# Space Mission Digital Target of Preservation Proforma (DTOPP) Checklist

## Introduction

This document provides a checklist for a space mission, program, or project (hereafter referred to as simply “mission”) to document the policy which is implemented by that mission’s program/project management concerning what data is important enough to be preserved in the long term[[1]](#footnote-1), past the “event horizon” of system/software obsolescence. Proforma means the conventional business communications [definition](https://dictionary.cambridge.org/us/dictionary/english/pro-forma); an example to show how other documents of the same type should be written or prepared.

This DTOPP Checklist is an example intended to be used generally by an organization to tell the mission participants (stakeholders, customers, contractors, subcontractors, etc.) which digital data under this space mission program/project should be prepared for long-term preservation. For example, when a certain data type is identified as a preservation target, subcontractors will know that they shall preserve adequate metadata or executable application software so that the data will be retrievable and understandable in the long term. Basically, this checklist is a coordination tool to ensure that ***failures*** to preserve mission products and information are made by a conscious choice of the mission management rather than by oversight.

The intention is that program management for the mission, in concert with their legal counsel and records manager, will establish this list during the pre-phase A (earliest) stage of the program, and will indicate by checkmarks the types of data that they expect to be preserved throughout the mission, and after mission termination. Concurrently, program management will then know what funding and resources to establish for the gathering of metadata, establishment of migration strategy, or arrangements for long-term hosting of applications as long as the object data is intended to be retrievable. It will also cause management to address funding and planning strategies for turnover of long-term preservation object data to post-mission establishments (organization CIO, national archives, etc.) for long term preservation of that object data after mission termination.

This DTOPP Checklist is formatted in a manner and in a sufficient level of detail that missions can use as attachments for contracts and other program/project management vehicles. If a mission finds portions of the checklist unsuitable, the CCSDS Data Archive Interoperability (DAI) Working Group (WG) welcomes participation and inputs to improve the Space Mission DTOPP Checklist for later use and for other missions. This entire section, including this introductory material, should be included in mission documentation so that mission participants will understand the purpose, motivation and value of the DTOPP Checklist. A word-processing document (docx) is available on the CCSDS website, with easily “checkable” items; it can be used as a template for your specific mission. Once management decides what to preserve, it should distributed to the team in write-protected format, and included as an attachment to contracts.

## Space Mission DTOPP Checklist Form

Annex to *Information Preservation to Enable Long Term Use* (CCSDS 6NN…)

Mission Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Company/Agency: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Contract (if applicable): \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

## Level 1 statement (Chose one):

This organization/mission chooses to enact long-term digital preservation for the valuable products of this mission as described below in the level 2 and 3 statements.

Proceed to Level 2.

This organization/mission chooses to not enact long-term digital preservation for any data associated with this mission because no products of this mission will be of value to stakeholders, the public, or future mission developers after this mission terminates. No further completion of this form is needed. NOTE: Please consult legal counsel and records management before checking this box.

## Level 2 statement: (Choose all applicable)

|  |  |
| --- | --- |
|  | Data Type |
|  | 1.5.1 Spacecraft-originated Science Telemetry |
|  | 1.5.2 Other Science Data Products |
|  | 1.5.3 Ground-originated Science Data |
|  | 1.5.4 Spacecraft originated Systems Telemetry |
|  | 1.5.5 Ground-originated Systems Data |
|  | 1.5.6 Spacecraft Engineering Data |
|  | 1.5.7 Test Article Engineering Data |
|  | 1.5.8 Spacecraft Design Data |
|  | 1.5.9 Spacecraft Operations Data |
|  | 1.5.10 Mission Program/Project Data (budget, schedule, etc.) |
|  | 1.5.11 Additional data types unique to this program/project (expand for your project) |

## Level 3 statement (Choose all applicable)

To reiterate, this proforma checklist is intended to be an example. It is essential that program and project management for space missions should clearly identify what digital assets and data are necessary to preserve the mission products in the long term, after the operational mission ground systems are obsolete. This form can be modified by a program/project to utilize program-specific terms and definitions. However, as a reminder, those program-specific terms and definitions need to be documented in order for later personnel (not involved in the mission) and later systems (newly developed systems) to recover and use the mission products.

