

Department of the Interior  
U.S. Geological Survey

# **LANDSAT PROJECT GROUND SEGMENT SYSTEMS ENGINEERING MANAGEMENT PLAN (SEMP)**

**Version 3.0**

**October 2007**



## **Executive Summary**

---

This Systems Engineering Management Plan (SEMP) outlines the engineering processes that the Landsat Project Ground Segment staff use to carry out the development and sustaining engineering activities of the Landsat systems located at the U.S. Geological Survey (USGS) Center for Earth Resources Observation and Science (EROS).

This document is configured and under the control of the Ground Segment Configuration Control Board (GCCB).

## Document History

---

| Document Number | Document Version | Publication Date | Change Number |
|-----------------|------------------|------------------|---------------|
| L7-PD-19        | Version 0.3      | March 2004       |               |
| L7-PD-19        | Version 1.0      | June 2004        |               |
| LS-PD-19        | Version 2.0      | July 2006        | CCR 3963      |
| LS-DIR-04       | Version 4.0      | October 2007     | CCR 4999      |

# Contents

---

|   |            |
|---|------------|
| <b>Executive Summary</b> .....                              | <b>ii</b>  |
| <b>Document History</b> .....                               | <b>iii</b> |
| <b>Contents</b> .....                                       | <b>iv</b>  |
| <b>List of Figures</b> .....                                | <b>v</b>   |
| <b>Section 1 Introduction</b> .....                         | <b>1</b>   |
| 1.1 Background.....   | 1          |
| 1.2 Purpose and Scope .....                                 | 1          |
| <b>Section 2 Systems Engineering Process Overview</b> ..... | <b>2</b>   |
| 2.1 Process Overview .....                                  | 2          |
| <b>Section 3 Systems Development Cycle</b> .....            | <b>4</b>   |
| 3.1 Project Initiation .....                                | 6          |
| 3.2 Requirements Development.....                           | 7          |
| 3.3 Preliminary Design.....                                 | 9          |
| 3.4 Detailed Design.....                                    | 11         |
| 3.5 Implementation .....                                    | 13         |
| 3.6 System Test.....  | 15         |
| 3.7 Project Closure .....                                   | 16         |
| 3.8 Emergency Deliveries .....                              | 17         |
| 3.9 Stakeholders .....                                      | 18         |
| <b>Section 4 Organizational Roles</b> .....                 | <b>20</b>  |
| 4.1 Systems Engineer.....                                   | 20         |
| 4.2 Software Engineering Lead.....                          | 20         |
| 4.3 Task Lead .....   | 20         |
| 4.4 Customer .....  | 20         |
| 4.5 Operations Lead .....                                   | 20         |
| 4.6 CM Analyst.....   | 21         |
| <b>Section 5 Additional Processes</b> .....                 | <b>22</b>  |
| 5.1 Configuration Management.....                           | 22         |
| 5.2 Requirements Management.....                            | 22         |
| 5.3 Risk Management .....                                   | 22         |
| 5.4 Security Management .....                               | 22         |
| 5.5 Document Management.....                                | 22         |
| 5.6 Trade Studies.....                                      | 23         |
| <b>Appendix A Glossary of Products</b> .....                | <b>24</b>  |
| <b>References</b> .....                                     | <b>27</b>  |

## List of Figures

---

|  |    |
|--|----|
| Figure 2-1. Systems Engineering Process Overview .....   | 2  |
| Figure 3-1. System Development Life Cycle .....          | 4  |
| Figure 3-2. Phased Development for Larger Projects ..... | 5  |
| Figure 5-1. Additional Processes .....                   | 23 |

## **Section 1 Introduction**

---

### **1.1 Background**

The Landsat Project is a joint initiative of the U.S. Geological Survey (USGS) and the National Aeronautics and Space Administration (NASA) to gather Earth resource data using a series of satellites. NASA was responsible for developing and launching the Landsat spacecraft. The USGS is responsible for flight operations, maintenance, and management of all ground data reception, processing, archiving, product generation, and distribution.

The primary objective of the Landsat Project is to ensure a collection of consistently calibrated Earth imagery. Landsat's Global Survey Mission is to establish and execute a data acquisition strategy that ensures repetitive acquisition of observations over the Earth's land mass, coastal boundaries, and coral reefs, and to ensure the data acquired are of maximum utility in supporting the scientific objectives of monitoring changes in the Earth's land surface and associated environment. The Center for Earth Resources Observation and Science (EROS) staff manages the Landsat 5 and 7 satellites for the USGS.

