Analysis

IRB Deliberations

Assessment Defined

Appropriate – The response, including future activities, fully addresses or exceeds the IRB recommendation, maximizing the probability for mission success.

Appropriate with additional work needed – The response largely addressed the IRB recommendation, missing a few key elements critical to maximizing mission success.

Inadequate – The IRB recommendation was not adequately addressed.

Assessment of Recommendations

Commissioning Risks

Recommendation

Establish the position of Commission Manager reporting to the [Goddard Space Flight Center, GSFC] [James Webb Space Telescope, JWST] Project Manager. The Commission Manager position must be filled by "world class" systems engineer with total end-to-end responsibility for commissioning success.

Assessment

Appropriate with additional work needed.

Observations

The JWST Project has made a major change to the organization in order to create and staff the Commissioning Manager office. The selected Commissioning Manager is a very good choice.

The Commissioning Manager has established an intra-JWST steering group, which is really a technical working group.

The Commissioning Manager has prioritized his work appropriately, identified a staffing shortfall (observatory pointing) which he is working, and begun work on those items he views as most important (first maneuver scheduling and contingency planning). This is all objective evidence that he recognizes his role, is taking charge, and is being supported by the project.

No external group to review Commissioning has been identified.

Contact with outside organizations and/or projects that could provide independent insight on the commissioning activity was not presented to the IRB.

Commissioning Risks

Work Still Needed

The Commissioning Manager should form up review groups with significant outside-the-project participation to review the overall commissioning activity and any significant sub-activities. These reviews should be in the nature of table-top or peer reviews in order to be most effective and provide the least amount of overhead to the ongoing project work.

The Commissioning Manager should look toward outside organizations and/or projects to dialogue with on his commissioning plans in order to gather additional information to guide his thinking. We suggest (but do not require) the InSight team as a potential source for input, given their recent preparations for their science mission, as well as other projects with significant deployment activities (not necessarily in the civil space program).

Commissioning Risks

Recommendation

Determine and implement the required sunshield hardware and simulation elements necessary to support the potential for sunshield anomaly identification and resolution.

Assessment

Appropriate.

Observations

The Project plans to perform a complete review of sunshield deployment, including direct and indirect telemetry and failure mechanisms. This work will enhance team understanding of sunshield characteristics, telemetry and potential failure modes. It will also enhance operational readiness. The commissioning team, Responsible Design Engineers (RDEs) and the integration and test (I&T) team will be involved in this review, which is planned for February 2019. Subsequently, it is planned that commissioning team members will shadow Spacecraft Element (SCE) deployments to reinforce their understanding.

The Project also plans to build a testbed/simulator that will allow them to assess potential problems in the sunshield deployment, in particular the potential and mechanisms for snags. The initial hardware is planned to be complete for testing in May 2019. Subsequent capability will be added that will enhance the simulator and enable flight system anomaly troubleshooting.

The IRB understands that this will be a continuing process throughout the test program.

Human Mistakes During I&T

Recommendation

NGAS [Northrop Grumman Aerospace Systems] functional organizations establish corrective actions in the following areas:

- *Processes – ensure current, accurate, implementable and not subject to interpretation.*
- *Training – small errors produce large consequences.*
- *Personnel certification – ensure people capable of performing the task at hand.*
- *Discipline – ensure individual accountability and follow the process, call a halt if the process appears questionable.*
- *Failure-proof "safety net" – testing, independent analysis, inspection.*

Assessment

Appropriate.

Observations

Progress has been made in bringing processes, training, and certifications up to date. A senior independent review has been conducted to identify needed corrective action. 191 processes have been brought up to date. 1800 hours have been invested to modernize I&T training, and 5600 hours of I&T training have been conducted. Training and discipline have been enhanced to reinforce individual accountability and an understanding of what a signature means on an inspection. Several relevant anecdotes were presented that indicate management's intent for employees to call a halt when something that doesn't look right is being implemented on the floor. Pre-execution reviews and pre-test table-top reviews are now conducted with the requirement that all needed personnel be present.

Human Mistakes During I&T

Observations (cont'd)

This includes RDEs, all of whom have been reassigned to the project and will now remain in place through telescope commissioning. Senior management has added and fenced funding for 63 full-time equivalents for a multi-year initiative in process excellence. A Mission Assurance Keystone Course has been initiated with 32 training hours on 22 topic areas.

The strengthened NASA resident team is a key element in assuring that focus is maintained in these functional areas.

Sustained excellence in engineering and mission assurance requires both constant vigilance and constant improvement. Assure multi-year, fenced funding for the Process Excellence Initiative remains in place.

Embedded Problems

Recommendation

GSFC and NGAS conduct an audit including forensic engineering, hardware pedigree assessment, drawing checks, etc. to identify potential embedded problems.

Assessment

Appropriate with additional work needed.

Observations

NASA and NGAS conducted audits for the assessment of residual risks associated with embedded problems. NASA undertook a methodical and systematic risk-based approach, bringing some key independent GSFC experts to bear in key areas and questions, while NGAS conducted an experience-based approach to identify key areas of possible concern and expert assessment of impact. NASA and NGAS shared, coordinated, and combined findings to inform the audit process.

The audit was far reaching into the SCE, including, Risk Reduction Audits, to screen for latent issues that could be revealed in future testing. There were also Design & Process audits as well as selected Observatory-level Audits. The resulting actions were prioritized so that any findings that affected the “return to environmental verification” of the SCE were addressed first. Two major actions are being tracked by the JWST Chief Engineer and are being implemented by NGAS System Engineers: Multilayer Insulation/Soft Structure; and Deployment Interfaces.

The Acoustic Test Anomaly Investigation also initiated several key detail design audits that led to actions to verify the adequacy of the design as built, additional tests and/or analysis, and modifications of processes and procedures.

