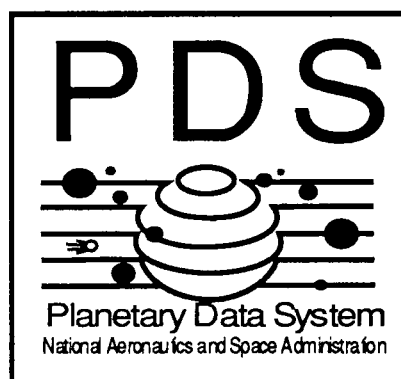


JPL D-7669, Part 1

Planetary Data System Data Preparation Workbook

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Version 3.0



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Chapter 1

Introduction

1.1 Purpose

This PDS Data Preparation Workbook (DPW) serves as a guide for the organization and preparation of data sets intended for submission to the Planetary Data System (PDS). This document describes procedures to be used for preparing an archive quality data set. The document is intended to be used in conjunction with the PDS Standards Reference and the Planetary Science Data Dictionary which contain specific PDS data preparation standards. The procedures provided in this volume reference the standards provided in the PDS Standards Reference. This document also describes tools that support the data preparation process that are available from PDS.

1.2 Audience

This Workbook is intended for scientists and engineers in the planetary science community who are in the process of, or are considering, submitting restored or new mission data sets to the PDS. The PDS has developed requirements and standards for data sets it will accept. The PDS standards ensure that the data it provides to users in the science community are complete, accurate, and easily accessible.

The PDS works with Flight Projects during all phases of the mission; before launch to help Flight Project personnel design data sets and data production systems, during the active mission to ingest new data sets, and after the active mission to ingest past data sets or newly derived data sets. The PDS also works with non-Flight Project personnel to restore old data sets and to develop new data standards. This manual is intended for all types of data suppliers and developers interfacing with the PDS.

1.3 Document Scope

The information included here constitutes Version 3.0 of the Planetary Data System data preparation procedures for producing archive quality data sets. These procedures, in conjunction with the standards provided in the PDS Standards Reference, supersede information given in the previous versions of this document.

1.4 Document Overview

This release of the PDS Data Preparation Workbook reflects a major revision over previous versions of this document. The document has been reorganized for ease of use. In addition, the requirements, standards, and procedures presented here reflect the most recent PDS updates.

The Workbook is organized by the steps involved in the data preparation and submission process. Chapter 2 provides the rationale for submitting data to the PDS. Chapter 3 provides an overview of the data preparation and submission process. The remaining chapters describe the steps of this

process in detail. Each chapter (beginning with Chapter 4) begins with a checklist outlining the steps described therein.

1.5 Related Documents

The following documents may be obtained from the PDS Operator (see Appendix A - Who to Contact).

Planetary Science Data Dictionary, D-6184
PDS Standards Reference D-7669, part 2
PDS Label Verifier User's Guide, D-8923
User's Guide for the PDS Label Generators, D-10265
PDS Toolbox Overview, D-10263
User's Guide for the PDS Simple Label Editor, D-9430
PDS Table Browser User's Guide, D-10264
PDS Toolbox Utilities User's Guide, D-9420
PDS Label Library User's Guide, D-9420

1.6 Overview of the PDS

The PDS was created by NASA to provide a cost-effective archive system for planetary data from both past and present planetary missions. Sponsored by NASA's Solar System Exploration Division (Code SL), PDS provides a system of organization and support that is designed to stimulate research, facilitate data access, and support correlative analysis. The PDS is based upon a widely distributed, electronically connected architecture which allows data sets to remain in the user community where they are most likely to be used and perpetuated, and where scientific expertise is available to assist the research scientist. The PDS is divided into several operational units (also known as Nodes) shown schematically in Figure 1. A Node is a service and research center funded for operation by the PDS.

1.6.1 The Central Node

The Central Node provides overall project management, coordinates and distributes data standards, and evaluates emerging technologies. It also coordinates data ingestion and restoration activities, provides an interface to planetary missions, provides tools for preparing and validating data, and maintains a central catalog system used for locating and ordering data sets. The Central Node resides at the Jet Propulsion Laboratory (JPL) in Pasadena, California.

The PDS Data Set Catalog provides users with information about the existence, availability, and location of planetary science data sets and ancillary information. It is accessible over the NSI/DECNET, NSI/INTERNET (TCP/IP), and dial-in connections. Users may be referred to or connected to a Data Product Catalog for additional information about a particular data set of interest.

Data Product Catalogs provide more detailed descriptions of individual data sets, and in some cases contain descriptive information down to the data product instance (e.g., an image). The user may order the data set or individual data products through the same catalog.

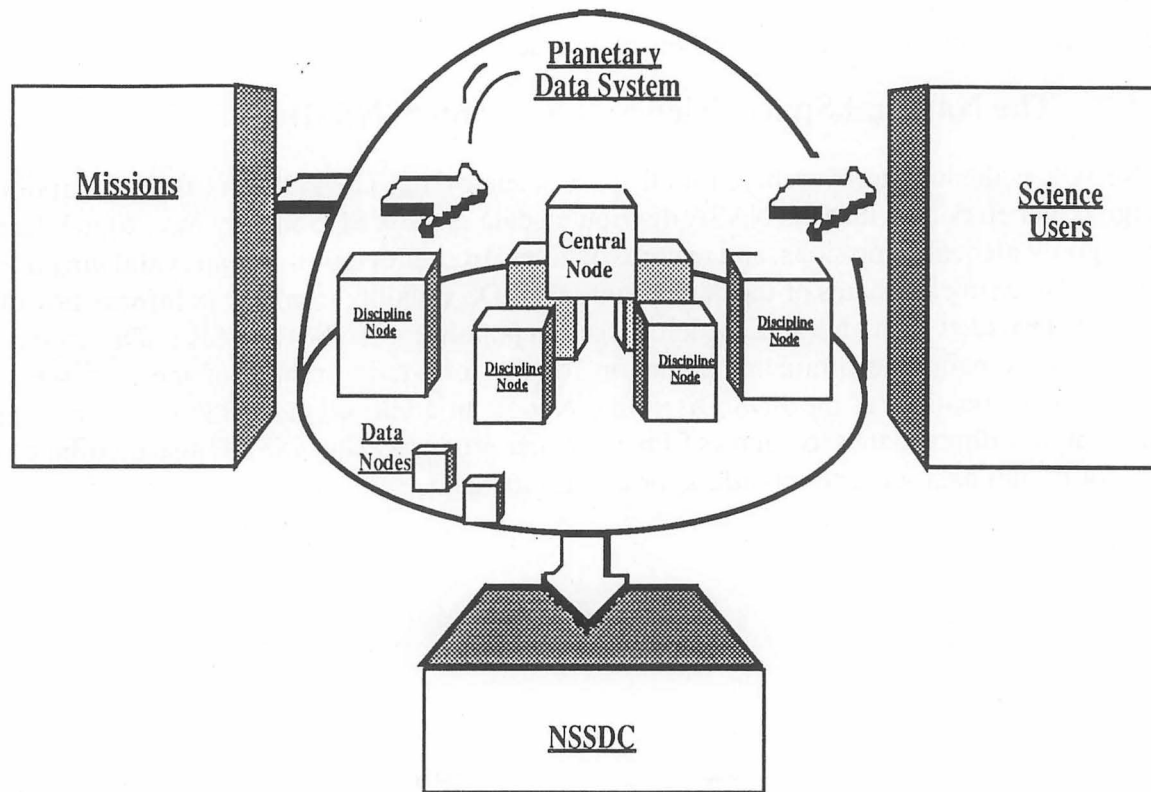


Figure 1: Schematic View of PDS

1.6.2 The Discipline Nodes

There are currently seven Discipline Nodes in the PDS located at institutions around the country, each having an expertise in a particular area of planetary science. These Nodes are listed below (see Appendix A, Who to Contact, for more information):

- Atmospheres (University of Colorado)
- Small Bodies (University of Maryland)
- Geosciences (Washington University, Missouri)
- Imaging (U.S. Geological Survey, Flagstaff, and JPL)
- Rings (Ames Research Center)
- Planetary Plasma Interactions (UCLA)
- Navigation and Ancillary Information Facility (JPL)

Each of the Discipline Nodes is responsible for curating data sets specific to its area of expertise. The Nodes also distribute these data to users in the science community. The nodes work with the Central Node, active flight missions, and data restorers in the various data ingestion and restoration activities. The Discipline Nodes also develop and make available methodologies and tools for examining discipline data and some retain data product catalogs of data sets located at their

particular institution.

Several Discipline Nodes provide electronic access to on-line data holdings and/or provide ordering mechanisms for receiving subsets of data sets.

1.6.3 The National Space Science Data Center (NSSDC)

The NSSDC is the long term archive for all space science data. The PDS acts as the point of entry for digital planetary data into the NASA distributed data system. PDS ingests new digital data sets from ongoing planetary missions, and restores data sets from previous missions, validating the data quality and entering attributes of the data set into the PDS Catalog. In addition, information on the data sets is provided to the NSSDC which is used to populate the NSSDC Master Directory.

The NSSDC remains the ultimate destination for the long-term archive of the data sets, with working copies residing at the PDS Discipline Nodes. In addition, the NSSDC will remain the archive for non-digital data sets such as film and paper products. The NSSDC also distributes bulk orders for digital data sets and all orders for non-digital data.