The Landsat Project objectives are met in part with various subsystems comprised of Commercial Off The Shelf (COTS) and custom-developed hardware and software. The Landsat Project employs technical staff to maintain and upgrade these systems as required to meet evolving Project goals.

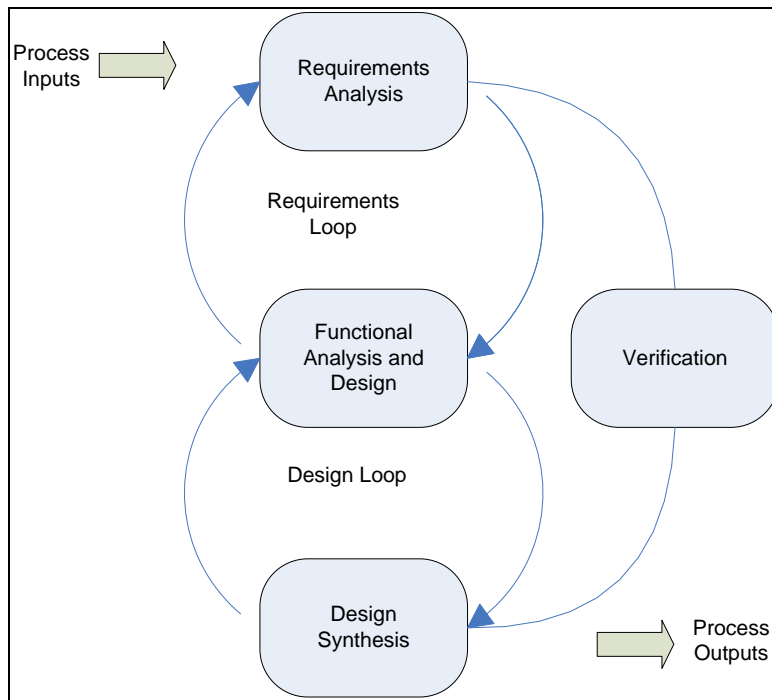
### **1.2 Purpose and Scope**

This Systems Engineering Management Plan (SEMP) describes the engineering practices employed in maintaining and developing ground systems for the USGS Landsat Project at EROS. This document serves as a guideline for the general procedures that Engineers and Developers must follow; it is not intended to explain how to accomplish each procedure. The Task Leads may determine to what degree they tailor the SEM to their system needs.

## Section 2 Systems Engineering Process Overview

### 2.1 Process Overview

The basic objective of systems engineering is to enable a development process to produce the desired outcome. Figure 2-1 shows a top-level view of the basic systems engineering process.



**Figure 2-1. Systems Engineering Process Overview**

The systems engineering process is concerned with four primary activities:

- Requirements analysis — the process of building a set of well-formed requirements that fully captures the customer objectives.
- Functional analysis and design — the process of transforming these requirements into a functional architecture for the system to be developed or modified to meet the requirements. The Project uses this functional architecture to verify that the Engineers/Developers captured the requirements correctly. Iteration between these first two phases is the Requirements Loop, which the Engineers/Developers complete to arrive at the best set of requirements. The Requirements Loop is equivalent to the Requirements Phase.
- Design synthesis — a process in which the functional architecture and requirements are transformed into a completed system design, and ultimately, into a complete implementation of the system requirements. During this design phase, there is some iteration with the functional analysis and design process in a Design Loop. This repeats until the selected design and functional architecture

best achieves the requirements. The Design Loop is equivalent to the Preliminary Design and Critical Design Phases.

- The verification loop — the final, and most critical, step in the process. At all phases, the Project compares the current process outputs against the current requirements to ensure that the Engineers/Developers complete the right work, and that the product meets the requirements.

The principle processes described above can be applied in an iterative fashion at all levels (see Section 2.1.1 for detailed description of all levels). Section 3 of this document outlines the specific implementation of this process for development in the Landsat Project. Because the Landsat Project is in a sustaining engineering mode, this process currently occurs mainly at the Subsystem Level.

### **2.1.1 Functional Decomposition Levels**

RM-09 Requirements Management Plan (RMP) specifies that the Project has four conceptual levels. Levels are the perspective by which the Engineers/Developers write the requirements, and are based on who requires the statement or requirement.