Embedded Problems

Observations (cont'd)

Several items were not subject to the audit process [Test As You Fly (TAYF), Single Point Failures (SPFs), Propulsion, Electronics, Optical Telescope element & Integrated Science (OTIS) instrument module], except by association to items that were audited [e.g. Multi-Layer Insulation /Soft Structure] or other risk reduction actions (e.g. Deployment Interfaces); the rationale being that they are being or have been audited extensively as part of independent Mission Assurance processes (NGAS and NASA) and/or have completed robust test programs, and their test programs going forward have been augmented to add robustness as documented in response to JWST Standing Review Board recommendations.

NASA and NGAS teams are to be commended for the combined thoroughness of the audit process, the follow through, and the corrective actions undertaken to increase the probability of mission success. The process did not/has not uncovered catastrophic missteps or embedded problems, but clearly pointed to areas that warranted a second look and to process improvements to improve the probability of mission success.

Embedded Problems

Example Outcomes from NASA/NGAS Audits

- Direct Reach Across Audit: Audit of the qualification efforts to solve the loose screws problem with the Membrane Cover Assembly (MCA) pointed to omissions that needed correction. A model correction was made and a more realistic loads case was realized that required additional testing to verify hardware compliance.
- Sunshield Cable Length Audit: Audit of nominal deployment cable routing and off-nominal cases for potential cable snags was expanded for potential snag sources for all cable release deployment systems; corrective actions were taken as needed.
- Direct Reach Across Audit: Audit to identify fastening hardware at risk of backing out due to deviation from NGAS standard practice resulted in 832 drawings being reviewed, with 19 flagged as deviating from the application of NGAS standard practices.
- Patch-Lock Audit: Audit to identify fastening hardware with low patch-lock thread engagement identified a concern within the Mass and Thermal Simulator of potentially insufficient Fastener Patch Lock engagement.
- Critical Clearance Audit: Assessment of MCA clearances based on MCA batten re-design and bumper design testing and dynamic clearances indicated motions greater than expected, leading to further analysis and a need for top-side bumpers to mitigate aft deployable Integrated Science Instrument Module radiator damage risk.
- Heat Treat Audit: Paperwork audit of the inspection of the Membrane Release Device stud revealed that the wrong heat treatment was applied to the stud material. The stud passed strength testing so a “use-as-is” determination was made. However, the finding led to an audit of inspection paperwork and drawings to be sure that there was no confusion in the flow down of requirements within NGAS or its parts vendors.

Embedded Problems

Work Still Needed

NASA and NGAS should produce an integrated report of the audit process, findings, and actions undertaken to correct deficiencies or discrepancies where those were found. The report should include the rationale for the exclusion of items from the audit. The report should be a deliverable to the NASA Technical and SMA Authorities.

The search for embedded problems needs to be a continuous effort, particularly to bring to closure actions resulting from the audit effort as part of a strong safety net. NASA GSFC should be prepared to augment and dedicate engineering and safety and mission assurance expertise to review the report and for follow up efforts as required.

The IRB recognizes that with respect to OTIS, the potential for embedded problems is small, but its critical importance warrants that NASA audit OTIS utilizing the NASA risk-based screening and selection criteria to make sure that nothing has been missed.

Residual Risks

Recommendation

GSFC conduct an audit of the JWST project residual risk, reviewing the objective evidence of (1) the completed TAYF and SPFs mitigation plans, and (2) failure corrective action effectiveness to determine the "as built" residual risk.

Assessment

Appropriate.

Observations

The Project engaged in an extensive review of both closed and open risks and took actions which resulted in minor recharacterization, promotion and re-opening of risks. Clear objective evidence showed that the review was comprehensive, and a fresh-eyes review was presented.

TAYF exceptions and SPF processes were reviewed and are continuing, per the Project's plans.

Project should review events since the Critical Design Review (changes, test results including both discrepancies and revealed design maturity features) to determine if any additions to the TAYF exceptions are warranted.

Residual Risks

Recommendation

Reconcile the “as built’ residual risk with the expected “as designed” residual risk.

Assessment

Appropriate.

Observations

The Project has a well-established and continuing process of conducting detailed data reviews after every major test.

Unexpected test results or unexpected observed hardware behaviors are identified and investigated. These are submitted as either new risks or issues to Project Management and Mission Systems Engineering. As part of this process the risk status of the “as-built” and tested configuration items are compared to the expected risk levels of the “as-designed” items. As part of this reconciliation, mitigations may be added or modified as required.

Discrepancies with no residual risk are dispositioned while significant discrepancies with residual risk are carried on the unverified failure list. The number of unverified failures at this point (21) is in family with other large, complex space vehicle development activities.

Mission Success Dependence on Launch Vehicle

Recommendation

LSP [Launch Services Program] shall be accountable for JWST launch success at the same level of responsibility they have for U.S. launches, or NASA should contract with Aerospace Corporation for similar accountability.

Assessment

Inadequate.

Observations

Ariane's launch mission success record is comparable to U.S. provided launch vehicles of the same class.

Interactions between NASA and the European Space Agency (ESA) have resulted in LSP participation in additional and key reviews conducted by ESA, and, where ESA has agreed to provide data and information to LSP system engineers as appropriate, better understanding the logic and rationale for decisions.

LSP informed the IRB that they are unwilling to accept accountability for launch mission success. This puts the NASA Administrator in the position of accepting launch mission success risk without the full benefit of NASA's launch expertise.

The IRB recognizes that utilizing an international launch vehicle dictates unique circumstances, however the IRB believes that the importance of JWST requires that LSP do everything possible to be accountable for launch success.

Alternate Opinion

A minority view exists that NASA's response is appropriate since NASA has achieved accountability (in spirit) and significant insight to make risk informed decisions about the launch vehicle.

