National Aeronautics and Space Administration

NASA

EXPLORE SCIENCE

Summary of Recommendations and Findings from the SOFIA Reviews

Paul Hertz, Astrophysics Division Director, NASA HQ
Kartik Sheth, Program Scientist, NASA HQ

Background

- SOFIA became fully operational in 2014
- Completed its 5 year prime mission in 2019
- SOFIA was scheduled to be in the 2019 Senior Review with other Astrophysics Division missions, but Congressional appropriations language banned it from being put in the Senior Review.
- However, SOFIA needed to be reviewed as it had been 5 years since prime mission started, thus, it underwent 2 reviews.

SOFIA Operations and Maintenance Efficiency Review (SOMER) Executive Summary

- The SOMER team has concluded that fundamental changes in the management model, operational paradigm, and workforce construct are necessary to significantly improve flight-hour production and/or reduce program Operations and Maintenance (O&M) costs.
- SOFIA conducts safe flight operations. The O&M staff are dedicated professionals and the aircraft is well-maintained.
- Despite abundant funding, the program suffers from sub-optimal flight-hour production, historically low dispatch rates and is laden with unnecessary, and/or underutilized workforce.
- These inefficiencies encumber the program and originate from SOFIA senior management's failure to effectively transition its workforce and processes from a developmental program to an [Full Operational Capability] FOC model.

Flagship Mission Review (FMR) Executive Summary

(Slide 5 of 6 – rest of FMR executive summary slides in backup)

The recommendations are:

1. *Nurture a science-driven culture within the mission*
2. *Embrace change in operational approaches,*
3. *Emphasize completion of high priority science programs*
4. *Emphasize the collection of high quality data,*
5. *Maximize observing time at stratospheric altitudes,*
6. *Fly more southern hemisphere flights,*
7. *Transfer data products into the archive quickly,*
8. *Split aircraft operations from telescope/science operations,*
9. *Invoke HIRMES cost and schedule control, and*
10. *Focus on current science operations rather than future instrument development.*

NASA Response / Changes

1. NASA Ames will manage SOFIA with the focus on science and mission operations, as recommended by FMR.

   i. To facilitate implementing the FMR recommendations, NASA is converting SOFIA from a single-project-program to a project within the Astrophysics Strategic Missions Program.

   ii. The SOFIA project manager will develop a new project plan that includes metrics based on the FMR report. A basic set of science metrics proposed by the FMR are:
      i. # of science papers per year
      ii. Completion rate of approved high-priority programs
      iii. % of complete high-priority programs resulting in at least one science pub
      iv. H-index
      v. % of level 3 data to archive in 15 days
      vi. % of level 2 data to archive in 30 days

FMR noted: "*... [these metrics] should form the basis for a more extensive set that include standard metrics such as oversubscription rate, number of investigators, number of new investigators, number of citations to refereed papers, amount of data downloaded from the archive, number of scientific press releases, etc.*"

NASA Response / Changes

2. Ames is directly engaged with AFRC in identifying new operational procedures.
3. HQ expectation that SOFIA will be operating at a higher cadence and higher science productivity by no later than the end of CY 2019.

BACKUP

SOMÉR & S5YFMR (FMR)

- SOFIA Aircraft & Operations Maintenance Reviews (SOMER) - primarily looked at aircraft operations and maintenance - chaired by Shane Dover (Chief of Aircraft Operations, NASA LaRC)
- SOFIA Five Year Flagship Mission Review (S5YFMR) - primarily looked at science and mission operations - chaired by Dr. Ken Sembach (Director, Space Telescope Science Institute, Baltimore MD)
    - *See presentation by K. Sheth at Oct 2018 APAC meeting*
- Like all other SMD missions in extended missions phase, we anticipate reviewing SOFIA triennially to determine whether it continues to be scientifically productive and to improve its science productivity and community value.