#### **2.1.1.1 Mission Level (Level 1)**

The Mission Level is a broad, high-level overview of the entire Landsat mission. USGS Management, in coordination with other agencies involved, directs the Mission requirements.

#### **2.1.1.2 Segment Level (Level 2)**

The Landsat Project consists of the Space Segment and the Ground Segment. These segments are derived from the Mission-Level requirements. The USGS provides direction and approvals at this level.

#### **2.1.1.3 Element Level (Level 3)**

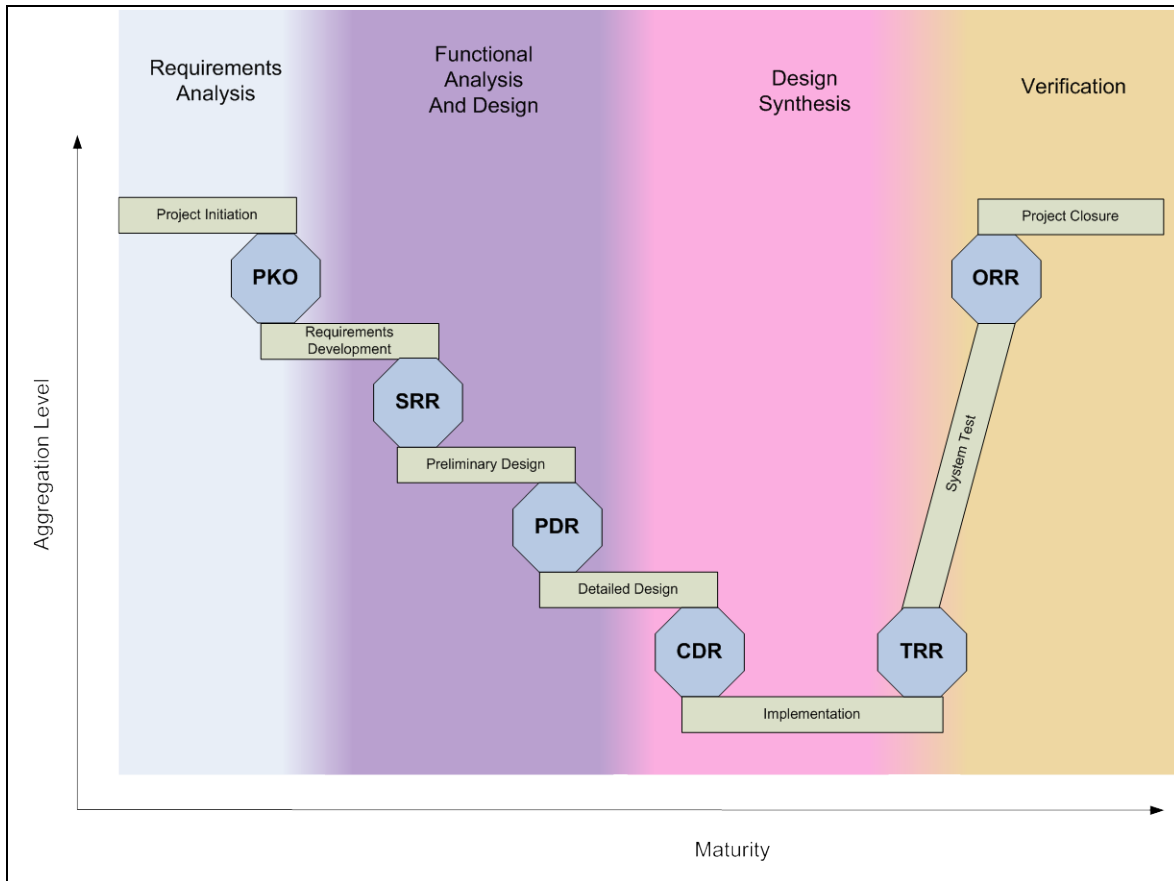
Elements are derived from Segment-Level requirements. One or more Elements can exist for each Segment. This document only addresses the Ground Segment's elements. The USGS Technical Support Services Contractor (TSSC) manages and directs the elements at the Ground Segment Configuration Control Board (GCCB). Currently, the Landsat Project has not defined standard element groupings.

#### **2.1.1.4 Subsystem Level (Level 4)**

Most engineering work in the Landsat Project occurs at the Subsystem level. Subsystems perform a specialized set of tasks and functions. Requirements are grouped logically into these subsystems. Subsystems are derived from the element grouping from which they belong.