Transport and Spacecraft/Launch Integration

Recommendation

NASA define security requirements and plan for JWST transport to launch site.

Assessment

Appropriate.

Observations

NASA has coordinated security requirements and the JWST transportation plan and schedule with the appropriate federal Agencies.

Transportation security issues have been raised to the NASA Associate Administrator level for appropriate awareness and cross-Agency coordination.

The JWST Program has developed a transportation plan, timeline, and contingency options for shipping JWST to the launch site.

Security considerations will be updated six months before shipment of the observatory.

The Program should continue to assess the need for added security considerations for transportation in consultation with other government agencies.

Transport and Spacecraft/Launch Integration

Recommendation

Develop contingency operations and sparing plan for spacecraft/launch site operations.

Assessment

Appropriate.

Observations

The JWST Project has developed a contingency operations and a sparing plan (they are closely coupled) for final observatory integration and for integration activities with the launch vehicle.

A schedule and timeline for launch site integration activities has been developed, with an understanding of associated schedule margins.

Integration risks have been identified, driving appropriate contingency and sparing planning.

Further details to the sparing plan will be updated pending results of final observatory integration and testing at NGAS.

The Program should continue to assess the need for updating the sparing plan and contingency plan as observatory integration proceeds at NGAS.

Transport and Spacecraft/Launch Integration

Recommendation

Develop "pathfinder" JWST simulator and contamination protection systems for integration "dry runs."

Assessment

Appropriate with additional work needed.

Observations

The JWST Project has developed contamination protection systems and processes for integration of the observatory at the launch site, including:

- Launch pad protective curtain.
- HEPA (High Efficiency Particulate Air) filter system and filter optimum location placement studies.
- Transit and traffic through and between buildings.
- Etc.

The Project has developed a detailed timeline (with some margin) and process flow for the launch site, and it has developed local contamination control processes.

The JWST Project has chosen not to develop and exercise an observatory pathfinder to "dry run" launch processing of the payload.

- Not an issue with respect to mission success risk.
- Lack of pathfinder dry runs will likely lead to processing delays (beyond current margins).

Work Still Needed

Given the decision to not have the pathfinder, the Program should continue to update the launch processing plan and add appropriate margin to accommodate for the "first time" processing of the observatory at the launch site.

Transport and Spacecraft/Launch Integration

Recommendation

Assess shipping vessel contamination environment and develop contingency plans for off-nominal shipping operations.

Assessment

Appropriate.

Observations

The JWST Project has developed plans for measuring the vessel contamination environment via witness plates and air sampling external to the observatory shipping container.

Vessel contamination environment measurements are planned for both the observatory shipment and for earlier transportation voyages of the transportation system.

Contingency and a back-up for the shipping-container environmental control system are planned for shipment of the observatory.

Shipping plan has contingency operations and “safe havens” during transport in case of environmental conditions (weather) exceeding transportation limits.

Mission Operations

Recommendation

Critically important that GSFC JWST Project Office maintain responsibility and provide adequate support to ensure [Space Telescope Science Institute] STScI mission operations readiness.

Assessment

Appropriate.

Observations

It is clear that GSFC is responsible for operations and will remain so throughout the life of the mission. The model of operations is the same as that used for the Hubble Space Telescope, with flight operations being performed under contract with GSFC overall management. The one difference is that the Hubble Flight Operations Team has been, for the most part, housed at GSFC, while the JWST Flight Operations Team will be at STScI. This off-center location does not change GSFC oversight or accountability and enhances the connection between science and mission operations. The Project will maintain offices at STScI.

Mission Operations

Recommendation

Review all simulators/testbeds and required usage against pre-launch tests and rehearsals, post-launch deployment anomaly resolution, fault isolation and correction.

Assessment

Appropriate.

Observations

The Project plans to perform a complete review of sunshield deployment, including direct and indirect telemetry and failure mechanisms. This work will enhance team understanding of sunshield characteristics, telemetry and potential failure modes. It will also enhance operational readiness. The commissioning team, RDEs and the I&T team will be involved in this review, which is planned for February 2019. Subsequently, it is planned that commissioning team members will shadow SCE deployments to reinforce their understanding.

The Project also plans to build a testbed/simulator that will allow them to assess potential problems in the sunshield deployment, in particular the potential and mechanisms for snags. The initial hardware is planned to be complete for testing in May 2019. Subsequent capability will be added that will enhance the simulator and enable flight system anomaly troubleshooting.

Mission Operations

Recommendation

GSFC JWST Project Office develop a staffing plan that meets the needs of I&T and operational readiness.

Assessment

Appropriate.

Observations

The Project has a staffing plan that covers I&T, operational readiness and commissioning activities (and ultimately, operations). It includes the identification of RDEs needed for various activities. Ten pre-launch activities have been added, taking good advantage of the additional time to launch and working around the observatory I&T schedule. These include additional rehearsals and exercises for contingency planning, deployment, critical operations, launch readiness and the full integrated crew. The plan represents a sustainable workload for the mission operations team and accommodates schedule agreements with ESA for Integrated Crew Exercises.

Mission Operations

Recommendation

Develop and approve a transition plan that defines the level of mission operations responsibility for STScI as a function of time with independent gate reviews at transition points.

Assessment

Appropriate.

Observations

There is no specific point in time that transitions mission operations responsibility to STScI. The STScI operations staff will be involved in exercises and rehearsals with members of the implementation team frequently between now and launch. After observatory commissioning there will be some changes in responsibility and these will be documented and presented at the Flight Operations Review currently planned for July 2020. The Post-Launch Assessment review will be the final occasion for assessing STScI readiness to operate the observatory. At this time, the state of observatory performance will be laid out and any workarounds, changes to procedures, software, processes, unexpected conditions, trends and the like that will affect ongoing work by the STScI flight operations team will be documented. While the other players – NGAS, Ball Aerospace, instrument teams, the Jet Propulsion Laboratory – will no longer be resident in the Mission Operations Center, they will be available to the Flight Operations Team as needed for understanding of any anomalous behavior on the observatory.