Chapter 2

Why Submit Data to the PDS?

As detailed in NASA Management Instruction 8030.3A, NASA seeks to make reduced data records and analyzed data records from space science flight experiments available on a timely basis for use by the scientific community. The plan for implementing this data transfer is to be documented in a Project Data Management Plan (PDMP). The NASA Space Science Data Center (NSSDC), as the central data disseminating repository for data obtained from space science flight investigations, is a signatory of the PDMP.

The Planetary Data System (PDS), in accordance with a Memorandum of Understanding between NSSDC and the PDS, serves as the point of entry for planetary data into the NASA distributed data system. As such, PDS is trying to do a better job of archiving, validating, cataloging, and distributing planetary science data than has been done in the past.

PDS hopes to obtain better and more uniform input from science teams and projects by providing:

- Data preparation requirements and standards -- These standards have been developed with the involvement of most of the disciplines of planetary science, and although some of the standards represent compromises, the advantage gained from uniformity is substantial.
- Catalogs -- Catalogs make it possible to find data that span discipline boundaries, and to undertake correlative studies across instruments, missions, and planets or other target bodies.
- Common nomenclature and data structures - The use of these standards means enhanced access to data and understanding of these data by the individual scientist.
- Tools -- Production tools for creating, labeling, and validating data sets for archive and analysis tools for displaying and manipulating data of interest for those who do not have intimate familiarity with the available data.
- Proven technology for archiving large volume data sets -- The PDS has pioneered the use of CD-ROMs to distribute large digital data sets.
- Data management expertise -- The PDS offers data management expertise to flight projects and researchers.

The PDS approach is the result of a realization by the planetary community that the data acquired in the past have great value; that the data may lose that value if not curated; and that large amounts of new data could suffer the same fate if a new approach is not devised. The support given to the PDS by NASA is a clear indication that experimenters are now expected to be involved with the new approach, and to make additional effort to provide their data in ways that ensure its long-term utility.

Chapter 3

The Data Preparation Process

This chapter provides an overview of the process of preparing and submitting data to the PDS. It provides a general description of the steps involved in preparing and submitting data. Subsequent chapters contain the detailed information for completing each of these steps.

There are six steps involved in preparing and submitting data to the PDS. These six steps are listed below. Subsequent chapters of this Workbook address each step in detail. The six steps are:

- PDS Orientation
- Archive Planning
- Archive Design
- Data Set Assembly and Validation
- Data Delivery Review
- Archive and Distribution

The steps to submit planetary science data to the PDS are similar whether data is being submitted from an active flight project, or data is being restored from past projects.

For active flight projects, the early participation of the PDS during the archive design phase allows the mission to utilize the expertise of PDS Discipline Node personnel who have worked with several Flight Projects in the past. In return, this participation allows the PDS to ensure that data sets produced later in the mission will be of archive quality. This cooperative development is cost-effective for both the Flight Project and PDS.

For restoring data sets, you will work closely with a PDS Discipline Node that is relevant to your planetary science discipline to request that your data set be submitted to PDS for archiving. See Chapter 10 for a discussion of data restoration.

Figure 2 shows the Flight Project time-line and the correlation between Project and PDS events.

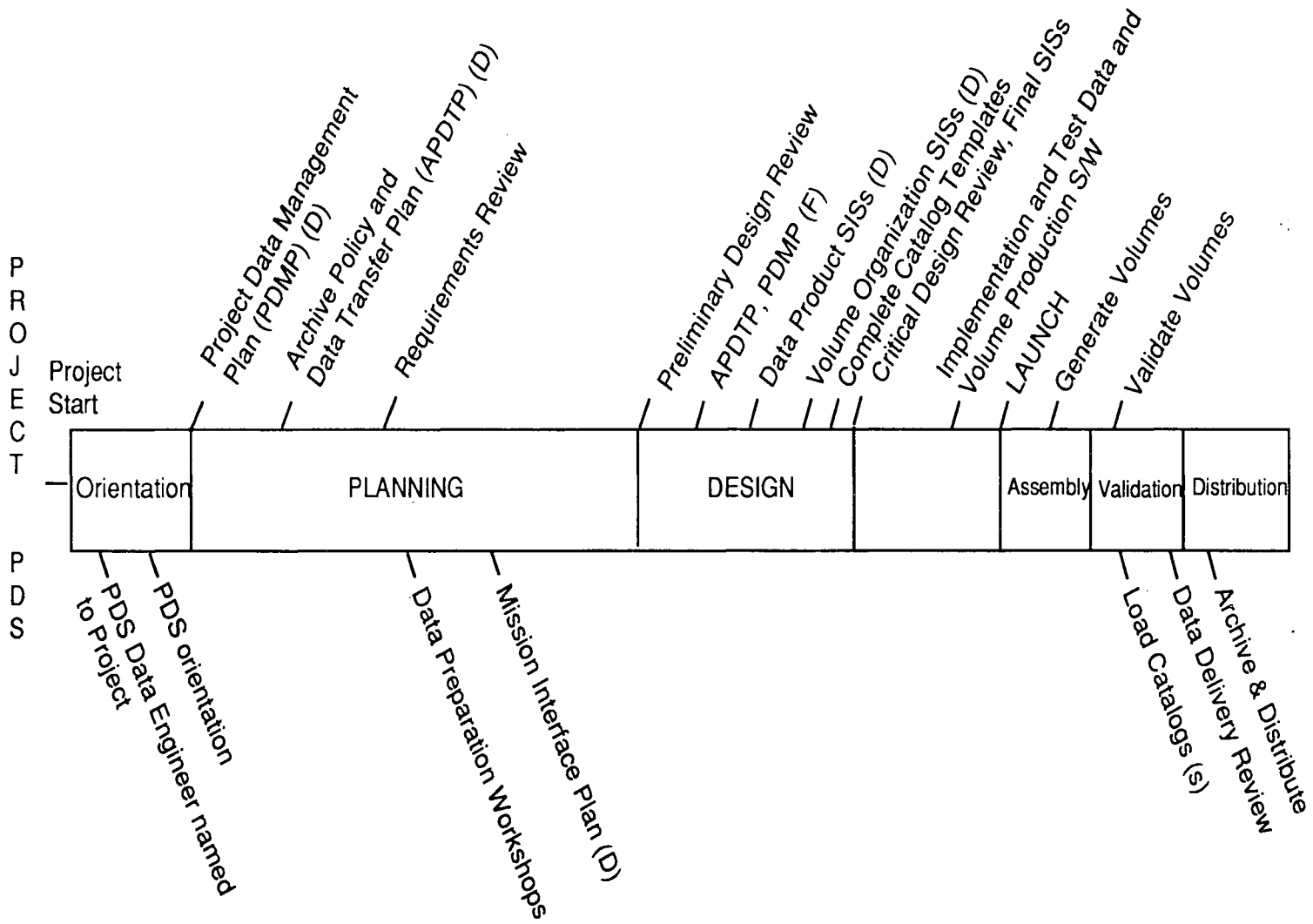


Figure 2

Chapter 4

PDS Orientation Checklist

- 4.1. Establish Contact with PDS Mission Products Manager
- 4.2. Provide High-level Information to the PDS
- 4.3. Attend PDS Orientation Meeting
- 4.4. Establish Technical Contacts

Chapter 4

PDS Orientation

This section describes the first phase of the archive process. During this phase, contact is established between PDS and project management and technical personnel, and high-level information is exchanged.

4.1 Establish Contact with PDS Mission Products Manager

The first point of contact with the PDS should be through the PDS Mission Products Manager (see Appendix A, Who to Contact). The Mission Products Manager oversees and coordinates the submission, ingestion, archival, and distribution of restored and active mission data.

4.2 Provide High-level Information to the PDS

The following information should be provided to the PDS Mission Products Manager:

- High-level Project description (including: mission description, types of instruments, science objectives, estimated volume of data to be archived)
- Major project milestones (launch date, encounter date, major project reviews)
- Project contact(s) for archive issues

4.3 Attend PDS Orientation Meeting

A PDS Orientation will be scheduled. At this orientation, you will be given an overview of the PDS, including a high-level description of the roles and responsibilities of the project, PDS Central Node, and PDS Discipline Nodes during the archive process.

You will obtain the Data Preparation Package, consisting of:

- PDS Standards Reference
- PDS Data Preparation Workbook (this document)
- Planetary Science Data Dictionary

You will also be given an overview and demo of the PDS tools that you may obtain. These tools, which are described in Appendix B, include:

- PDS Label Library
- PDS Label Verifier
- PDS Table Browser
- PDS Label Generators

User's Guides for these tools are available from the PDS Operator (see Appendix A, Who to Contact).

4.4. Establish Technical Contacts

The Mission Products Manager will identify a Central Node Data Engineer and the PDS Discipline Node or Nodes who will provide technical support to the mission or restoration archive task.

The project must also identify their management and technical contacts for archive issues at this time.

Generally, flight projects will establish teams (such as the Data and Archives Working Group on Mars Observer and the Data Product Working Group on Magellan) to address project-wide archive issues. These teams are chaired by members of the project's science community and consist of representatives from each instrument team, PDS representatives, and flight project engineers involved in data archive.