## Section 3 Systems Development Cycle

The Project follows the System Development Life Cycle (SDLC) when developing a new system or implementing new features into an existing system. Figure 3-1 illustrates the development process.



**Figure 3-1. System Development Life Cycle**

This SEMP describes the steps shown in Figure 3-1. The Systems Engineering staff assigned to a specific system is responsible for tailoring this process to suit the system's needs. The text of each of the following sections provides specific tailoring guidelines.

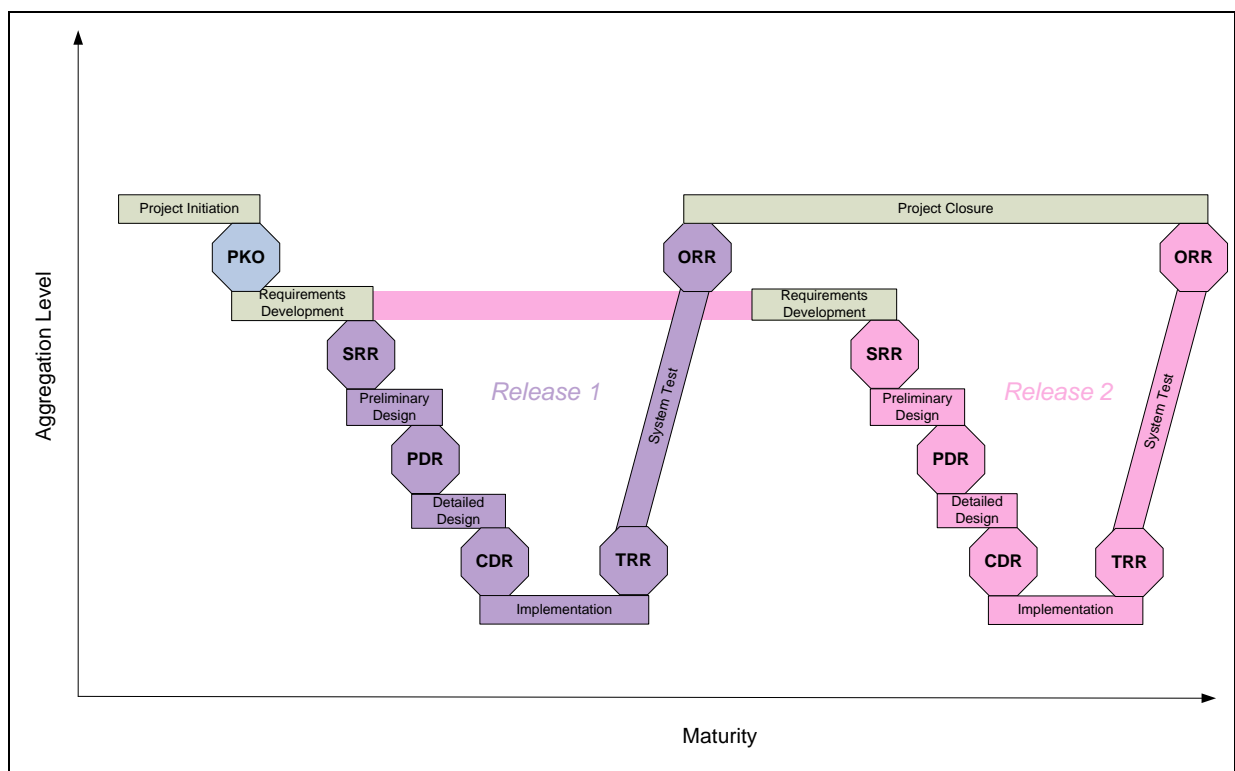
Figure 3-1 also illustrates how the SDLC process works down to successively finer levels of detail, and how the system maturity increases through all of the steps. Engineering begins at the highest level of aggregation, or the lowest level of detail, with the concept and requirements development. By implementation, all of the work is at a very high level of detail, dealing with individual modules of code or hardware.

This SEMP is optimized for the small- to medium-scale efforts, which represent the majority of the work in the Landsat Project. For particularly large-scale development

efforts, the concept of level becomes important. In such cases, each of these steps is applied at the top level and then again at one or more lower levels of design. For example, a mission-level requirements development activity may lead to the commencement of a mission-level preliminary design, concurrent with a new requirements development activity for each system that composes the mission. Each system that comprises the overall mission in this case follows the process described in this document.