JWST Reporting

Recommendation

Implement JWST reporting structure as represented by accompanying diagram.
(See diagram in JWST IRB Report, May 31, 2018)

Assessment

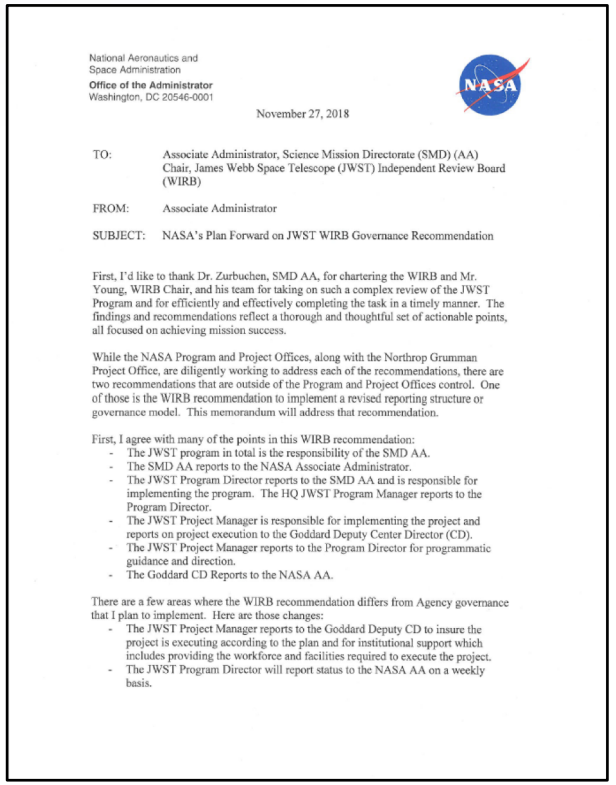
Inadequate.

Observations

The NASA response to the "JWST Reporting" recommendation is documented in the memorandum from the NASA Associate Administrator dated November 27, 2018 with the subject "NASA's Plan Forward on JWST WIRB Governance Recommendation."

Establishing the Science Mission Directorate (SMD) Associate Administrator (AA) as responsible for the JWST Program in total is consistent with the IRB recommendation.

The reporting relationships for the SMD AA, the JWST Program Director and the JWST Program Manager are consistent with the IRB recommendation.



National Aeronautics and Space Administration
Office of the Administrator
Washington, DC 20546-0001

November 27, 2018

TO: Associate Administrator, Science Mission Directorate (SMD) (AA) Chair, James Webb Space Telescope (JWST) Independent Review Board (WIRB)

FROM: Associate Administrator

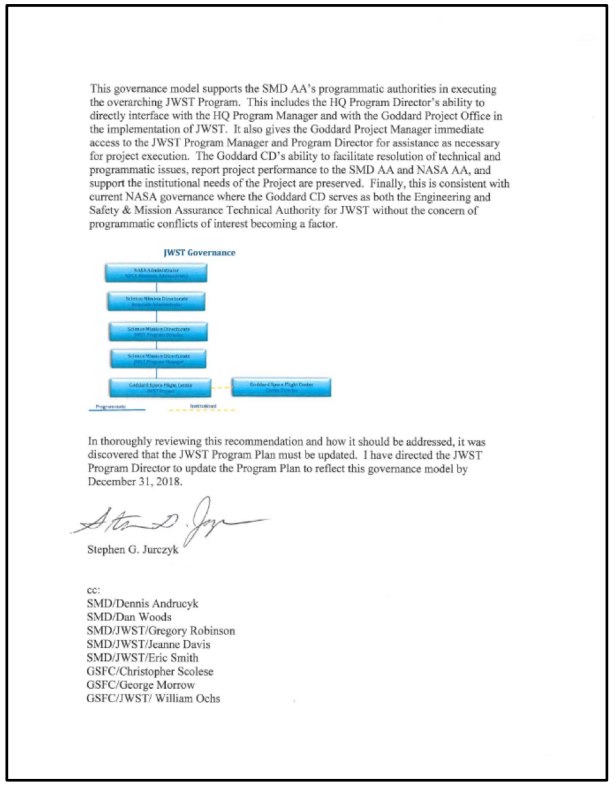
SUBJECT: NASA's Plan Forward on JWST WIRB Governance Recommendation

First, I'd like to thank Dr. Zurbuchen, SMD AA, for chartering the WIRB and Mr. Young, WIRB Chair, and his team for taking on such a complex review of the JWST Program and for efficiently and effectively completing the task in a timely manner. The findings and recommendations reflect a thorough and thoughtful set of actionable points, all focused on achieving mission success.

While the NASA Program and Project Offices, along with the Northrop Grumman Project Office, are diligently working to address each of the recommendations, there are two recommendations that are outside of the Program and Project Offices control. One of those is the WIRB recommendation to implement a revised reporting structure or governance model. This memorandum will address that recommendation.

First, I agree with many of the points in this WIRB recommendation:
- The JWST program in total is the responsibility of the SMD AA.
- The SMD AA reports to the NASA Associate Administrator.
- The JWST Program Director reports to the SMD AA and is responsible for implementing the program. The HQ JWST Program Manager reports to the Program Director.
- The JWST Project Manager is responsible for implementing the project and reports on project execution to the Goddard Deputy Center Director (CD).
- The JWST Project Manager reports to the Program Director for programmatic guidance and direction.
- The Goddard CD Reports to the NASA AA.