In addition, PDS may establish a team, called a Mission Interface Team (MIFT), which meets more frequently than the flight project team, and addresses some of the more detailed archive issues. The MIFT will consist of members of the PDS Central and Discipline Nodes, the NSSDC, and the flight project.

Chapter 5

Archive Planning Checklist

- 5.1. Prepare a Project Data Management Plan (PDMP)
- 5.2. Prepare an Archive Policy and Data Transfer Plan (APDTP)
- 5.3. Plan for Updates to the PDMP and APDTP
- 5.4. Keep the PDS Central Node Data Engineer Informed
- 5.5. Participate in Planning Meetings
- 5.6. Review/Sign off Mission Interface Plan

Chapter 5

Archive Planning

Archive planning consists of identification of the data to be archived, development of a detailed archive schedule, and definition of the data flow, roles, and responsibilities. This activity is generally more formal for an active flight project than for a data restoration.

5.1 Prepare a Project Data Management Plan (PDMP)

The Project Data Management Plan (PDMP), required for all missions by NASA, is a high-level description of the project data processing, cataloging, and communication plan. The PDS Project Manager has signature authority on this document.

- Obtain a copy of PDS Guidelines for Project Data Management Plans, JPL document D-5111 and a sample PDMP from the PDS Mission Products Manager.
- Provide a draft PDMP to PDS and NSSDC for review.
Note: PDS will provide assistance in developing the PDMP at the request of the Project.
- Resolve issues that come out of the document review.

5.2 Prepare an Archive Policy and Data Transfer Plan (APDTP)

The APDTP provides a detailed description of the production and delivery plans for archival products for a particular mission. The PDS Project Manager has signature authority on this document.

APDTP contents include:

- 1) List of proposed data sets for archive including a general description of the science content of each data set and a prioritization of data sets in terms of expected general science popularity for each data set.
- 2) Schedule of availability of data sets, keeping in mind:
 - In general, the PDS cannot accept proprietary data.
 - Project users of PDS data do not have priority over other PDS users even during an active mission, therefore, the Project may want to keep their own copies of certain data sets for a period of time.
 - All products do not need to have the same transfer schedule.
- 3) Storage medium, count, total size, processing level, etc., of each proposed data set.
- 4) Proposed data transfer mechanism.

- Obtain a sample Archive Policy and Data Transfer Plan (APDTP) from the PDS Central Node Data Engineer.
- Provide a draft APDTP to PDS and NSSDC for review.
- Resolve issues that come out of the document review.

5.3 Plan for Updates to the PDMP and APDTP

It is inevitable that changes will occur in the data set list during the mission. The PDS Central Node Data Engineer should be notified of these changes as soon as they occur. Changes include additions and deletions of products, changes in schedule, changes in quantity and changes in product content or format.

5.4 Keep the PDS Central Node Data Engineer Informed

Ensure that PDS Central Node Data Engineer is placed on all relevant Project distribution lists.

5.5 Participate in Planning Meetings

The PDS Central Node Data Engineer or Mission Interface Team (MIFT) leader will schedule regular planning meetings. During these meetings, data flow, roles and responsibilities will be clarified.

5.6 Review/Sign off Mission Interface Plan

A Mission Interface Plan will be written by the PDS Central Node Data Engineer or other member of the Mission Interface Team. Upon receipt, review/sign this document, or bring issues for discussion to the planning meetings. The Mission Interface Plan establishes roles and responsibilities for PDS Central and Discipline Nodes, NSSDC, and the mission teams.

Chapter 6

Archive Design Checklist

- 6.1** **Become familiar with PDS Standards**
- 6.2** **Data Product and Label Design**
 - 6.2.1 Define the Data Product
 - 6.2.2 Estimate File Sizes
 - 6.2.3 Determine the Data Format
 - 6.2.4 Determine the Data Objects and Object Relationships
 - 6.2.5 Determine Data Product File Configurations
 - 6.2.6 Design Data Product Labels
 - 6.2.7 Validate Label Syntax
 - 6.2.8 Validate Data Object Definitions
 - 6.2.9 Write Data Products SISs
- 6.3** **Design the Data Set/Data Set Collection**
 - 6.3.1 Define the Purpose and Scope of the Data Set/Data Set Collection
 - 6.3.2 Determine Other Data Set/Data Set Collection Components
 - 6.3.3 Create DATA_SET_NAME and DATA_SET_ID (and, if applicable, create DATA_SET_COLLECTION_NAME and DATA_SET_COLLECTION_ID)
- 6.4** **Determine the Storage Medium**
- 6.5** **Volume Set/Volume Design**
 - 6.5.1 Map Data Sets/Data Set Collections to Volumes
 - 6.5.2 Name the Volume Set
 - 6.5.3 Name the Volumes
 - 6.5.4 Determine which Non-data Subdirectories and Files will be present on each Volume
 - 6.5.5 Determine the Data Organization
 - 6.5.6 Establish Data Product File Naming Convention
 - 6.5.7 Establish Directory Naming Convention
 - 6.5.8 Determine the Indices Needed
 - 6.5.9 Write Volume Organization Software Interface Specifications (SIS)
- 6.6** **Design of the Data Production Process**
 - 6.6.1 Design Label Generation Process
 - 6.6.2 Design the Volume Production Process
- 6.7** **Data Validation Planning**
 - 6.7.1 Investigation Planning
 - 6.7.2 Write Data Validation Plan
 - 6.7.3 Design, Implement, and Test Project Data Validation Software
 - 6.7.4 Plan for updates to Data Validation Procedures and Software

- 6.8** **Complete the Catalog Object Templates**
- 6.8.1 Receipt of the Catalog Object Templates
- 6.8.2 Become familiar with the structure of the Catalog Object Templates
- 6.8.3 Complete the Catalog Object Templates
- 6.8.4 Validate the Completed Catalog Objects
- 6.8.5 Submit the Completed Catalog Objects
- 6.8.6 Plan for updates to the Templates

Chapter 6

Archive Design

Archive design, consists of:

- becoming familiar with PDS standards
- data product and label design
- data set/data set collection design
- determination of storage medium
- volume set/volume design
- design of the data production process
- data validation planning
- completion of the PDS Catalog templates.

This chapter describes each of these activities. These tasks are not meant to be sequential. In many cases there are inter-dependencies between the tasks that are not shown here.

6.1 Become familiar with PDS Standards

- Become familiar with PDS documentation

Become familiar with the PDS Data Preparation Workbook (this document), the PDS Standards Reference, and the Planetary Science Data Dictionary provided during PDS Orientation.

- Attend Data Preparation Workshops

For active flight projects, the PDS usually sponsors one or more Data Preparation Workshops. These Workshops focus on PDS archive standards.

- Request technical assistance

The PDS Data Engineer and Discipline Node(s) will answer your questions about PDS standards and provide guidance to you on archive design issues. In addition, they will be able to provide examples of PDS labeled data products, SISs, templates, and archive volumes.

6.2 Data Product and Label Design

This activity includes the determination of file format of the data product, definition of the data objects that make up the product, and definition of the data product label. A Data Product SIS is written to document this design.

6.2.1 Define the Data Product

This activity involves the definition of the data product from a scientific perspective. This includes defining how the data should be divided into individual data products (e.g., an image, one hour's worth of time series data, etc.) and determining which parameters or measurements will be included.

6.2.2 Estimate File Sizes

Data should be grouped into appropriate-sized files. There is a trade-off between size (very large files -- say more than a megabyte -- may be difficult to handle and to transfer between computers) and the number of files (the more files that result from a request for data, the more complex the record keeping, transfer and handling).

6.2.3 Determine the Data Format

The format for each type of data product file that will be present in the data set/data set collection needs to be determined.

When restoring data sets, this may require some research, since documentation of data formats is sometimes discarded after the initial set of analysis software is written or is not updated when formats are altered. Data formats for existing data may be found in software user's guides, requirements or interface specification documents, or embedded in the software source code.

The anticipated use of the data will have a great bearing on the type of format and organization of the data. Generally, the more structured the anticipated usage, the less concern about the storage format.

See the *Record Formats* standard in the PDS Standards Reference. Detailed data formats are described in PDS labels after determination of the data objects that make up a data product.

6.2.4 Determine the Data Objects and Object Relationships

The PDS has designed a set of standard data object definitions to be used in define both the contents and structure of a data product. Appendix A of the PDS Standards Reference describes these standard data objects. The use of primary data objects (e.g. Table, Image, Spectrum, Qube...) as well as secondary objects (e.g. Histogram, Palette, History...) is also discussed in the *PDS Objects* section of the Standards Reference.

- Determine the primary data object type(s) in the data product. (e.g., Table, Image, Spectrum, Qube, etc.)
- Determine the secondary data object type(s) in the data product. (e.g., Histogram, Palette, etc.)
- Determine object relationships
- Define specific objects

6.2.5 Determine Data Product File Configurations

Once the data objects of a given data product have been identified, determine whether primary and secondary data objects are to be in the same file or different files.

Example: For the Magellan Full-Resolution Mosaic Image Data Records data set: The 56 framelets of a mosaic, the primary data objects, are related to one another in a left to right, top to bottom sequence and numbered 1 through 56. The secondary data object, a histogram, is related to one mosaic, or the group of 56 framelets. Each histogram and framelet is stored in a separate file.