The Project must apply this process to even small maintenance deliveries. These deliveries can consist of a small number of Configuration Change Requests (CCRs) fixed in one release. Even for these small efforts, the steps laid out in Section 3 still apply. (The tailoring guidelines in each section establish the minimum requirements for each phase.)

When developing large sets of functionality, it is preferable to separate the development work into two or more phases. The objective is to provide for a manageable amount of development for each phase. An additional advantage of this approach is that it allows the end users a chance to use an operational version earlier, and the Engineers/Developers can include feedback from this experience into later releases. Figure 3-2 illustrates this phase release process. At the requirements development step, the Engineers/Developers can split the requirements into two or more logical groups. Development of each group of requirements then takes place sequentially.



**Figure 3-2. Phased Development for Larger Projects**

The following sections contain references to specific documents used in the development cycle. For descriptions of these documents, please see Appendix A.

### **3.1 Project Initiation**

The first step in any project is to scope and plan the project. This is primarily a project management activity; however, Systems Engineers play a technical role in establishing the scope of work for the Project Manager.

The Project Initiation phase is mandatory, and the Project staff cannot skip this step for any project. The Project may scope this activity as appropriate for the activity at hand. A Project Kick-off (PKO) meeting is required. The PKO slides serve as the official project charter for the release.

#### **3.1.1 Inputs**

- USGS customer input
- CCRs
- Work Plan
- Lessons Learned from previous Project Initiation phases

#### **3.1.2 Key Activities**

- Soliciting customer/stakeholder requirements
- Planning and scoping engineering activities
- Developing Project Initiation documentation
- Preparing for PKO

#### **3.1.3 Products**

- PKO Presentation (serving as the Project Charter), including:
  - Key Project stakeholders
  - Objectives
  - Required resources
  - Risks and constraints
  - E0 (+/- 50%) schedule estimates
- Revised Work Plan (optional)
- PKO meeting
- Lessons Learned (if applicable)

#### **3.1.4 Performance Measures**

<none>

#### **3.1.5 Methods and Tools**

- Microsoft Project

- PKO meeting briefing template
- Serena TeamTrack
- Xerox DocuShare

### **3.1.6 Exit Criteria**

- Work Plan written or updated
- PKO meeting successfully held and signatures obtained

## **3.2 Requirements Development**

The Requirements Development process is a period spent repeating the Requirements Development loop shown in Figure 2-1. The end goal is to produce an operations concept and requirements for the system.

The Requirements Development process is mandatory and is the most important step in the development process. Although the Engineers/Developers scale this phase appropriately to the scope of the project, the time required to capture the requirements fully is time well spent. A large project may have all of the products described below. A smaller project may not produce as many documents, but it still develops the same content.

### **3.2.1 Inputs**

- PKO Presentation (serving as the Project Charter)
- USGS customer input
- Operations Concept Document (OCD)
- Requirements from the next higher level (if applicable)
- Existing OCD
- Existing Landsat Metadata Description Document (LMDD) (LS-DIR-05)
- Existing requirements (System Requirements Document (SRD)) (the SRD is optional at the Task Lead's discretion)
- New or existing Operations Agreement (OA) (if applicable)
- E0 schedule estimates
- Action items from the Project Initiation Phase
- Lessons Learned from previous Requirements Development phases
- Revised Work Plan (if applicable)

### **3.2.2 Key Activities**

- OCD formulation
- Requirements elicitation
- Requirements development
- Functional architecture formulation
- Interface requirements development
- Initial interface definition

- Update schedule
- Interface changes coordinated with impacted systems
- Requirements tracing
- Risk assessment
- System Requirements Review (SRR) preparation

### **3.2.3 Products**

- Baseline Operations Concept (optional at the Task Lead's discretion)
- Baseline Dynamic Object Oriented Requirements Software (DOORS) requirements module
- Baseline SRD (the SRR PowerPoint presentation may serve as the SRD per the Task Lead's discretion)
  - Requirements traceability matrix (objectives to requirements)
- E1 (+/- 30%) schedule for project completion (the E1 schedule delivery may shift to Preliminary Design Review (PDR) depending on the size and scope of the project)
- Updated Baseline LMDD, if applicable
- Updated Baseline Data Format Control Books (DFCBs), if applicable
- Updated Interface Control Document (ICD) draft(s), if applicable
- SRR
- Lessons Learned

### **3.2.4 Performance Measures**

- All requirements reflect customer-specified needs
- All affected requirements trace to release objectives