There are a few areas where the WIRB recommendation differs from Agency governance that I plan to implement. Here are those changes:
- The JWST Project Manager reports to the Goddard Deputy CD to insure the project is executing according to the plan and for institutional support which includes providing the workforce and facilities required to execute the project.
- The JWST Program Director will report status to the NASA AA on a weekly basis.



This governance model supports the SMD AA's programmatic authorities in executing the overarching JWST Program. This includes the HQ Program Director's ability to directly interface with the HQ Program Manager and with the Goddard Project Office in the implementation of JWST. It also gives the Goddard Project Manager immediate access to the JWST Program Manager and Program Director for assistance as necessary for project execution. The Goddard CD's ability to facilitate resolution of technical and programmatic issues, report project performance to the SMD AA and NASA AA, and support the institutional needs of the Project are preserved. Finally, this is consistent with current NASA governance where the Goddard CD serves as both the Engineering and Safety & Mission Assurance Technical Authority for JWST without the concern of programmatic conflicts of interest becoming a factor.

JWST Governance

In thoroughly reviewing this recommendation and how it should be addressed, it was discovered that the JWST Program Plan must be updated. I have directed the JWST Program Director to update the Program Plan to reflect this governance model by December 31, 2018.

Stephen G. Jurczyk

cc:
SMD/Dennis Andrucyk
SMD/Dan Woods
SMD/JWST/Gregory Robinson
SMD/JWST/Jeanne Davis
SMD/JWST/Eric Smith
GSFC/Christopher Scolese
GSFC/George Morrow
GSFC/JWST/ William Ochs

JWST Reporting

Observations (cont'd)

The IRB interpretation of the memorandum is that the GSFC Center Director is not responsible (including accountability and authority) for all aspects of the JWST project reporting to the SMD AA. Additionally, the JWST Project Manager does not report to the GSFC Center Director. This role for the GSFC Center Director is not consistent with the IRB recommendation.

The judgment of the IRB is that restricting the involvement of the Center Director as specified in the NASA Associate Administrator's memorandum will significantly reduce the probability of JWST success including cost, schedule and in-flight performance. Aside from the JWST Project Manager, the GSFC Center Director is in the best position to assure successful execution of the approved program. The Center Director controls the resources required to formulate and execute such a complex space system development effort. The belief of the IRB is that the Center Director is an extraordinary resource that should be fully utilized in the implementation of JWST.

An observation of the IRB is that the governance model identified in the November 27, 2018 memo is inconsistent with NASA Policy Directive 1000.0B which states that "Center Directors are responsible and accountable for all activities assigned to their Center."

JWST Reporting

Recommendation

Revise NASA policy directive consistent with recommendation.

Assessment

Inadequate.

Observations

The NASA decision contained in the November 27, 2018 memorandum from the NASA Associate Administrator is not consistent with the IRB recommendation.

Management Communication

Recommendation

GSFC and NGAS Project Offices established as consistent and factual source of all JWST mission status.

Assessment

Appropriate.

Observations

The responses of the Project (NASA and NGAS) and other stakeholders in the reporting structure in this area are commendable.

The Project is coordinating closely with NGAS on status, risks, issues, assessments, and using the data and information to prepare formal status reports and to inform interactions with stakeholders.

The structuring of key meetings and participation to be more inclusive of those with a “need to have accurate and timely data and information at all times” regarding the general technical and programmatic status, risks and issues; and to present the Project’s position (including NGAS) directly and frequently all the way to the NASA AA reinforces the Project’s role as the factual source of all JWST mission status.

The Project reinstituted weekly teleconferences with the Science Working Group (SWG) in close coordination with the Program Office, where the Project has an opportunity to present status, plans, risks, and issues and interact with science stakeholders on specific topics of interest.

Management Communication

Recommendation

Communications of status and details appropriate for stakeholders needs to be presented clearly and frequently.

Assessment

Appropriate with additional work needed.

Observations

A Communication Plan has been drafted to enhance and coordinate the sharing of JWST news with the stakeholders and the community at large.

There is a plan in place to engage the SWG on how to most effectively harness their time and talents to act as conduits to the broader community on mission challenges.

Work Still Needed

The reinvigoration of and corrections to the reporting chain are commendable. However, the communication with the broader science community and the public appears to be moving at a very slow pace and needs to be accelerated to communicate status, risks, accomplishments, and results of related science studies.

Management Communication

Recommendation

NASA HQ [Headquarters] should be responsible for developing a “communication plan” (messaging strategy) for JWST.

Assessment

Appropriate with additional work needed.

Observations

The IRB was given a draft communication plan. This plan is in a preliminary stage and has numerous deficiencies. The plan is overly complex and does not communicate the science breadth, does not address immediate needs for pre-launch communications, and does not have buy in from the SWG. The focus is on post-launch communications, and does not address the urgent need for proper pre-launch messaging during this challenging period. The IRB notes opportunities to provide the science community and the public regular information about environmental test progress (e.g. successful completion of acoustic testing of the spacecraft) have been missed.

Work Still Needed

The plan must be finalized soon and must include pre-launch, launch and commissioning messaging strategies. The SWG needs to be fully engaged in finalizing the communication plan.

Management Communication

Recommendation

Communicating complexity, risk and science return for JWST is critically important.

Assessment

Appropriate with additional work needed.

Observations

The communications plan draft does not include adequate planning for communicating the complexity and risk associated with the deployments - most notably the sunshield. The stakeholders, including the science community and the public must fully understand that JWST is the most ambitious robotic mission NASA has undertaken and that the risks are amply justified.

Work Still Needed

The communications plan needs to include more focus on capturing and describing the challenges (and rewards) of pushing the limits of technical capabilities. More lessons from the successful MSL entry, descent, and landing communications should be incorporated into the plans.