SOMER Timeline

- Sep 26, 2018: Terms of Reference issued
- Oct 4, 2018: Introductory telecon of panel
- Oct 11-12, 2018: Site visit by SOMER panel to AFRC
- Dec 18, 2018: SOMER panel meets at HQ

Dec 22-Jan 25: Government Shutdown (5 weeks)

- Apr 22, 2019: Final report of SOMER delivered to HQ
- May 10-13, 2019: AFRC, ARC, SOFIA responses to HQ

Throughout the review period, the SOMER Executive Secretary, Mr. Elbert "Lucien" Cox, collected and forwarded 76 specific Requests for Information (RFIs) to the SOFIA team. SOMER recommendations were generated through: the auditing of programmatic data, budgetary analysis, operational modeling, as well as personnel interviews with SOFIA maintenance personnel, operations personnel, and the program's management team. The SOMER panel used private-sector and other governmental aircraft operators for benchmarking and comparative analysis.

SOMER Membership

1. **Shane Dover (Chair), Chief of Flight Operations, NASA Langley**
2. Carol Carroll, Program Operations, NASA ARC Deputy Director
3. Thomas Decher*, Operations, Special Mission Aircraft Services, Lufthansa
4. Matt Elder, Research Pilot / Aircraft Operations, NASA Langley
5. Christy Hansen*, Program Management, Airborne Science Ops, NASA GSFC
6. Andy Roberts, Government & Commercial Management of Aircraft Operations & Maintenance, BAERI
7. Mihailo Rutovic, Aircraft Ops, Program Management, Engineering, NASA JSC
8. Rick Shetter, Aircraft Operations for Science, BAERI
9. Bruce Tagg, Agency Strategic Management of Airborne Science, NASA HQ
10. Mike Thompson, Airborne Program, NASA AFRC
11. Burkard Wigger, Fleet-management, Flight-operations, Airworthiness & Maintenance Management, DLR
12. Elbert (Lucien) Cox, Executive Secretary, SOFIA PE, NASA HQ

* *served only through site visit*

SOMER Specific Recommendations for Improvement

Based upon a detailed analysis of identified issues, the SOMER has made specific recommendations for improvement in three major areas:

Management

1. Transition SOFIA aircraft operations away from an integrated astrophysics program into an existing independent aircraft management model - such as SMD's Airborne Science Program (ASP) - in order to leverage aircraft operations expertise.
2. Consider issuing a Request for Information (RFI) on the feasibility of a Government-Owned Contractor-Operated (GOCO) mode of operations.
3. Re-establish firm operational metrics and regularly measure SOFIA performance against them.

SOMER Specific Recommendations for Improvement

Operations

4. Reduce flight profiles to 8 hour flights, improving safety posture, dispatch rate, scheduling flexibility and increasing the percentage of aircraft time at high-value altitudes.
5. Schedule 6 flights per week, which would directly correlate to an increased number of total flights per year.
6. Adjust aircrew mission briefing, pre-flight, and post-flight duty periods to shorten the overall crew duty day, improving crew turn-around times and maximizing maintenance touch-time.
7. Manage the number of instrument changes to allow for more aggressive aircraft scheduling.

SOMER Specific Recommendations for Improvement

Operations

8. Dedicate assigned aircrew to a primary SOFIA role (limit to two total aircraft qualifications of similar category on a not-to-interfere basis) which would decrease scheduling complexity and reduce the overall pilot training requirements, both in time and cost.
9. Incorporate exchange aircrew support from DLR to improve operational diversity and add unique experience/thought processes.

Workforce

10. Reduce/reassign full-time O&M workforce in specified areas (such as engineering, inspection, technicians, flight safety and aircrew) decreasing extraneous program costs.