### **3.2.5 Methods and Tools**

- DFCB template (TPL-08)
- ICD Template (TPL-02)
- Microsoft Project
- Requirements Management Plan (RM-09)
- Requirements Management Tool User Guide (RM-01)
- Serena TeamTrack
- SRR briefing template
- Telelogic DOORS
- Xerox DocuShare

### **3.2.6 Exit Criteria**

The exit criterion for the requirements development phase is the successful completion of an SRR. The SRR is a peer- and customer-review event designed to ensure the programmatic and technical completeness of the requirements before proceeding with the design phases. At the SRR (as with every milestone review), the Project reviews

the remaining project schedule, milestones, and risks with the stakeholders. See Section 5.3 for more information on risk management.

The SRR must take place in some form for all development activities within the project. This is required because good requirements are critical to the success of any development project. The SRR may be scaled appropriately for the current task. Development of a new system may justify an eight-hour formal review with the Milestone Review Board (MRB). Approving requirements for inclusion in a quarterly sustaining development cycle may only require a brief review with the customer in an office. In all cases, completion of the SRR requires approval of the MRB (see Section 3.9.1). At the Task Lead's discretion, the formal Word document SRD may be waived and substituted with the SRR PowerPoint slides.

### **3.3 Preliminary Design**

After establishing the requirements, the Engineers/Developers begin the Preliminary Design phase. In this phase, they map out an implementation strategy and produce various design documents.

The Engineers/Developers may scope the Preliminary Design phase as appropriate to the activity in question. For very small development projects, the Task Lead may omit the entire Preliminary Design phase, and the project can move immediately to the Detailed Design phase. If they omit the Preliminary Design phase, the Engineers/Developers should communicate this at the SRR.

#### **3.3.1 Inputs**

- Baselined operations concept, if applicable
- Baselined SRD
- ICD drafts, if applicable
- Baselined DFCEB(s), if applicable
- Baselined LMDD, if applicable
- Existing Functional architecture
- Existing system documentation, if applicable
- Baselined Software Development Plan
- E1 (+/- 30%) schedule for project completion (depending on the project size/scope, this may shift to become a deliverable for Preliminary Design; if this is the case, E0 (+/- 50%) is the input)
- Action Items from the Requirements Development Phase
- Lessons Learned from previous Preliminary Design phases

#### **3.3.2 Key Activities**

- Functional decomposition and analysis
- Requirements allocation
- Final Interface distribution

- Physical architecture definition and analysis
- Prototyping
- Schedule development
- Interface changes coordinated with impacted systems
- Design and execution of trade studies
- Risk assessment
- Preliminary Design Review (PDR) preparation

### **3.3.3 Products**

- Updated SRD
- Trade study documentation and results, if applicable
- Draft Software Design Document (SDD), if applicable
- Functional and physical architectures draft, if applicable
- Draft ICDs, if applicable
- Prototype and demonstration results, if applicable
- E1 (+/- 30%) schedule (if not delivered during the Requirements Development Phase)
- PDR meeting
- Lessons Learned

### **3.3.4 Performance Measures**

- <None>

### **3.3.5 Methods and Tools**

- PDR briefing template
- Telelogic DOORS
- Serena TeamTrack
- Xerox DocuShare
- Telelogic System Architect
- Microsoft Project

### **3.3.6 Exit Criteria**

The exit criterion for the Preliminary Design phase is the successful completion of the PDR. The PDR is a formal peer review of the preliminary system design. At the PDR (as with every milestone review), the Project reviews the remaining project schedule, milestones, and risks. See Section 5.3 for more information on risk management.

Depending on the scope of the project, the Engineers/Developers may scale the PDR substantially. For large projects, high-risk projects, or where directed by the USGS, a full formal PDR must take place. For smaller development efforts, a formal PDR may not be necessary – in this case, a desk review may take the place of a formal PDR.

To complete a PDR successfully, the MRB must evaluate and approve the following items:

- Requirements are fully traced to functional architecture.
- Functional architecture is fully traced to physical architecture.
- Functional architecture is consistent with a signed OCD.
- All interfaces are identified and documented with baselined ICDs, if applicable.
- Schedules are updated.

### **3.4 Detailed Design**

In the Detailed Design phase, the Engineers/Developers refine the functional and physical architectures. Emphasis is at the physical implementation level, as compared to the Preliminary Design phase.