Management Communication

Recommendation

Same criticality and assessment charts used for all JWST reporting.

Assessment

Appropriate with additional work needed.

Observations

The structure of key meetings has been re-focused to be more inclusive of those with a “need to have accurate and timely data and information at all times” regarding the general technical and programmatic status, risks and issues.

The GSFC Monthly Mission Status Reviews and the SMD Flight Program Reviews have been combined, streamlining communications, minimizing risks associated with translation, and providing everyone with the opportunity to see and use the same charts.

The frequency of meetings is optimized and being reinforced within NASA and with NGAS.

In cases where there may be differences in risk posture (e.g. Headquarters is holding reserves to mitigate a risk at the Project level) being communicated, these differences are discussed and understood.

Work Still Needed

Summary status charts reflecting status and high level “stop light” assessments should be consistent at all levels and also fully capture the exact language and emphasis used by the Project in communicating risks and issues. The Project’s “Top Ten” issues should accompany the summary status to make sure that all stakeholders are fully aware of them.

Mission Success

Recommendation

Management unambiguously emphasize the priority of mission success to “working level” personnel.

Assessment

Appropriate.

Observations

The IRB was positively impressed with the focus on Mission Success at all levels of the JWST project. Mission Success is clearly communicated and recognized as the top JWST priority. It is extremely important that this emphasis on Mission Success continue. The IRB believes that this need for continued emphasis is well recognized.

Mission Success

Recommendation

Employees must feel empowered to stop or slow down if the pace or procedures can jeopardize mission success.

Assessment

Appropriate.

Observations

Employees feeling empowered to stop or slow down if the pace or procedures can jeopardize mission success is critically important to eliminating mistakes and human errors. This empowerment is an important element of an effective mission success program. Examples were presented to the IRB that demonstrated that this "empowerment to stop or slow down" has been effectively implemented.

Mission Success

Recommendation

NASA assess “top ten” mission success enhancements (see following three charts) and implement where appropriate.

Assessment

Appropriate.

Observations

During the initial IRB review, NASA GSFC, NGAS and STScI were requested to develop a "Top Ten" list of items that would enhance mission success. Cost and schedule were not to be considered in developing the list. The resulting lists represented extraordinary items that were judged to be important contributors to JWST success. The JWST Project Office at GSFC led the effort to integrate the three lists and identify those items that were appropriate for implementation. Funding was provided and the selected items have been or are being implemented. The IRB believes this process has had the dual benefit of incorporating items that will positively impact JWST mission success and illustrating to all involved in the JWST Program the importance of mission success and the associated leadership support.

Responsible Design Engineer Role

Recommendation

RDEs be involved and responsible for their element through the successful commissioning of the observatory.

Assessment

Appropriate.

Observations

NGAS indicates that RDEs on JWST will remain available to support the project through commissioning. Their participation in pre-test and table top reviews is mandatory. Those RDEs previously released have been recalled. GSFC should also be commended for augmenting their parallel support of pre-test and table top reviews.

I&T Staff Adequacy

Recommendation

Augmentation of staff critically important to execute the I&T program.

Assessment

Appropriate.

Observations

NGAS has added staffing to its I&T workforce. Adding more RDEs has allowed for real-time decision making on the floor, whereas the RDE role was previously focused on design and test. Additional test experts are involved (e.g., two vibe test experts on call). Functional staff has undergone additional training and/or certification, as appropriate. GSFC has a larger engineering presence (i.e., between 7 and 40 people that cover multiple disciplines on any given day, depending on the activities – more oversight during testing) on-site at NGAS, and has incorporated more people on the floor for oversight (i.e., 1-2 senior managers).

NGAS has also been able to reduce the standard work schedule such that it is sustainable over the long duration of the I&T function.

Employee Morale

Recommendation

Augment I&T staff to achieve more realistic work schedules.

Assessment

Appropriate.

Observations

NGAS is currently working a two-shift/six-day per week schedule. However, the staffing has been augmented such that not everyone is working a consistent six-day per week schedule. The work schedule includes two full weekends off per month. NGAS has also started providing additional time off at holidays (e.g., two days at Thanksgiving, with plans to consider additional time off at Christmas).

The length of I&T is much longer than the normal duration for most civil space programs. It is important that NASA/NGAS continue to ensure this positive I&T staffing approach is sustainable.

The planning process has also been greatly improved to forecast the needs of personnel when performing activities.

Employee Morale

Recommendation

Implement strategies for improving team morale, such as periodic science lectures for NGAS personnel and families.

Assessment

Appropriate.

Observations

Reports from GSFC and NGAS leadership indicate that employee morale is significantly improved. Science lectures have been scheduled that include excellent speakers. The attention paid by NGAS management to engaging with staff on the importance of mission success and the mission's scientific purpose is highly responsive to the IRB recommendations.

Engagement of Science Working Group

Recommendation

Ensure consistent, sustained and meaningful engagement of SWG.

Assessment

Appropriate.

Observations

The IRB heard from the JWST Program Scientist about the improved efforts to engage the Science Working Group and keep them informed of mission status. IRB members also interviewed several SWG members. The consensus view is that the Program engagement with the SWG is greatly improved, and there is a high level of satisfaction with the regularity of the telecons and the efforts of the Project to keep the SWG apprised of technical progress and issues.

The SWG appreciates interactions with Project leadership (Project Manager, Project Systems Engineer etc.), and the IRB encourages continued engagement at this level. There is concern about the state and content of the communications plan, which appears to largely be a result of distributed responsibility at NASA Headquarters, and the degree to which the SWG has input. As noted under the “Communications Plan” recommendation, it is critically important to be actively engaging the entire science community and other stakeholders now, well before launch.