6.2.6 Design Data Product Labels

See the *Data Product Labels* standard in the Standards Reference. Design of the data product labels consists of the following steps:

- Choose detached, attached, or combined detached label format.
- Determine label standards identifiers including SFDU usage.
- Define file characteristics data elements
- Define data object pointers
- Select identification and description data elements
 - include PDS required data elements
 - include any project required data elements
 - select additional data elements from the PSDD
 - work with the PDS Central Node Data Engineer to propose new data elements for addition to the PSDD or to propose modifications to existing data elements (e.g. modifying definitions, adding standard values, etc.)
- Design data object definitions

6.2.7 Validate Label Syntax

Using a text editor, create a sample data product label as designed. Use the PDS Label Verifier to ensure that your data product label follows correct ODL syntax.

6.2.8 Validate Data Object Definitions

TABLE, SERIES, SPECTRUM If the data is formatted using the TABLE, SERIES, or SPECTRUM object, create a sample labeled data product and use the PDS Table Browser to validate that the label correctly defines the sample data.

IMAGE If the data is formatted using the IMAGE object, create a sample labeled data product and use IMDISP, IMAGE4PDS or other image display software to display the sample image.

6.2.9 Write Data Product SISs

A Data Product Software Interface Specification (SIS) is a document that describes the format and size of the individual data products. This document will include the PDS data product label design that will be used. The PDS Mission Products Manager will have a signature line on this document.

- Usually there is a project requirement to produce these SISs. If so, obtain the Data Product SIS outline or example from the project. A sample Data Product SIS may also be obtained from the PDS Central Node Data Engineer.
- Provide a draft Data Product SIS to the PDS Central Node Data Engineer and Discipline Node(s) for review.
- Resolve issues that come out of the document review.

6.3 Design the Data Set/ Data Set Collection

6.3.1 Define the Purpose and Scope of the Data Set/Data Set Collection

- Define the objective and the scope of the data set/data set collection.
 - What do the data in the data set/data set collection describe or measure?
 - What form of the data (e.g., raw, calibrated, sampled) should be archived?
 - What range of data will be included in the data set (e.g., a single planetary encounter, samples from several encounters, a particular time range)? -Should multiple data sets be grouped together as a data set collection?

Data sets may be grouped together with other data sets into data set collections. Data set collections consist of data sets that are related by observation type, discipline, target, or time, and should be treated as a unit, to be archived and distributed together for a specific scientific objective and analysis. This is usually done during a restoration task.

An example of a data set collection is the Pre-Magellan CD-ROM containing a collection of selected Earth-based radar data of Venus, the Moon, Mercury, and Mars, Pioneer Venus radar data, airborne radar images of Earth, and line of sight acceleration data derived from tracking the Pioneer Venus Orbiter and Viking Orbiter 2.

6.3.2 Determine Other Data Set/Data Set Collection Components

Determine the ancillary data (e.g., navigation data, calibration data, pointing information), software, and documentation that will be included with the data set or data set collection. Required components of a Data Set/Data Set Collection are documented in the *Volume Organization and Naming* standard in the PDS Standards Reference.

6.3.3 Create DATA_SET_NAME and DATA_SET_ID (and, if applicable, create DATA_SET_COLLECTION_NAME and DATA_SET_COLLECTION_ID)

See the *Data Set/Data Set Collection Contents and Naming* standard in the PDS Standards Reference for the naming formation rules.

6.4 Determine the Storage Medium

Media used for storage of archival data sets should be utilized efficiently. This includes full recording of individual media volumes, selection of recording formats to minimize wasted space on the media, and the use of simple data compression techniques to reduce the volume of infrequently accessed data. If a medium other than magnetic tape or CD-ROM is to be used, then PDS should be notified to determine whether it can be accommodated. The use of replicable media, such as CD-ROM, for products that are expected to be widely used, is recommended. For active flight projects, the medium selected for use will usually be determined by the project. See the *Media Formats for Data Submission and Archive* Standard in the PDS Standards Reference.

6.5 Volume Set/Volume Design

A volume represents a physical unit of data such as a magnetic tape, floppy disk, or CD-ROM. The hierarchical organization, as described in the *Volume Organization and Naming* standard in the PDS Standards Reference, should be used on the storage medium if possible, e.g., CD-ROM. When using a serial medium, such as magnetic tape, a hierarchical organization can not be physically implemented, but only described in the VOLDESC.CAT file included on the medium. For the purposes of this discussion, we will consider a data volume that supports a hierarchical directory structure. A Volume Organization SIS is written to document the Volume/Volume Set design.

6.5.1 Map Data Sets/Data Set Collections to Volumes

Taking into account the total volume of data to be archived (including ancillary data), estimates of individual file sizes, schedule of availability of the data (including any proprietary period), and operational constraints of the volume assembler, determine the allocation of data to physical volumes.

- Data sets/Data set collections may reside on one or more physical volumes.
- Multiple data sets may also be stored on a single volume.

Note: When a data set spans multiple volumes, it is recommended that each volume provide a complete set of ancillary data pertaining to the data contained on the volume.

6.5.2 Name the Volume Set

If the data set or data set collection spans more than one volume, a name must be selected for the volume set which will identify it to a data user.

Name the Volumes

A name must be selected for each volume which will identify it to a data user.

Determine which Non-data Subdirectories and Files will be present on each Volume

The standards for PDS required and optional non-data subdirectories and files are discussed in the *Volume Organization and Naming* standard in the Standards Reference.

6.5.3 Determine the Data Organization

Scientific data sets are generally organized by event time, by the target of the observation, or by some cyclic value such as orbit number. The effort put into organizing the data can make the difference between simple access by the user or tedious searching. It is important to minimize the number of directory levels that must be traversed to get to the data and to minimize the amount of directory changing required during normal data access operations. For example, if two related data files are always processed in conjunction with each other, the files should be grouped in the same directory.

Organization in continuous ranges of event time is advised, with the exception being data that clearly relates to some well-understood observation, target, or event. If the data are organized on some other basis, the preparer should make available a mechanism to extract data based on event time in order to support correlative analysis.

- Time-Oriented Organization

The simplest approach is to create a single data file containing a fixed time interval, such as a day, week, or month. See Figure 3. (See the *Date/Time* standard in the PDS Standards Reference.)

NOTE: Since directories are sorted by name, the use of month names (JAN, FEB, MAR), will produce a directory listing which is not in chronological order (APR, AUG, DEC).

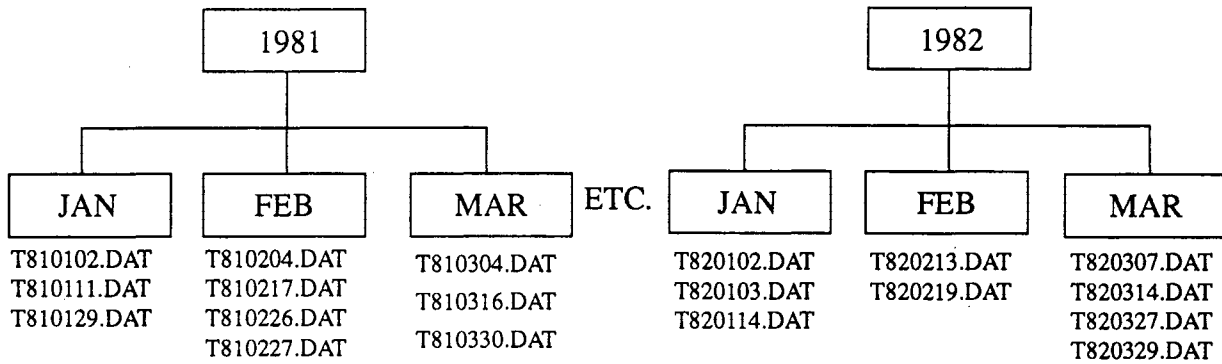


Figure 3: Example of Time-Oriented Organization

- Target-Oriented Organization

In the target-oriented approach, the target of the instrument observations is used to build a directory structure, and all observations of that target within a certain time span of data are included. See Figure 4.

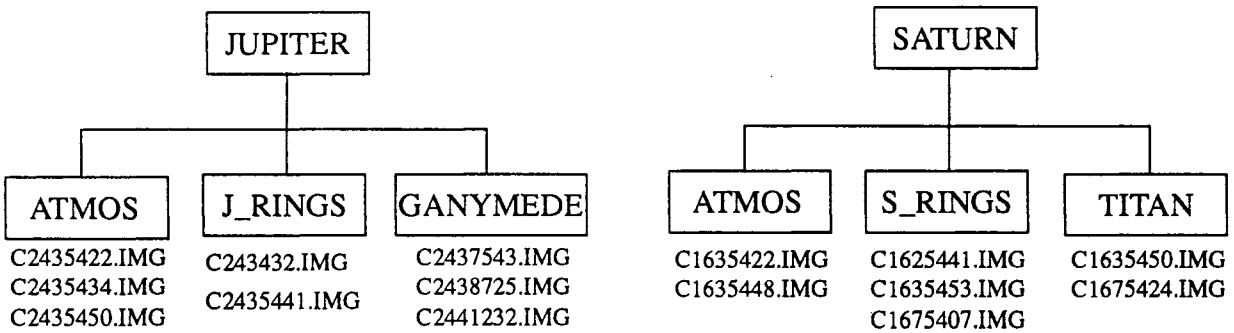


Figure 4: Example of Target-Oriented Organization

- Event-Oriented Organization

Event-oriented organization collects data based on events related to spacecraft operations or observed phenomenon. See Figure 5.