FMR Timeline

- Nov 19, 2018: Terms of Reference issued
- Dec 19, 2018: Panel appointed (some changes in Jan/Feb)
- Feb, 2019: Two members of FMR fly on SOFIA *(all offered option to fly; some already familiar with SOFIA ops)*
- Mar 4, 2019: Introductory telecon of FMR panel
- Mar-May, 2019: RFIs requested (four separate requests)
- Apr 17, 2019: FMR reviews SOFIA Instrumentation (webex)
- Apr 22, 2019: FMR hears the SOMER Exec Summary & Recommendations (same as here)
- Apr 24-25, 2019: Site visit by FMR panel to ARC
- May 31, 2019: Debrief to SOFIA from FMR panel
- Jun 7, 2019: Final FMR report shared w/ all stakeholders

FMR Panel

1. **Kenneth Sembach, Chair (Space Telescope Science Institute)**
2. Laura Ferrarese (National Research Council of Canada / Herzberg Astrophysics)
3. Phil Jewell (National Radio Astronomy Observatory)
4. Oliver Krause (Max-Planck-Institut für Astronomie, DLR-appointed)
5. Sangeeta Malhotra (Goddard Space Flight Center)
6. Rick Shetter (BAERI, SOMER panel member)
7. Matthias Steinmetz (Leibniz Institute for Astrophysics Potsdam, DLR-appointed)
8. Lisa Storrie-Lombardi (Caltech / Jet Propulsion Laboratory)
9. Lou Strolger (Space Telescope Science Institute)
10. Burkard Wigger (DLR, SOMER panel member)
11. Belinda Wilkes (Smithsonian Astrophysical Observatory)
12. Kartik Sheth (NASA HQ), SOFIA PS, Executive Secretary

FMR Executive Summary (Slide 1 of 6)

- *SOFIA observations to date have resulted in 144 science publications in the peer reviewed astronomical literature. These publications have been cited 1836 times, with an observatory h-index value of 22.*
- *The working relationship between NASA and DLR appears to be both productive and collegial. Both partners have a vested interest in the future of SOFIA.*
- *Science productivity has increased over the past few years, but falls short of that expected by the science community for a flagship mission with an annual operating cost to NASA of approximately $86M per year.*

FMR Executive Summary (Slide 2 of 6)

- *Bold vision and transformative change are needed to take SOFIA to the next level and strengthen its role as a general-purpose flagship-class observatory that takes full advantage of its observational capabilities.*
- *The mission would benefit greatly from a paradigm shift in aircraft operations, a substantial increase in flight hours at stratospheric altitudes, implementation of ambitious observing programs that have lasting archival legacy value, and aggressive pursuit of science synergies with ground-based observatories and other missions in NASA's astrophysics portfolio.*

FMR Executive Summary (Slide 3 of 6)

- *More science would result by focusing efforts on extracting the latent science potential of existing instruments and developing data archive tools than from development of new instruments beyond those already underway (e.g., HIRMES).*
- *There is also need for a clearer, more focused role for SOFIA Science Mission Operations and a relentless commitment to moving the mission forward with science at the forefront of decision making in the next few years.*
- *A stronger sense of urgency within SOFIA leadership is essential to set the course for the future.*

FMR Executive Summary (Slide 4 of 6)

- *We offer ten recommendations aimed at improving SOFIA's science return, with the expectation that NASA and the SOFIA project will find ways to implement these recommendations in a cost neutral fashion, without additional funding needed beyond the in-guide profile for FY20-22.*

FMR Executive Summary (Slide 5 of 6)

The recommendations are:

1. *Nurture a science-driven culture within the mission*
2. *Embrace change in operational approaches,*
3. *Emphasize completion of high priority science programs*
4. *Emphasize the collection of high quality data,*
5. *Maximize observing time at stratospheric altitudes,*
6. *Fly more southern hemisphere flights,*
7. *Transfer data products into the archive quickly,*
8. *Split aircraft operations from telescope/science operations,*
9. *Invoke HIRMES cost and schedule control, and*
10. *Focus on current science operations rather than future instrument development.*

FMR Executive Summary (Slide 6 of 6)

- *For each recommendation there is an accompanying set of actions that we believe would promote mission success.*
- *We also recommend that SOFIA use a robust set of metrics appropriate for a flagship mission in its prime mission at full operational capability to judge scientific productivity, mission progress, and future viability.*
- *A core set of metrics is provided in this report to use as the starting point for discussions of the complete set to be developed.*