

**LCROSS LUNAR IMPACTOR -
PIONEERING RISK-TOLERANT EXPLORATION
IN A SEARCH FOR WATER ON THE MOON**

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ABSTRACT

The Lunar CRater Observation and Sensing Satellite (LCROSS) was launched with the Lunar Reconnaissance Orbiter (LRO) on June 18, 2009. While the scientific purpose of the LCROSS mission was to determine the presence of water-ice in a permanently-shadowed crater on the south pole of the moon, an equally important purpose was to be a pioneer for future low-cost, quick-turnaround NASA missions that could accept a higher-than-normal level of technical risk.

When LCROSS was selected by NASA's Exploration Systems Mission Directorate (ESMD), NASA Ames Research Center and its industry partner, Northrop-Grumman, initiated a spacecraft mission project two-years after its sister mission had started, with less than one-fifth the budget, that had to be completed in time to launch on the same launch vehicle. With a \$79M total cost cap (including operations and reserves) and 31-months until launch, LCROSS needed a game-changing approach to be successful.

LCROSS found that approach to be a ground-breaking combination of having NASA Class D mission status, in which a moderate-to-high risk of not achieving mission success was acceptable, and finding the right balance point between the inflexible elements of cost and schedule and the now-flexible element of technical capability. Using a novel risk assessment and management technique together with unusually candid and open relationships among project stakeholders, LCROSS found that the proven technical capabilities of true high-heritage hardware, existing Commercial Off-the-Shelf (COTS) instrumentation, LRO avionics designs, and simple ground support equipment would allow the project to launch on schedule, stay within budget, and achieve its water detection mission goals.

With the success of LCROSS, NASA demonstrated the potential for conducting high-value science missions at a fraction of the cost of traditional mission approaches.