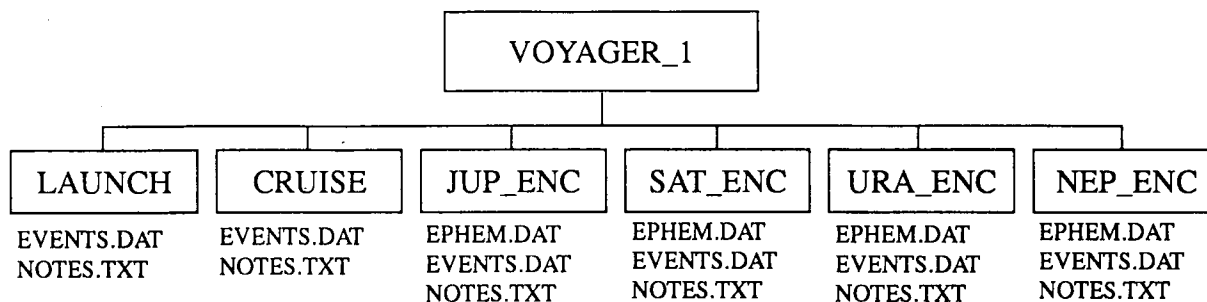


Figure 5: Example of Event-Oriented Organization

- Bin-Oriented Organization

Bin-oriented organizing schemes collect data in spatially defined bins, such as 5-degree lat-lon bins (numbered sequentially). This is similar to target-oriented organization, except that bins are used to represent the observation targets. If arbitrary bin names are used (BIN1, BIN2, etc.), a mapping between bins and spatial coverage must be supplied. It is often possible to include the limits of the binning parameter in the name as shown in Figure 6, where longitude is used to group and name files.

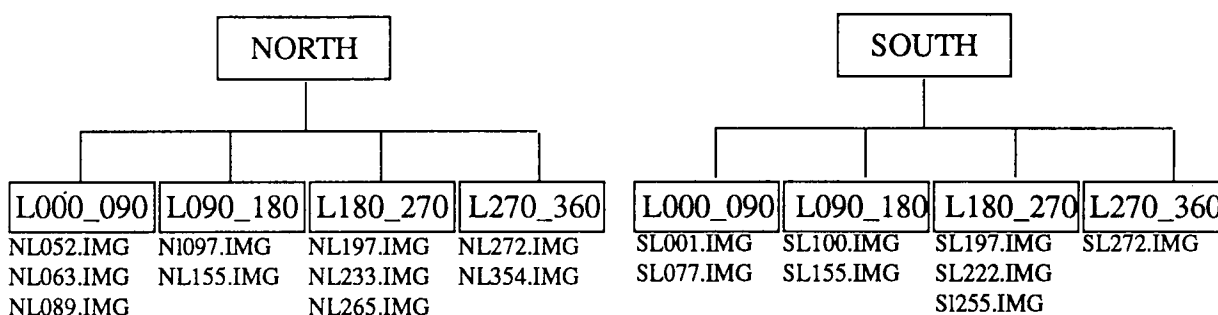


Figure 6: Example of Bin-Oriented Organization

6.5.4 Establish Data Product File Naming Convention

The file naming scheme utilized should result in file names that uniquely identify the data included in the file but have some characteristics in common with other files. For example, T810111.dat contains data from January 11, 1981 and allows use of file selection capabilities like the use of wildcards (T81011*.dat selects January 10th through 19th).

Note: Special consideration should be given to constructing file names which contain dates. File names which begin with the names or partial names of months (such as JAN1989.DAT) can cause problems when outside applications process a series of files alphabetically. A series of files with

file names starting with month names will be arranged with APRIL first, then AUGUST and so on, rather than the desired JANUARY, FEBRUARY, etc.

If possible, all file names on a volume should be unique, even if the files are stored in different subdirectories. The reason for this is to avoid confusion and possible data loss if files are transferred from a hierarchical directory structure to a flat one.

If detached labels are used, it is recommended that the name of the label files be the same as the data object files, except with a .LBL extension.

See the *File Specification and Naming* standard in the PDS Standards Reference.

6.5.5 Establish Directory Naming Convention

Directories should contain about a “screenful” of file entries. If too many files are included in a directory, it becomes difficult for users to “browse” through the file names using the directory command. If too few files are included, this will severely increase the complexity of locating a file. As a rule, the depth of directories should be kept to a minimum unless the number of files per directory becomes too large (about 100 is a reasonable maximum).

Balance simplicity with explicitness in attempting to encode a description of the directory contents in the name. It is often better to use simple arbitrary names, than complex but meaningful ones (DIR1, DIR2, DIR3 vs. VGPWSXZ2, VGPWSXZ1, VGPWSXZ3).

See the *Directory Types and Naming* standard in the PDS Standards Reference.

6.5.6 Determine the Indices Needed

- Select indices that will be used on each volume. Indices provide a path for the user into the information stored on the medium. For instance, a column of latitude/longitude ranges followed by a column of directory and file names provide the user with information needed to find the data object file of interest. Wherever possible, indices should be built from the data product labels.
- Create INDEX.LBL This is the PDS Label that will describe INDEX.TAB, the index table for a volume.
- Select indices that will be used across volumes. Another type of index is a cumulative index. For instance, if the current volume is only one of a volume set, the cumulative index can provide context for the user as to how this volume fits into the set and what volumes have been produced previously.
- Create CUMINDEX.LBL This is the PDS Label that will describe CUMINDEX.TAB, the cumulative index table.
- Validate the index labels. Create several sample index records and use the PDS Table Browser to verify that INDEX.LBL and CUMINDEX.LBL are correct.

6.5.7 Write Volume Organization Software Interface Specifications (SIS)

A Volume Organization SIS describes the design of an archive volume or volume set. In

Magellan, these SISs were called the CD-ROM SISs. In Mars Observer they are called the Archive Collection SISs. The PDS Mission Products Manager will have a signature line on these documents.

- Usually there is a project requirement to produce these SISs. If so, obtain the Volume Organization SIS outline or example from the project. A sample SIS may also be obtained from the PDS Central Node Data Engineer.
- Provide a draft Volume Organization SIS to the PDS Central Node Data Engineer and Discipline Node(s) for review.
- Resolve issues that come out of the document review.

6.6 Design of the Data Production Process

6.6.1 Design Label Generation Process

The PDS Discipline Node or Central Node Data Engineer can offer suggestions and possibly tools to help automate the process of generating labels. The Label Library, a library of subroutines developed by PDS, may be integrated into your data production software to automate label generation.

- The PDS Table to Label Generator (TAB2LAB) may sometimes be used to produce labels from an index table, or a table of ASCII data produced from a database.
- The PDS File to Label Generator (FILE2LAB) may sometimes be used to produce labels from existing file headers, providing that they are ASCII and that the data values do not require processing before transfer to a PDS label.

6.6.2 Design the Volume Production Process

The PDS Discipline Node or Central Node Data Engineer can offer suggestions and possibly tools to help automate the process of generating volumes.

6.7 Data Validation Planning

For active Flight Projects, data validation plans are usually documented in Project operational procedures. For restored data, planning data validation is part of the peer review process which sets the criteria for accepting data sets.

6.7.1 Investigate Availability/Suitability of PDS Data Validation Tools

Some of the currently available tools include: PDS Label Verifier PDS Table Verifier PDS Volume Verifier

6.7.2 Write Data Validation Plan

A Data Validation Plan is a document that defines the operational procedures that will be in place for validating the content and physical organization of the volumes produced.

The PDS Mission Products Manager will have a signature line on this document.

- Usually there is a project requirement to produce a Quality Control or Validation Plan. If so, obtain an outline or example from the project. A sample Validation Plan may also be obtained from the PDS Central Node Data Engineer.

When planning data validation, the following must be addressed:

- Definition of the validation process, including the establishment of both automatic and manual validation procedures
- Assignment of roles and responsibilities for each validation step
- Provide a draft Data Validation Plan to the PDS Central Node Data Engineer and Discipline Node(s) for review.
- Resolve issues that come out of the document review.

6.7.3 Design, Implement, and Test Project Data Validation Software

In some cases, the project may choose to write its' own data validation software. In this case, resources must be allocated to this task.

6.7.4 Plan for updates to Data Validation Procedures and software

Planning data validation is often an iterative process. In the case of Magellan, test volumes were made and test plans implemented and iterated upon until a flow of validation checkpoints was designed and tested, including internal and external quality control.

6.8 Complete the Catalog Object Templates

All data submitted to the PDS requires the completion of catalog object templates or forms used for loading the PDS Data Set Catalog. By filling out these templates, the data supplier provides high-level information concerning the mission, spacecraft (or earth based host), instruments, and Project personnel, as well as information about each of the data sets or data set collections being submitted to the PDS.

