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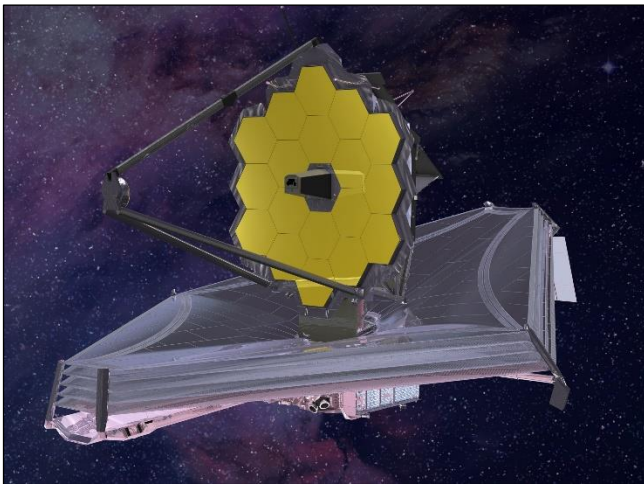
The James Webb Space Telescope

Introduction

The National Aeronautics and Space Administration (NASA) reported in March 2018 that it expects to breach the \$8 billion cost cap established by Congress for formulation and development of the James Webb Space Telescope (JWST). If that occurs, NASA would have to stop work on the project unless Congress enacts legislation authorizing it to continue. In addition, an independent review of JWST in May 2018 identified a number of technical and management challenges.

This CRS In Focus provides information on JWST, the cost cap, and the independent review. It concludes with a brief discussion of issues that Congress may face as it considers the future of JWST.

Figure 1. The James Webb Space Telescope.



Source: NASA.

Note: Artist's impression. Not yet launched.

What Is JWST?

NASA and its prime contractor, Northrop Grumman, are developing JWST as a successor to the Hubble Space Telescope, which has been operating since 1990. The main scientific goals of JWST are to study the formation of galaxies, stars, and planets. Unlike Hubble, which orbits the Earth at an altitude of 353 miles, JWST is designed to operate in deep space, about 1 million miles from Earth. Its primary mirror (the gold structure in **Figure 1**) is larger than Hubble's, and its instruments are optimized for infrared rather than visible light. This is expected to allow it to observe galaxies and other objects that are farther away and further back in time, as well as relatively cool objects such as protostars and protoplanetary disks. The likelihood of important scientific discoveries made JWST the highest-priority large project recommended by the National

Academy of Sciences 2001 decadal survey of astronomy and astrophysics.

Among the new technologies developed for JWST is a multilayer sunshield (the large flat structure in **Figure 1**) that is designed to fold up for launch and unfold in orbit to approximately the size of a tennis court. The sunshield is needed to protect the telescope optics and instruments from the heat of the sun, which would otherwise prevent effective infrared observations.

NASA plans to launch JWST in March 2021 on an Ariane 5 rocket, provided by the European Space Agency as an in-kind contribution to the project. The launch date has slipped several times. As recently as September 2017, the launch was expected to occur in October 2018.

The Cost Cap

When the National Academy of Sciences endorsed the project in 2001, it estimated that the total cost would be \$1 billion. After several years of project formulation work, NASA designated JWST as a development project in 2006. In FY2009, it formally committed to a baseline JWST budget and schedule with an estimated life-cycle cost of \$4.964 billion (including \$4.381 billion for formulation and development and \$582 million for operations) and a launch date in June 2014.

In October 2010, an independent review (known as the Casani report after its chair, John Casani of the Jet Propulsion Laboratory) concluded that these estimates were unachievable. In July 2011, the House Committee on Appropriations recommended cancelling JWST. NASA developed a revised plan for the project, with a life-cycle cost of \$8.835 billion and a launch date in FY2018. In November 2011, in the conference agreement on FY2012 appropriations, Congress approved continued funding, subject to a cap of \$8 billion on the cost of JWST formulation and development.

The cost cap appeared in the Consolidated and Further Continuing Appropriations Act, 2012 (P.L. 112-55) and has been repeated in annual appropriations acts ever since. The statutory language ties the \$8 billion cap to existing cost control requirements and procedures in 51 U.S.C. §30104. If the responsible NASA official determines that JWST's development cost is likely to exceed the cap, he or she must immediately notify the NASA Administrator; the Administrator must notify Congress within 15 days; and starting 18 months after Congress is notified, NASA must cease spending funds on the program, other than for termination costs, unless Congress enacts legislation that authorizes the program to continue.