Engagement of Science Working Group

Recommendation

Appoint an executive committee of NASA-selected members of the SWG to act as conduits to broader community on mission challenges.

Assessment

Appropriate.

Observations

The Program leadership chose to include the entire SWG in detailed and sensitive communications about project status and challenges. This accomplishes the goal of the recommendation, and the Project is commended for its open communications with the entire SWG over the last few months.

Launch Date

Recommendation

The Webb IRB recommends the launch date be established as March 2021 (based upon the Project's 5/18 assessment of the impact of the membrane cover assembly acoustic anomaly).

Assessment

Appropriate with additional work needed.

Observations

Since the IRB's May 2018 assessment of JWST's launch date, the project has completed the MCA recovery plan and SCE vibration testing. The preparation and execution of the SCE vibration testing consumed more margin than expected by the IRB. It is the judgement of the IRB that the added time was warranted to ensure the successful completion of the SCE vibration test.

The Project has made a variety of improvements that positively impact schedule management going forward:

- Project has performed engineering audits, risk reduction testing, and established a Commissioning Manager to work risk mitigation in advance of and during I&T.
- OTIS and SCE had an earlier opportunity to coordinate for integration purposes (in parallel with recovery work vs. as part of I&T flow).
- Project has increased the presence of RDEs on the floor, which helps with real-time resolution of issues/potential issues (i.e., "decision makers") and overall work efficiency.
- GSFC has a larger engineering on-site staff at NGAS and has incorporated more people on the floor for oversight.
- Process documents have been updated to incorporate lessons learned and reduce process escapes.

Launch Date

Observations (cont'd)

- I&T training and certification has been implemented (i.e., approximately 1800 hours invested to modernize training and 5600 training hours completed).
- More participation of relevant personnel in table-top reviews.
- NASA and NGAS are promoting the theme of "ensuring mission success" by allowing flexibility for workforce to stop work pending any unclear processes or potential issues. Mitigating risks before they become problems generally results in less impact to the schedule.
- NASA Project Management is getting the help it needs from NASA senior management through more interaction in management communications (e.g., more meeting opportunities for NASA Project Management to interact with levels of senior management all the way up to the NASA AA).

Work Still Needed

The IRB has not repeated the May 2018 in-depth programmatic analysis. Because greater than planned schedule reserve has been utilized, the IRB recommends that the in-depth analysis be updated and the NASA management team and the SRB continue to closely monitor schedule and cost performance and programmatic risk.

Summary and Conclusion

- JWST is an observatory with incredible capability, awesome scientific potential and significant complexity, risk and first-time events.
- JWST has a demanding level of work yet to be accomplished requiring continuous focus on mission success.
- The Webb IRB report dated May 31, 2018 contains 32 recommendations intended to maximize the probability of JWST mission success.
- NASA, Northrop Grumman and the Space Telescope Science Institute have developed a response to the Webb IRB recommendations.
- The Webb IRB overarching observation is that the response is high quality and comprehensive.
- The responses to 29 of the 32 recommendations are assessed to be “Appropriate” or “Appropriate with additional work needed”.
- Three responses are judged to be “Inadequate”.
    - JWST Reporting (2 recommendations).
    - Mission Success Dependence on Launch Vehicle (1 recommendation).
- This concludes the Webb IRB activities. Any further review of JWST will be determined by NASA.
- The Webb IRB maintains its belief that JWST should continue based on its extraordinary scientific potential and critical role in maintaining U.S. civil space leadership.

APPENDICES

Terms of Reference
Acronyms
NASA Response

Terms of Reference

James Webb Space Telescope Independent Review Board

Recommendations Progress Review

Terms of Reference (ToR)

I. Background

On April 4, 2018, the James Webb Space Telescope (JWST) Independent Review Board (IRB), as per the ToR dated March 22, 2018, initiated an assessment of factors that influence JWST mission success. The IRB provided a report to NASA on May 31, 2018, with observations, findings, concerns, and recommendations. Based on this report and other input, NASA has begun implementing the recommendations and has approved a revised launch date of March 30, 2021. This ToR describes the expectations for the IRB to conduct a review of the JWST implementation plan of the IRB recommendations provided on May 31, 2018.

II. Terms of Reference

The JWST IRB will assess NASA's implementation of the IRB recommendations and document the results of its assessment in a non-consensus final report presentation.

III. Management

The convening authority for the JWST IRB is NASA's Science Mission Directorate (SMD) Associate Administrator (AA). As such, the IRB will report to the SMD AA. For consistency in review, the IRB shall be comprised of members from the original IRB membership convened in April 2018.

The SMD AA and the GSFC Director will assure the necessary support for the JWST IRB. The IRB Chair and the Review Manager will support all activities of the IRB and coordinate production and ensure the quality of review deliverables. The non-consensus final briefing will be verbally given to the SMD AA, GSFC Director, JWST program, JWST project, and other NASA stakeholders (e.g., NASA AA, OSMA, OCE, OCFO) followed by the provision of a non-consensus final report presentation with observations.

After completion of this task the JWST IRB review activities will be concluded. Any further reviews will be conducted by the JWST Standing Review Board, as deemed necessary by the JWST Program Director, or as part of the typical life cycle review schedule.

IV. Notional Schedule

The JWST IRB will conduct the assessment over a period of not more than a 4-week period from initial meeting to completion of the non-consensus final report. The assessment will start no later than the week of November 5, 2018 and a final report and briefing of the report provided to the SMD AA no later than the week of December 3, 2018. All meetings times will be pre-coordinated through the Review Manager.