Examples and assistance will be provided by the PDS Data Engineer and the PDS Discipline Node with which you are working. Also, automated tools may be available to support the editing and validation of the templates. Contact your PDS Data Engineer for more information.

6.8.1 Receipt of the Catalog Object Templates

You will receive a set of catalog templates from the PDS Central Node Data Engineer via electronic mail or on some electronic media through the mail, in the form of one or more ASCII flat files. You will only receive those templates required for the data set or sets you are submitting. Some templates may need to be duplicated several times (e.g., three Data Set Templates because you know you are submitting three data sets), each for a different type of data. Templates may also require duplication of objects within them (e.g., multiple References for a Mission description).

Any standard text editor can be used to complete these catalog object templates. Descriptions and examples of these objects are provided in Appendix B of the PDS Standards Reference.

6.8.2 Become familiar with the structure of the Catalog Object Templates

Each object template begins with a set of comment fields which describe the object (or set of objects). These comment fields contain the template name, notes about the object, and a hierarchy structure of the object, if needed. Many objects have a hierarchical structure of a parent object containing one or more child objects. A child object can also be a parent object with its own child objects. In other words, there can be multiple levels of nesting.

The body of the parent object with its child objects is delimited by the OBJECT and END_OBJECT data elements. The OBJECT data element indicates the beginning of a new object and should not be modified. The END_OBJECT data element indicates the end of a single object or a nested set of objects and should not be modified.

6.8.3 Complete the Catalog Object Templates

When you receive your templates, some of the values may already have been filled in by the PDS Data Engineer. Those should remain unchanged. No other part of the template should be altered, with the exception of the comments to the right of each keyword=value pair which may be deleted. The template should be filled in where there are blank keyword=value pairs and submitted intact.

The data supplier will complete a template by entering values to the right of the equal sign in the keyword=value clauses. The values to be entered may be either standard values, numeric values constrained to a range, text strings, or values resulting from the application of formation rules.

Units may be entered following a value using angle brackets (<KM>). The type of value, data type, and units to be entered for a particular data element is denoted by a comment (starts with /*) on the template.

The Planetary Science Data Dictionary (PSDD) gives the definitions of the objects, definitions of the data elements, and the allowable values (standard values) for each data element.

- Not Applicable or Unknown Values

In certain cases, a data element may not be applicable within the context of the data being submitted. In such cases, the value "N/A" is entered. In other cases, where they value is not known, "UNK" may be used.

- Using the Comments in the Templates

The templates include comments (delimited by /* */) that indicate the type of value to be supplied. The following list defines the types of values.

6.8.4 Validate the Completed Catalog Objects

Validate the completed catalog objects using the PDS Label Verifier.

6.8.5 Submit the Completed Catalog Objects

The completed catalog objects should be returned to the PDS Central Node Data Engineer, either via electronic mail, or on some electronic media through the mail, in the form of an ASCII flat file. The comment area of the object templates can be used to include a date or version number. The PDS Data Engineer will review the completed catalog object templates and return comments to you. Preparing the catalog information is an iterative process. The catalog information may be submitted and reviewed several times until both the data supplier and the PDS Data Engineer are satisfied with their correctness and completeness.

6.8.6 Plan for updates to the Templates.

As the mission progresses, more information will become available and the catalog object templates will need to be updated.

Chapter 7

Data Set Assembly and Validation Checklist

- 7.1 Create the Labeled Data Products
- 7.2 Create a Data Staging Area for Volume Production
- 7.3 Write Volume Documentation
- 7.4 Collect Catalog Files
- 7.5 Collect and Format Documentation
- 7.6 Prepare Supporting Software
- 7.7 Collect Geometry and Calibration Files
- 7.8 Generate the Data Indices
- 7.9 Validate Non-product Labels
- 7.10 Prepare a Set of Test Volumes and Distribute
- 7.11 Execute Data Validation Procedures
- 7.12 Transfer the Data to the Final Medium

Chapter 7

Data Set Assembly and Validation

Data set assembly consists of collecting and formatting all components of the data set, processing it according to the design, and storing it on the planned medium. It also involves preparing PDS data product labels, writing the volume documentation, and creating the volume indices.

7.1 Create the Labeled Data Products

Process and format the data objects and PDS data product labels as designed. Creation of the labels may be concurrent with processing the data objects themselves.

7.2 Create a Data Staging Area for Volume Production

Before volume production can begin, a data staging area should be created. This area should provide a structure similar to that which will be used on the final medium, and will allow the volume assembler to store the pieces of the data set as they are assembled.

7.3 Write Volume Documentation

- Prepare a VOLDESC.CAT file to summarize the contents of each volume submitted. (See the VOLUME Object Definition in the PDS Standards Reference, Appendix A.) This file will describe the contents of the volume. This file will be the first one written to the volume and will contain physical volume data and the structure of directories and files. (This is especially important for magnetic tape volumes.)
- Prepare the AAREADME.TXT file. This file is a high-level description of the contents of the volume in human-readable form. An outline or example can be obtained from the PDS Central Node Data Engineer.
- Prepare a VOLINFO.TXT file (if this file has been identified for inclusion on the volume during the Design process). The VOLINFO.TXT file provides a detailed summary of the contents of each volume in human-readable form. An outline or example can be obtained from the PDS Central Node Data Engineer.
- Prepare other text files (such as ERRATA.TXT) that have been identified for inclusion on the volume.

7.4 Collect Catalog Object Files

- If Catalog Object files have been identified for inclusion on the volume during the Design process, these files need to be assembled. The configuration controlled catalog object templates can be obtained from the PDS Central Node Data Engineer. These have been corrected and are the ones you should use in your data set. It is acceptable to delete the comments in

these templates.

- Prepare CATINFO.TXT file to describe the contents of the Catalog subdirectory.

7.5 Collect and Format Documentation

- If Document files have been identified for inclusion on the volume during the Design process, these files need to be assembled and formatted. An ASCII version of all document files should be prepared.
- Prepare DOCINFO.TXT file to describe the contents of the Document subdirectory.

For the standard, see the *Documentation* standard in the PDS Standards Reference.

7.6 Prepare Supporting Software

- Software which was used to generate, process, or analyze your data set should be submitted along with the data set. Software submitted along the your data set should include the source code for all subroutines, and batch files or instructions for building executable programs on applicable computer systems. Comments which might help a user who is unfamiliar with the software should also be added.

Software documentation such as requirements, design, and user manuals, where available, should be provided along with the software itself if that software is intended for eventual use by general PDS users at a Discipline Node.

- Prepare SOFTINFO.TXT file to describe the contents of the SOFTWARE directory.

7.7 Collect Geometry and Calibration Files

- Collect Calibration data that has been identified for inclusion on the volume. This calibration data includes all pre-flight and in-flight calibration procedures and operations, along with the results of those calibration operations. In most cases, existing project pre-flight calibration documentation will suffice for the pre-flight requirement.
- Prepare CALINFO.TXT file to describe the contents of the CALIB subdirectory.
- Collect Geometry data that has been identified for inclusion on the volume. This Geometry data may include spacecraft and target ephemeris data, instrument geometry information, platform pointing information, and events files. This collection of geometry information is commonly referred to as the SPICE data sets, or ``kernels.'' Contact the PDS Navigation Ancillary Information Facility (NAIF) at JPL for assistance in putting together geometry files.
- Prepare GEOMINFO.TXT file to describe the contents of the GEOMETRY subdirectory.

7.8 Generate the Data Indices

- Generate the indices for your volume (INDEX.TAB) as designed. List the full path names of the data object files and associate them with their specific attribute value, such as latitude/lon-

gitude, or orbit number, for instance.

- For a volume (cumulative) index, list the volume IDs and their specific attribute values.
- Prepare INDEXINFO.TXT file to describe the contents of the INDEX subdirectory.

7.9 Validate Non-product Labels

The VOLDESC.CAT, INDEX.LBL, CUMINDEX.LBL, and any label files in the DOCUMENT subdirectory should be validated with the PDS Label Verifier. The index files should be checked with the PDS Table Browser.

7.10 Prepare a Set of Test Volumes and Distribute

Test volumes should be prepared and distributed to the PDS Central Node Data Engineer, Discipline Node(s), and project PI teams (for active flight projects) for volume validation.

7.11 Execute Data Validation Procedures

Volumes will be validated according to the operational procedures and validation criteria outlined in the active Flight Project's Data Validation Plan or Data Restoration validation criteria.

The PDS will also validate volumes to ensure adherence to PDS standards.

7.12 Transfer the Data to the Final Medium

For magnetic tapes, copy your data files to ANSI labeled tapes. The ANSI standard allows the data product to be composed of meaningful files which can be extracted on various computer hardware. ANSI labeled tapes can be written on a VAX computer using the COPY command. (DO NOT use the VMS backup command.)

For CD-ROMs, a pre-master tape must be prepared to be sent to a CD-ROM vendor. Contact the PDS Project Engineer (see Appendix A) if you would like more information on how to prepare data for CD-ROMs.

Chapter 8

Data Delivery Review Checklist

- 8.1 Prepare for the Data Delivery Review or Peer Review
- 8.2 Participate in a Data Delivery Review or Peer Review
- 8.3 Correct Review Liens

Chapter 8

Data Validation and Delivery Review

Prior to archive by the PDS, the data volumes are reviewed. This section describes this review process.