### Spacecraft-originated Science Telemetry

Interpretation of the below list requires understanding of conventional definitions of Level 0, 1 and 2 telemetry processing. For the purposes of this generalized list, we have adopted these definitions:

* In level 0 processing, duplicate data are removed from the data stream, data are time ordered, and data quality and accounting summaries are appended.
* In level 1 processing, the data are separated out by instrument and each instrument data set is formatted to meet the requirements of that data set and team.
* Level 2 processing includes such operations as application of calibration data and detector response maps, organization of data into appropriate energy and time bins, and application of ancillary data.

Note that Systems telemetry addressed below in 1.5.4 may include the science telemetry if it is archived as the original intact telemetry stream. It is broken out here separately because some science facilities may only archive the science telemetry after separation from systems telemetry.

|  |  |  |
| --- | --- | --- |
|  | Data Type | |
|  | Raw Telemetry Data recorded as a stream (requires products below for interpretation) | |
|  | Level 0 Telemetry Products | |
|  | Science Telemetry through Level 2 processing |
|  | Associated major/minor frame and channel structure definitions |
|  |  |
|  |  |
|  | Level 1 Telemetry Products | |
|  | Science Telemetry through Level 1 processing |
|  | Position, altitude and spin phase of the spacecraft |
|  | Command history and comments |
|  | Calibration of the spacecraft clock |
|  |  |
|  |  |
|  | Level 2 Telemetry Products | |
|  | Calibration algorithms for all parameters |
|  |  |
|  |  |
|  | Ancillary data | |
|  | Data Dictionaries, XML Schema, Schematron validation files (or equivalent) | |
|  | Human language terms and definitions | |
|  | Representative onboard computer dumps | |
|  | Select spacecraft telemetry system and instrument design information that informs interpretation of the telemetry | |

### Other Science Data Products

Interpretation of the below list requires understanding of Science Data Processing of raw data in analytical formats. The conventional definition for raw data is reconstructed, unprocessed instrument and payload data at full resolution, with any and all communications artifacts (e.g., synchronization frames, communications headers, duplicate data) removed.

|  |  |  |
| --- | --- | --- |
|  | Data Type | |
|  | Science data: The data to be preserved, for example an image from a camera or a time series from a magnetometer. | |
|  | Raw data (in analytical formats) |
|  | Calibrated data (reversible and non-reversible) |
|  | Higher-order results (photometry, maps, shape models, production rates, etc.) |
|  | Calibration data: The data (flat fields, dark current, sky images, cross-talk etc.) needed to perform the calibration of the science data. | |
|  | Calibration documentation: The documentation which describes the process and algorithms applied during the calibration of the science data. | |
|  | Geometry data: The data needed to orient the science data. | |
|  | Attitude and pointing |
|  | Target ephemerides |
|  | Correlation of data structure to pointing (e.g., FITS WCS) |
|  | Context Information: Additional data from the ***spacecraft*** about the spacecraft’s environment within which the data were collected. | |

### Ground-originated Science Data products

This data type originates on the ground. It may be a science data product, or other ground-originated data required to interpret the telemetry from the spacecraft.

|  |  |
| --- | --- |
|  | Data Type |
|  | Uplink data, including commands and command sequences that are ground originated. |
|  | Command history in database format |
|  | Context Information: Additional data from ***ground sources*** about the environment within which the data were collected. |
|  | Investigation - The mission or project managing the collection of the science data |
|  | Observing System - The spacecraft and/or other platforms on which the instrument was mounted. |
|  | Instrument - The identification of the instrument used to collect the science data |
|  | Target - The object(s) from or for which the science data were collected. |
|  | Facility - A site or institution involved in the collection of the science data or institutions that could have made decisions that affected the quality of the data and documentation being deposited |
|  | Provenance information - observing logs, hardware descriptions, archive plans, etc. |
|  | High-level introductory documentation - Documents that support the scientific use of the science data. |
|  | Specifications and Standards (including version number) that the science data was intended to comply with. |
|  | Other Documentation: Information about understanding how the data were produced or are to be used. |

### Spacecraft originated Systems Telemetry

These are the data products received from the spacecraft, primarily traditional telemetry, but could also include “session traffic” for internet protocol transactions. This may also include the science telemetry which is also included in the first section above, if they are archived in an intact stream as received from the spacecraft.

