NASA Advisory Council Recommendation

Technology Infusion in Small to Medium Class Science Missions
2014-02-04 (TIEC-01)

Recommendation:
The Council recommends that the Space Technology Mission Directorate (STMD) Associate Administrator and Science Mission Directorate (SMD) Associate Administrator engage with each other and their communities to determine how policies and procedures could be modified to allow the infusion of new mission-enabling and mission-enhancing technologies developed by Principal Investigators, STMD or others in small to medium class missions. Once appropriate policies and procedures have been defined, formulate an implementation plan that assures that the selection decision process is consistent with those policies and procedures.

Major Reasons for the Recommendation:
In highly competitive program solicitations, such as Discovery and Explorer, there is a disincentive to propose new technology because of the perceived risk. As a result, NASA may be missing an opportunity to leverage scientifically beneficial technology through small and medium science missions. In the long-term, this could erode NASA's scientific and technical capabilities. If the Agency wants to encourage and infuse appropriate new technologies in its small and medium class missions, it must develop a policy that provides a pathway to the inclusion of these technologies in the solicitation release.

Consequences of No Action on the Recommendation:
Erosion of NASA's science and technical capabilities.

NASA Response:
Although we understand and agree with its intent, NASA does not concur with the specificity of this recommendation. We believe the current policies, plans, and implementation strategies provide deliberate pathways for the inclusion of new and innovative technology for all mission classes. SMD and STMD work closely on technology investments for future missions through both competitive and strategic initiatives. In addition, SMD has specific technology programs in each of its science divisions that are funded through competitive solicitations to advance technology for future missions. SMD and STMD welcome the opportunity to brief the committees jointly or separately on the current policies and procedures that already support an aggressive effort for technology infusion activities into SMD's programs. The following elaborates in more detail the extent of current SMD technology investment activities within the Directorate and with other external partners.

In recent years SMD has increased its technology investments and its collaboration with STMD to help facilitate infusions of new, mission-enabling and mission-enhancing technologies for small- to medium-class missions. The Agency believes these actions have addressed many of the concerns raised by the Council. NASA believes its current policies on Discovery and

Explorer solicitations and selection adequately allow for the infusion of new technology and acceptance of associated risks at a level commensurate with the nature of those programs. The following are examples of technology infusion in recent Discovery and Explorer solicitations, as well as other efforts.

In Planetary Science, the 2010 Discovery solicitation included incentives to infuse advanced capabilities such as the NASA Evolutionary Xenon Thruster (NEXT) and the Advanced Stirling Radioisotope Generator (ASRG), and nearly 40% of the proposals received included at least one of the incentivized technologies. The Discovery 2014 solicitation is explicitly encouraging the use of new, mature technologies that have not yet been demonstrated in flight. Discovery is leveraging the STMD Technology Demonstration Mission (TDM) program offering cost cap incentives for the Deep Space Optical Communications (DSOC) system, the Deep Space Atomic Clock (DSAC), and the Heatshield for Extreme Entry Environment Technology (HEEET). NEXT Thrusters and DSOC are being offered as Government-Furnished Equipment (GFE) to proposal teams, with any technical risk for readiness borne by NASA. Advanced Solar Arrays and Green Propellant technologies are being treated as mature commercial technology from proven vendors for purposes of proposal evaluation. Proposers will also be invited to include highly innovative technology demonstrations that will not add penalties for inherent technical risks. On the instrument side for competed missions nearly all the instrumentation leverages new technology. First and foremost missions are judged by the science merit of the measurements and investigations. Often the most compelling science requires, and we select, innovative technology to make the measurements. For example, on the Mars 2020 rover most if not all of the instruments will be flying new and compelling technology, i.e. Raman spectroscopy flying for the first time on a Mars mission.

Similarly in the Astrophysics and Heliophysics Divisions, the Explorers program benefits from an effective technology value chain that identifies technology gaps, mitigates those gaps through technology development solicitations, and subsequently makes use of suborbital experiments to mature technologies in preparation for use on Explorer-class missions. The Astrophysics Division is also partnering with STMD to invest in and infuse targeted technologies, including the Astrophysics Focused Telescope Assets (AFTA) coronagraph, thin-film physics/optical coatings, and others. Successful technology infusions include the development of a superconducting bolometer that was deployed on the second Background Imaging of Cosmic Extragalactic Polarization (BICEP2) experiment in Antarctica, and the REgolith X-ray Imaging Spectrometer (REXIS) instrument scheduled to fly on the Origins-Spectral Interpretation-Resource Identification-Security-Regolith Explorer (OSIRIS-Rex) mission is making use of technology developed through earlier Astrophysics technology solicitations. The slumped-glass mirror segments for the Nuclear Spectroscopic Telescope Array (NuSTAR) Explorer mission were made possible through technology investments under the Physics of the Cosmos program. In Heliophysics, the legacy Reuven Ramaty High Energy Solar Spectroscopic Imager (RHESSI) and the EUV Variability Experiment on the Solar Dynamics Observatory (SDO-EVE) both made extensive use of suborbital assets to raise their instrument Technology Readiness Levels (TRLs) and retire risk. More recently the Heliophysics Low-Cost Access to Space (LCAS) program solicited the Heliophysics Technology and Instrument Development for Science (H-TIDeS) for science and/or technology investigations on suborbital or CubeSat platforms and state-of-the-art instrument technology development specifically for infusion on future missions.

In the Earth Science Division, the Earth System Science Pathfinder (ESSP) program has accommodated innovative, science-focused, low-to-moderate cost, small-to-medium sized missions. Current investments include the Cyclone Global Navigation Satellite System (CYGNSS), which will capture surface wind measurements from an unprecedented constellation of eight small satellites, and the Global Ecosystem Dynamics Investigation Lidar (GEDI), which will provide global high resolution observations of forest vertical structure. ESSP is also investing in technology maturation for a mission that will capture the time evolution of precipitation through a constellation of CubeSats. The Earth Science Technology Office (ESTO) regularly invests in mid-TRL technologies by aligning its portfolio of technology projects with future mission and measurement requirements. Since 1998 nearly 50 new instrument, component, or information technologies have been infused across multiple spacecraft missions. The ESTO annual reports (available at http://esto.nasa.gov/about_esto.html) are annual summaries of recent technology development efforts and their infusion into NASA missions.

NASA agrees that a proactive focus on technology development and demonstration is of critical importance, which is why our existing planning and policies specifically encourage innovation in our competed missions. We will continue to work within the existing framework to explore additional constructive opportunities within our respective budget constraints. Furthermore, NASA welcomes additional discussion on this topic that might further refine the existing policies and procedures. SMD and STMD welcome the opportunity to brief the committees jointly or separately on the current policies and procedures that already support an aggressive effort for technology infusion activities into SMD's programs, which if timed appropriately, could include the results of the 2014 Discovery solicitation and its pathfinder approach to infuse mature, yet un-flown technology into new missions.