8.1 Prepare for the Data Delivery Review or Peer Review

The Review Committee will receive a Review package. The package consists of the science data sets (or samples of them), supporting documentation, completed high-level catalog templates, detailed-level catalog samples if applicable, and PDS labels.

Completed catalog templates will be test-loaded into a Review database to confirm modeling and loader mapping. After loading, the data is then inspected via the SQL interface to confirm table contents and inspected via the PDS user interface to confirm referential integrity. Reviewers will be advised on how to inspect this Review database.

8.2 Participate in a Data Delivery Review or Peer Review

Prior to release of the final volumes to the PDS for archive, a review is held. This review is called a Peer Review for restored data sets, and a Data Delivery Review for active flight project data sets. In some cases, the flight project itself conducts the review, in others, PDS conducts the review.

During the review meeting, the data providers or their representative may make presentations on the data set(s) which they have provided as part of their submission package. Any comments as to the associated catalog data may form part of the presentation.

During and after the presentation, the various members of the Peer Review committee may ask questions to help them understand the data set submission package.

The review committee examines data set contents, state of documentation, formats, ancillary data, and software to ensure the accuracy, dependability, and usefulness of science data. The review committee then summarizes its deliberations and conclusions.

Liens identified during these reviews are documented in either a Peer Review Report or a Data Delivery Review Report.

One or more reviews may be held before all the data are delivered.

8.3 Correct Review Liens

Wherever feasible, liens are corrected prior to delivery of the data set to PDS for archival. If it is not feasible to correct the liens, the results of the review will be archived with the data sets to document all known errors.

Notes may also be added to the Data Set Catalog to indicate the quality of data, adherence to PDS standards, or data usability.

The PDS Data Set Catalog and Data Product Catalogs (if applicable) will be updated to include information about the new data set.

Chapter 9

Archive and Distribution Checklist

- 9.1 Coordinate Generation of CD-ROM Copies with PDS (if applicable)
- 9.2 Physically Transfer Archive Volumes to PDS and NSSDC
- 9.3 Assist the PDS Discipline Node in Generating the DIF
- 9.4 Updating Data Sets

Chapter 9

Archive and Distribution

After the Data Delivery Review or Peer Review is complete, data sets are delivered to PDS for archival. The data sets are then made available to the planetary science community.

9.1 Coordinate Generation of CD-ROM Copies with PDS (if applicable)

If the Flight Project chooses to use CD-ROMs for internal project distribution, the Project will maintain the CD-ROM vendor contract. PDS and the NSSDC will then pay to have additional copies made for the general science community. The project should keep PDS informed about production plans in order to reduce multiple setup costs for additional CD-ROM copies.

In some cases, pre-order distribution lists are provided to the CD-ROM vendor to facilitate early distribution.

9.2 Physically Transfer Archive Volumes to PDS and NSSDC

Current Flight Projects will implement the data delivery steps specified in their Archive Policy and Data Transfer Plan, including the delivery to a PDS Discipline Node or Nodes, and possibly NSSDC.

Restored data sets will be delivered to the relevant PDS Discipline Node.

When delivery is made to a PDS Discipline Node, the physical data set will be added to the Discipline Node data inventory. The Node will then be responsible for archiving the data set at the NSSDC.

9.3 Assist the PDS Discipline Node in Generating the DIF

Information about the archive data is provided to the NSSDC in Directory Interchange Format (DIF). The DIF information is required by the NSSDC and is used by them to populate the Master Directory. The PDS Discipline Node will be responsible for generating the DIFs, but may request assistance from the data supplier.

9.4 Updating Data Sets

Data sets can be updated to include corrections or enhancements after they have been archived. Contact your PDS Data Engineer or Discipline Node for information on this process.

Chapter 10

Data Restoration

10.1 The Data Restoration Process

The Archive Planning, Design, and Assembly activities described in Chapters 5 through 7, are generally not as formal for data restorations as for active flight projects. In most cases, the restoration work is done by a Discipline Node with the assistance of a Central Node Data Engineer. The amount of documentation required (such as Archive Policy and Data Transfer Plan and Data Product SISs) will depend on the scope of the restoration. The details will be worked with the Mission Products Manager. The Peer Review process, described in Chapter 8, ensures that the restored data meets PDS standards for archive. Following a successful Peer Review, data are archived and distributed as described in Chapter 9.

10.2 Requesting restoration

For Data Restorations, contact the Discipline Node with your request to submit data for restoration. Your request should include the following descriptive information about the data set:

- 1.) Scientific value of the data
- 2.) Descriptive information about the data (name of spacecraft, instrument, target, event, and range of data contained in the data set)
- 3.) Physical description of the data set (current media, total size, how are the data organized, how are the data formatted, what condition is the media in?)
- 4.) Description of supporting software needed for understanding and/or analyzing the data (e.g. data processing software, data reduction software, data analysis software, supporting documentation)
- 5.) Description of relevant ancillary data (SEDRs, SPICE kernels, calibration data, etc.)
- 6.) Special considerations (e.g., tape is in danger of deterioration, PIs may move on to other projects, there is a large demand by users for the data, data would be easy to restore and ingest into the PDS)

The descriptive information provided is used by the PDS Management Council in establishing restoration priorities. After the PDS Management Council has released the approved list of data sets for restoration, you will be notified by the appropriate Discipline Node manager.

Appendix A

Who to Contact

Mission Products Manager

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Small Bodies Node Manager

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Appendix B

PDS Tools

B.1 PDS Toolbox Release 4

Release 4 of the PDS Toolbox will take place in two stages. Executables for all programs will be made available via electronic distribution in November of 1992, in order to provide the user community with tools that support the PDS Version 3 standard for archive data products. Source code for the Label Library and other tools will then be made available at a later date. The Release 4 libraries include the following:

- PDS Label Verifier (lvtool), Version 1.2
A tool for checking the syntax and semantics of PDS labels by comparing them to the Toolbox Data Dictionary. Compared to Version 1.1, contains bug fixes, reduced number of warning messages, and handling for the new Data Dictionary.
- PDS Table Browser (tbtool), Version BETA
A tool for interactively examining PDS labelled ASCII and binary data in the form of TABLEs, SERIES, or SPECTRUMs, in order to verify the correctness of the label or browse, summarize, and visually verify columns of data. The alpha version of this tool was called "tvtool."
- PDS Table to Label Generator (tab2lab), Version 2.1
A tool for generating PDS labels given a template label and an ASCII table of data values for insertion into the template. Compared to Version 1.2, contains bug fixes, new label file naming capabilities, a new command line interface, and new capabilities for handling duplicate keywords in labels.
- PDS File to Label Generator (file2lab), Version BETA
A tool for generating PDS labels given a template label and a set of ASCII data files (or file headers) that contain values for insertion into the template.
- PDS Simple Label Editor (sled), Version 2.4
A command line editor for verifying, modifying, and reformatting PDS labels. Includes hooks to the PDS Label Verifier. (NOTE: SLED does not support PDS version 3 SFDU labelling standards. You will receive warnings from the software.)
- PDS Utilities
- A PDS label formatter (labform), for pretty-printing labels. (Version 1.0)
- A PDS label expander (explab), for expanding a label with STRUCTURE keywords into a

new label. (Version 1.0)

- A PDS version 0 to PDS version 2 image label converter (img0to2), for updating old image labels, (Version 1.1) (Note that the standard is now PDS version 3, but his utility has not been updated.)
- A Label Dealiasing Utility (dealias), for use in updating labels with old keywords to new standards. (Version 1.1)
- An Add Columns to Table Utility (addcols), for converting old format PDS tables (OBJECT = NAME) to new format (OBJECT = COLUMN). (Version 1.1)
- The Make Data Dictionary Index Utility (make_index), for generating the index associated with the Toolbox Data Dictionary. (Version 1.2).
- PDS Toolbox Data Dictionary, Version 3.0
Contains all the updates included in the new release of the Planetary Science Data Dictionary.

The following documents are also available with this release of the PDS Toolbox:

The PDS Label Verifier User's Guide
 The User's Guide for the PDS Label Generators
 The PDS Toolbox Overview
 The User's Guide for the PDS Simple Label Editor
 The PDS Table Browser User's Guide
 The PDS Toolbox Utilities User's Guide
 The PDS Label Library User's Guide

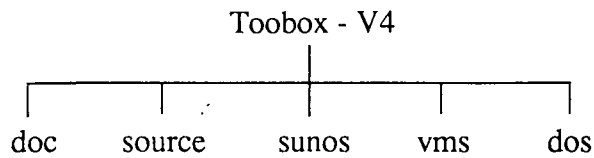
The executables for the PDS Toolbox were generated on:

- A Sun SPARCstation using SunOS 4.1 and Sun C compiler.
- A VAX 4000 running VMS 5.4 and VMS C compiler.
- A PC-386 running MS-DOS 5.0 and Borland C(++) 2.0.

B.2 Obtaining the Toolbox

If you wish to obtain PDS Toolbox Executables and Data Dictionary files, you can ftp them to your system. The PDS Toolbox ftp account is set up so that you may obtain one program or all of them.