The FY2012 appropriations conference report (H.Rept. 112-284) also mandated ongoing oversight of the JWST project by the Government Accountability Office (GAO), including annual reports on “key issues relating to program and risk management; achievement of cost and schedule goals; and program technical status.” As recently as December 2016, GAO found that “JWST is meeting its cost commitments despite technical and workforce challenges.” In December 2017, however, GAO testified that “funding available under the \$8 billion congressional cost cap ... may be inadequate,” and in February 2018 it reported that “JWST is still resolving technical challenges and work continues to take longer than planned to complete. As a result, the project is at risk of exceeding its \$8 billion formulation and development cost cap.”

On March 26, 2018, NASA notified Congress that JWST is likely to breach the cost cap.

The Independent Review Board

In early April 2018, the agency convened an Independent Review Board (IRB) to review the JWST project and evaluate factors influencing the likelihood of JWST’s mission success. The IRB was chaired by Tom Young, a leading aerospace executive, former president and chief operating officer of Martin Marietta, and former director of NASA’s Goddard Space Flight Center.

The IRB issued its report at the end of May 2018. It noted a number of JWST’s accomplishments, including the delivery of all flight hardware and the successful integration and testing of the optical telescope and science instrument module. It cited the development of the sunshield as a noteworthy “first” with no significant technological precedent. On the other hand, it identified serious risks in two phases of the project that are yet to be completed: the remainder of the integration and test phase before launch and the commissioning phase after launch, in which the spacecraft and sunshield are to be deployed.

The IRB recommended a launch date in March 2021 and identified five factors that have led to the delays since the 2011 re-plan:

- human errors, such as using an incorrect voltage during an electrical wiring test;
- embedded problems, i.e., problems with completed hardware that are not discovered until much later (for example, improperly installed fasteners inside the sunshield that came loose several months later during a vibration test);
- lack of experience with unique technologies such as the sunshield;
- excessive optimism; and
- systems complexity.

The IRB made 32 recommendations to address the challenges it identified. Despite those challenges, it advocated continuing the project to completion.

In June 2018, NASA responded to the IRB, indicating that it agreed with most of the IRB’s recommendations and “agreed with the intent” of the remainder. NASA has established March 2021 as the new launch date and now estimates a life-cycle cost of \$9.663 billion, including \$8.803 billion (\$803 million more than the cap) for formulation and development.

Issues for Congress

As Congress considers the future of the JWST project, it may face the following issues.

Authorize or Terminate?

If Congress decides that NASA should complete the development, launch, and operation of JWST, it would need to enact legislation authorizing the continuation of the project despite the breach of the cost cap. To avoid suspension of the project, this legislation would need to be enacted within 18 months of March 26, 2018, when NASA officially notified Congress about the likelihood of the cap being breached. Alternatively, if Congress decides to terminate the project, it may wish to make that decision before the 18 months expire, to minimize the further expenditure of funds on the project (although most of the \$8 billion capped amount has already been spent).

Recover Costs?

At a House hearing on July 25-26, 2018, Members and witnesses discussed the possibility of recovering some of JWST’s cost increases from the project’s prime contractor, Northrop Grumman. The JWST contract is a cost-plus contract, in which Northrop Grumman is reimbursed for the costs it incurs and receives award fees (its profit) based on performance. NASA Administrator Jim Bridenstine testified that the JWST award fees have already been reduced based on the contractor’s performance to date. Some Members suggested going further, such as asking Northrop Grumman to pay all costs in excess of the cap.

Oversight of IRB Recommendations

If Congress decides to allow NASA to complete JWST, it would likely wish to assess the ongoing implementation of the IRB’s recommendations by NASA and its contractors. In addition to hearings and other direct congressional oversight, this process could include continuing the regular monitoring of the project by GAO.

Effect on Other NASA Programs

If JWST is continued, the additional cost may result in less funding being available for other NASA activities, especially in FY2020 and FY2021. Which activities would be affected would ultimately depend on Congress’s decisions in appropriations legislation, but the NASA Administrator and others have suggested that slowing down work on the Wide-Field Infrared Survey Telescope (WFIRST), another large space telescope, would be a likely option. WFIRST was the highest-priority large project of the 2010 decadal survey. Its status was already a matter of debate before it was linked to the continuation of JWST. The Administration’s FY2019 budget proposed terminating WFIRST “due to its significant cost and higher priorities within NASA,” but the House and Senate appropriations bills for FY2019 would both continue funding it.

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