Week #1	Meeting with Northrup Grumman (Redondo Beach, CA) Meeting with GSFC Project Office (Redondo Beach, CA) Meeting with NASA HQ (Washington DC)
Week #2	Develop and discuss draft observations for report; complete draft report
Week #3	Brief non-consensus final report to NASA HQ and GSFC.
Week #4	Prepare non-consensus final report; print and deliver to SMD AA

V. Deliverables

- Presentations to SMD AA, SMD AA, GSFC Director, JWST Program, JWST Project, and other NASA stakeholders summarizing the review results.
- Non-consensus final report presentation with observations.

Approved

8/15/18

Thomas Zurbuchen
Associate Administrator
Science Mission Directorate

Date

Acronyms

- AA – Associate Administrator
- ESA – European Space Agency
- GSFC – Goddard Space Flight Center
- I&T – Integration and Test
- IRB – Independent Review Board
- JWST – James Webb Space Telescope
- LSP – Launch Services Program
- MCA – Membrane Cover Assembly
- NGAS – Northrop Grumman Aerospace Systems
- OTIS – Optical Telescope element & Integrated Science instrument module
- RDE – Responsible Design Engineers
- SCE – SpaceCraft Element
- SMD – Science Mission Directorate
- SPF – Single Point Failure
- STScI – Space Telescope Science Institute
- SWG – Science Working Group
- TAYF – Test As You Fly

NASA Response to Webb IRB Assessment

National Aeronautics and
Space Administration

Headquarters
Washington, DC 20546-0001

Reply to Attn of: Science Mission Directorate February 28, 2019

NASA response to the Webb Independent Review Board recommendations implementation assessment

On February 8, 2019, the Webb Independent Review Board (IRB) provided their final briefing to NASA on their assessment of NASA's implementation of the recommendations from their report dated May 31, 2018. Of the 32 recommendations, the IRB deemed implementation of 21 of the recommendations as appropriate, 8 as appropriate with additional work needed, and 3 as inadequate.

Examples of appropriate implementation include enhancing the existing sunshield testbed/simulator that will allow the project to better assess potential problems in the flight sunshield deployment. Corrective actions have been taken to reduce the likelihood of human mistakes by improving processes and training, ensuring personnel certification is complete for complex or critical tasks, and ensuring individual accountability is stressed in the workplace. Another area deemed appropriate by the IRB included an extensive review of both closed and open risks, ensuring that the project fully understands and communicates risks as they move forward in the development phase. To better improve communication, a structuring of key meetings and participation to be more inclusive of all levels of management has been implemented to ensure that consistent and timely information is provided on technical and programmatic status, risks and issues.

NASA agrees with the additional work still needed for the eight items that were identified by the IRB, as they represented work planned but not completed at the time of review. Some examples include ensuring that the newly appointed JWST Commissioning Manager engages with experienced experts outside the project to incorporate any lessons learned to JWST on orbit commissioning. The JWST Project and Program are improving communication with the public and science community on current status, technical issues and accomplishments. The project and program will ensure that communication processes and protocols for pre-launch, launch and post-launch activities and products are clearly defined in the JWST communication plan. Also, an in-depth schedule risk assessment will be conducted within the next three months and reported to senior NASA management.

For the three areas that were deemed inadequate, the responses are provided below.

Recommendation: LSP [Launch Services Program] shall be accountable for JWST launch success at the same level of responsibility they have for U.S. launches, or NASA should contract with Aerospace Corporation for similar accountability.
Response: NASA does not believe that it is possible or prudent for LSP to be "accountable" for the Ariane 5 launch vehicle. The European Space Agency (ESA) and Centre National D'Etudes Spatiales (CNES) are the design and qualification authorities for the Ariane 5 launch vehicle and are the most appropriate organizations to ensure these activities are performed correctly; their managers, engineers and technicians are the experts for this launch vehicle. The Ariane 5 launch vehicle has a proven record, with 103 successful launches with only 2 catastrophic failures (the last of which occurred over 15 years ago).

The IRB recommendation has helped strengthen the partnership between NASA LSP and ESA's Ariane 5 Program. NASA and ESA have agreed to have LSP experts participate in specific technical activities to enhance NASA's insight into the qualification and monitoring of the Ariane 5 launcher. Senior Systems Engineers from LSP will participate in key ESA reviews to better understand the thoroughness of ESA's and CNES' decision logic related to the production of the launch vehicle for JWST. LSP will also review documents that define ESA and industry practices as well as specific analysis related to the JWST launcher. All of these activities will increase NASA's insight in the production and launch of the Ariane 5 vehicle that will launch JWST.

Recommendation: Implement JWST reporting structure as represented by accompanying diagram. (See diagram in JWST IRB Report, May 31, 2018).
Response: The governance model as described in the Nov 27, 2018, memo from the NASA Associate Administrator (AA), in response to the IRB recommendation, defines the most appropriate programmatic authorities for executing the JWST mission. This is consistent with the Agency governance model with programmatic authority and accountability held by the Science Mission Directorate (SMD) Associate Administrator. The AA has elevated reporting for key positions with the JWST Program Director reporting directly to the SMD AA and the JWST Project Manager reporting directly to the Goddard Space Flight Center (GSFC) Deputy Center Director. The AA is also ensuring that communications at all levels of JWST and NASA management are clear, continuous, consistent, and open, including weekly meetings with SMD and Goddard leadership, and the JWST Program Director and Project Manager.

Recommendation: Revise NASA policy directive consistent with recommendation.
Response: The governance model for JWST complies with the current NASA directive.

We want to thank the Board members for their thorough assessment and thoughtful consideration of all of the hard work by the JWST team to address the recommendations. We truly believe that mission success was enhanced by this activity. We all look forward to the day when the discoveries made by this incredible observatory will enrich our understanding of the universe.

Thomas H. Zurbuchen, Ph.D.
Associate Administer
NASA Science Mission Directorate

Stephen G. Jurczyk
Associate Administrator
National Aeronautics and Space Administration