1. Anonymous ftp to starhawk.jpl.nasa.gov (137.79.108.113)
2. Change directory to toolbox_v4 (cd "toolbox_v4"). The director structure underneath it will look like this:



The source directory is currently empty, and will be populated early next year.

3. If you need Data Dictionary files or user's guides, change directory to `toolbox_v4/tool_doc`.
4. Use "get <filename>" to get one file, or "mget *" to get all documentation files. We recommend that you get "overview.asc," as well as the user's guides for whichever tools you are interested in. We also recommend that you get "pdsdd.full" and "pdsdd.idx," the Toolbox Data Dictionary files.
5. Change directory to `toolbox_v4/sunos`, (or `dos`, or `vms`, depending on which system you want executables for).
6. Change your ftp mode to binary ("binary").
7. Get the files you need ("get lvtool", or "mget *" to get all files).
8. Quit ftp.

File "overview.asc" from the `tool_doc` subdirectory discusses installation of the programs on your system.

If you obtain the Label Verifier (`lvtool`) or the Dealias Utility (`dealias`) you will definitely need to copy the Data Dictionary files "pdsdd.full" and "pdsdd.idx." VMS users (or anyone who has trouble using the Data Dictionary files after copying them) should run the `make_index` utility after copying the Data Dictionary. For VMS this requires the following:

```
make_index ::= "$[your directory]make_index.exe"   make_index pdsdd.full
```

For other systems, the command is simply:

```
make_index pdsdd.full
```

(Program "make_index" is among the programs in the `sunos`, `dos`, and `vms` subdirectories.)

For additional information, contact
Marti DeMore at (818) 306-6017 or
mdemore@starhawk.jpl.nasa.gov (137.79.108.113),

or the Planetary Data System operator at
pds_operator@jpl-pds.jpl.nasa.gov (137.79.104.100) or
JPLPDS::PDS_OPERATOR.

Appendix C

Glossary

Browse Data Set

A data set, typically of limited size and resolution, created to rapidly provide an understanding of the type and quality of data available in a related full resolution data set. It may also enable the quick selection of specific products or intervals for further processing or analysis. For example, for an image data set, a browse data set could be a set of subsampled images of low resolution. The form of browse data is generally unique for each type of data set and depends on the nature of the data and the criteria used for data selection within the related science discipline.

Catalog Data

Data or meta data that is obtained from data sets or data products, and which serves to describe, identify, associate, characterize, or highlight the data set. In the PDS context, Catalog data are the attribute values in a catalog object.

Catalog Object

A catalog object is a set of required keywords with values used to provide catalog data for a data product or data set. In the PDS context, a completed Catalog Object Template is a catalog object. See Appendix B of the PDS Standard Reference for a complete set of PDS Catalog Object examples.

Catalog Object Template

A catalog object template refers to an uncompleted (no attribute values assigned) catalog object.

Data Element (Attribute, Element, Keyword)

A data element is a modeled characteristic of an object. Some data elements describe the physical or logical characteristics of the data (the number of rows in a table, for example). Others describe the content of the data (the target of an image, for example) or information to be used in interpreting the data (such as units of measure). The term keyword is used when a data element occurs in the context of the label.

Data Object

A data object is that portion of a data product that contains the actual data that can be manipulated or stored. A data object may be classified as a primary data object or a secondary data object.

Data Object Definition

A set of required and optional keywords which are used in a PDS label to define the structure of a primary or secondary data object. The PDS standard data object definitions are defined in Appendix A of the PDS Standards Reference.

Data Product

A data product is a grouping of primary and secondary data objects and their associated PDS labels resulting from a scientific observation. A data product is a component of a data set.

Data Product Label

A grouping of data elements, data object definitions, and optional SFDUs, expressed in ODL, identifies, describes, and defines the structure of a data product.

Data Set

The accumulation of data products, secondary or ancillary data, software, and documentation, that completely document and support the use of those data products. A data set can be part of a data set collection.

Data Set Collection

A data set collection consists of data sets that are related by observation type, discipline, target, or time, and therefore are to be treated as a unit, to be archived and distributed together for a specific scientific objective.

Keyword (see Data Element)

Label (see Data Product Label)

Logical Record

A record independent of its physical environment, that exists from the standpoint of its content, function, and use rather than its physical attributes. It is defined in terms of the information it contains. Portions of the same logical record may be located in different physical records, or several logical records may be located in one physical record.

Medium

Any physical material capable of holding data (e.g., pages, film, magnetic tape, optical disk, etc.).

Meta Data (see Catalog Data)

Object

An abstract or atomic entity that corresponds to something tangible in the an archive environment such as a grouping of data or a related grouping of information about that data. In PDS, for example, target, spacecraft, data set, volume, and image objects are defined.

Object Definition Language (ODL)

A language used to encode data product labels and catalog objects for the Planetary Data System and other NASA data systems.

Physical Record

A record whose characteristics depend on the manner or form in which it is stored, retrieved, or moved. A physical record may contain one or several logical records or a part of a logical record.

Pointer

A statement within a data product label or catalog object that identifies or references external files for inclusion or for descriptive information.

Primary Data Object

A Primary data object is a grouping of data resulting from a scientific observation. The actual science data, such as an image or table, it represents the measured instrument parameters or derived results.

Secondary Data Object

A Secondary data object is any data needed for processing or correctly interpreting the primary data object.

SFDU

A SFDU (Standard Formatted Data Unit) is a unit of data that conforms to a specific set of CCSDS (the Consultative Committee for Space Data Systems) recommendations for structure, construction rules, and field specification definition. Details about the PDS usage of SFDUs can be found in the SFDU Usage section of the PDS Standards Reference.

Standard Value

A standard value is one of a set of possible values that can be assigned to a data element.

Template (see Catalog Object Template)**Volume**

A volume is a unit of physical media such as a CD-ROM or CD-WO, an 8mm magnetic tape, or a 9-track magnetic tape. Data sets may reside on one or more volumes and multiple data sets may also be stored on a single volume. Volumes are grouped into volume sets.

Volume Set

A grouping of one or more related volumes treated as a unit.

April 22, 1993

TO: Distribution
FROM: S. M. Hess
SUBJECT: Planetary Data System Data Preparation Workbook Release

Enclosed is your copy of the Planetary Data System's release of the Data Preparation Workbook, Version 3.0, dated April 21, 1993. This document is to be used in conjunction with the PDS Standards Reference, Version 3.0 and the Planetary Science Data Dictionary, Revision C, both dated November 20, 1992. If you did not receive a copy of these two documents, require additional copies, or wish to be removed from the distribution for this set of documents, please contact the PDS Operator (JPLPDS::PDS_OPERATOR or pds_operator@jplpds.jpl.nasa.gov or call (818) 306-6130).

Version 3.0 of the PDS Data Preparation Workbook has been streamlined from earlier versions of the document to focus on the steps or procedures used in preparing data sets for archive by PDS. Specific PDS standards are described in detail in the PDS Standards Reference and the Planetary Science Data Dictionary. Checklists have been added to the workbook to help identify important steps in the overall data preparation process.

On-Line Document Access

In addition to these hardcopy documents, PDS is providing prototype on-line access and search capabilities for these and other references utilizing public domain Wide Area Information Servers (WAIS). These information sources are particularly helpful during data preparation for locating existing data elements (keywords) for labeling your data or for finding specific standards that apply to your work. Additional information about these new PDS services are attached.

For further information about PDS Standards development, please contact Sue Hess (JPLPDS::SHESS or shess@jplpds.jpl.nasa.gov or call (818) 306-6046).

Announcing PDS WAIS Information Sources

The Planetary Data System (PDS) is making available several prototype information sources through WAIS, Wide Area Information Servers, a public domain, distributed information retrieval system designed to allow searches over the Internet for sources of information based on search words. These PDS sources should be considered "beta" versions and any comments are welcome. It is also important to remember that WAIS returns the "most relevant" data, not necessarily "all" data meeting your criteria.

WAIS Client software is public domain and available for Macintosh, PC-DOS, MS Windows, and Unix/Motif platforms. To find out about getting WAIS Client software and accessing PDS WAIS sources, contact Ann Farny at afarny@jplpds.jpl.nasa.gov. For a "PDS and WAIS" information sheet, contact the PDS Operator. at pds_operator@jplpds.jpl.nasa.gov. If you already have a WAIS client and would like to access these sources, database names are given in parentheses below. The IP address and port information are:

:ip-address 137.79.108.113
:tcp-port 210

The PDS information sources include:

1. PDS Data Set Catalog Information extracted in a "report" format. Updated with each PDS data set catalog database update. ("catalog")
2. Planetary Science Data Dictionary, Revision C - descriptions and dictionary attributes for both OBJECTs and ELEMENTs. Updated with each set of changes to the PSDD database. ("psdd")
3. PDS Standards, Version 3.0. Updated with each Standards document or change page release. ("standards")
4. Data Preparation Workbook, Version 3.0. Updated with each DPW document or change page release. ("dpw")
5. PDS Templates, Version 3.0. Updated with each Standards document or change page release. ("templates")
6. PDS Standards Bulletin Board. Dynamic. ("sbb")

Other PDS related sources include Object Review Committee Minutes memoranda ("orc"), PDS brochure information ("one-pagers"), and Public Information Office (PIO) press release captions and images ("pio").