|  |  |  |
| --- | --- | --- |
|  | Data Type | |
|  | Raw Telemetry Data | |
|  | Level 0 Telemetry Products | |
|  | Associated major/minor frame and channel structure definitions |
|  |  |
|  |  |
|  |  |
|  | Level 1 Telemetry Products | |
|  | Position, altitude and spin phase of the spacecraft |
|  | Command history and comments |
|  | Calibration of the spacecraft clock |
|  |  |
|  |  |
|  | Level 2 Telemetry Products | |
|  | Calibration algorithms for all parameters |
|  |  |
|  |  |
|  | Command history and comments | |
|  | Ancillary data | |
|  | Data Dictionaries, XML Schema, Schematron validation files (or equivalent) | |
|  | Human language terms and definitions | |
|  | Representative onboard computer dumps | |
|  | Select spacecraft telemetry system and instrument design information | |

### Ground-originated Systems Data

This data type originates on the ground, but is required to interpret the products from the spacecraft as well as the performance and history of the spacecraft design and operations.

|  |  |
| --- | --- |
|  | Data Type |
|  | Uplink data, including commands and command sequences that are ground originated. |
|  | Command history in database format |
|  | Spacecraft observations from ground assets |
|  | Telemetry and data from ground communications system that provide information about the status of the transport of the spacecraft data to the archive. |
|  | Context Information: Additional data from ***ground sources*** about the environment within which the data were collected. |
|  | Onboard systems design/descriptions as needed to interpret the systems telemetry. |
|  | Onboard systems design documentation |
|  | Provenance information - observing logs, hardware descriptions, archive plans, etc. |
|  | High-level introductory documentation - Documents that support the scientific use of the science data. |
|  | Specifications and Standards (including version number) that the science data was intended to comply with. |
|  | Other Documentation: Information about understanding how the data were produced or are to be used. |
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### Spacecraft Operations Data

These data types are operational products that can be valuable for organizations to analyse to improve future missions or to analyse products from this mission, when not already covered above.

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| --- | --- | --- |
|  | Data Type | |
|  | Flight rules setting boundaries for safely and effectively operating the spacecraft | |
|  | Procedures for operating, maintaining and troubleshooting everything aboard | |
|  | Lists of in-flight anomalies, their causes and their solutions | |
|  | Logistics: materials, their properties and their locations. Logistics process descriptions. | |
|  | Lists and descriptions authorizing configuration changes | |
|  | Resource plans | |
|  | Activity schedules | |
|  | Robotic timelines |
|  | Ground-operated onboard activity schedules |
|  | Ground activity schedules |
|  | Inter-team communications covering the negotiations through the above topics | |
|  | Commercial Proprietary data that is protected and the methods (keys) to decrypt it. | |
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### Human-Crewed Vehicle Unique Data

Discussions of the International Space Station program illuminated some special needs for a crewed vehicle. In particular, for a ***long-term*** crewed vehicle, these items may be important to mission planners that are looking forward to surface colonies, etc.

|  |  |  |
| --- | --- | --- |
|  | Data Type | |
|  | State of the vehicle as it changes over time (crew- and ground-initiated changes) | |
|  | Software configuration lessons learned for non-vehicle devices (tablets, etc.) | |
|  | Activity Schedules | |
|  | Crew timelines (an addition to the uncrewed activity schedules in prior table) |
|  | Medical Privacy data that is protected, and the methods (keys) to decrypt it. | |
|  | Scientific results of experiments in long-duration human spaceflight. | |
|  | Management lessons learned in long-duration human spaceflight. | |
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### Other data types not yet expanded

There are a number of other data types that Mission Managers/Planners should consider as targets of long-term preservation. However, this SDO has not yet found volunteer authors with real mission experience to expand them yet. One check box is provided for that data type, so managers can indicate a general plan to reserve that data type. A future version of this document will hopefully expand them each of these data types to the section numbers indicated, with inputs from mission users.

|  |  |
| --- | --- |
|  | Spacecraft Engineering Data |
|  | Test Article Engineering Data |
|  | Spacecraft Design Data |
|  | Mission Program/Project Data (budget, schedule, etc.) |
|  | Additional data types unique to this program/project (expand for your project) |

1. Definition of “Long Term” from OAIS (CCSDS standard [**650.0-M-2**](https://public.ccsds.org/Pubs/650x0m2.pdf)): A period of time long enough for there to be concern about the impacts of changing technologies, including support for new media and data formats, and of a changing Designated Community or changes to the Designated Community’s Knowledge Base, on the information being held in an OAIS. This period extends into the indefinite future.” [↑](#footnote-ref-1)