The scope of the Detailed Design phase is determined based on the amount of design work required. Documentation can range from full standalone versions of all relevant documents (SDD, Database Description Document (DBDD), System Test Plan (STP), ICDs), may consist only of changes to existing documentation (in the case of a maintenance delivery), or may be condensed down to a single design document for a very small project.

#### **3.4.1 Inputs**

- Baselined OCD
- Updated SRD
- Draft functional and physical architectures
- Draft ICDs, if applicable
- Baselined DFCBs, if applicable
- Baselined LMDD, if applicable
- Draft SDD
- Trade study documentation and results, if applicable
- Prototype and demonstration results, if applicable
- E1 (+/- 30%) schedule
- Action Items from the Preliminary Design phase
- Lessons Learned from previous Detailed Design phases

#### **3.4.2 Key Activities**

- Design optimization
- Initial database design
- Hardware design
- Software design
- Design tracing to requirements
- Interface changes coordinated with impacted systems
- Government Off The Shelf (GOTS)/COTS evaluation and assessment

- Risk assessment
- Schedule updates
- Critical Design Review (CDR) preparation

### **3.4.3 Products**

- Draft DBDDs, if applicable
- Baselined SDD, if applicable
- Baselined functional and physical architectures
- Baselined Entity Relationship Diagrams (ERDs), if applicable
- Baselined ICDs, if applicable
- Updated SRD
- List of user documentation to be developed, if any
- E2 (+/- 10%) schedule for remaining tasks
- CDR Meeting
- Lessons Learned

### **3.4.4 Performance Measures**

- Design is fully traced to affected requirements.

### **3.4.5 Methods and Tools**

- CDR briefing template
- Microsoft Project
- Serena TeamTrack
- Telelogic System Architect
- Telelogic DOORS
- Unified Modeling Language (UML)
- Xerox DocuShare

### **3.4.6 Exit Criteria**

The exit criterion for the Detailed Design phase is the successful completion of the CDR. The CDR is a formal peer review of the final system and software design. At the CDR (as with every milestone review), the Engineers/Developers review the remaining project schedule, milestones, and risks with the stakeholders. See Section 5.3 for more information on risk management.

Depending on the scope of the project, the Engineers/Developers may scale the CDR substantially (like the PDR). For large projects, high-risk projects, or where directed by the USGS, a full formal CDR must take place. For smaller development efforts, a formal CDR may not be necessary – in this case, a desk review may take the place of a formal CDR.

To complete a CDR successfully, the MRB must evaluate the following items:

- Requirements are fully traced to physical architecture.
- Physical architecture is consistent with a signed OCD.
- All ICDs are consistent with system design and approved by associated system owners.
- The design is complete and ready for implementation.
- The design is fully traced to requirements.
- The schedule is updated.

### **3.5 Implementation**

The Implementation phase is where the Engineers/Developers build the actual system. This includes procuring and setting up hardware and COTS items and coding software. The Systems Engineering staff refines test plans and assists with Unit and Integration Test activities.

Testing is always required for system releases. The Engineers/Developers can scale test documentation as appropriate for the size of the project, the operational requirements, and to meet specific customer demands.

#### **3.5.1 Inputs**

- Updated SRD
- Baselined functional and physical architectures
- Baselined Entity Relationship Diagrams, if applicable
- Baselined ICDs, if applicable
- Draft DBDD(s), if applicable
- Baselined SDD, if applicable
- Updated traceability matrixes, if applicable
- Existing Unit Test Plan (UTP), if applicable
- Existing Integration Test Plan (ITP)
- Existing STP
- List of user documentation to be developed, if any
- E2 (+/- 10%) schedule
- Action items from the Detailed Design phase
- Lessons Learned from previous Implementation phases

#### **3.5.2 Key Activities**

- Coding/development
- Test plan generation
- Unit Test Plan execution, if applicable
- Integration Test Plan execution
- Test Readiness Review (TRR) preparation

### **3.5.3 Products**

- Baseline DBDDs, if applicable
- Completed system (hardware and software)
- Software Build Guide
- System Configuration Build Guide
- Baseline UTP and test cases
- Baseline ITP and test cases (optional)
- Baseline STP and test cases
- Test cases traced to requirements (traceability)
- Version Description Documents (VDDs)
- Draft Users Guide(s)
- TRR meeting
- Lessons Learned

### **3.5.4 Performance Measures**

- All unit tests pass
- All integration tests pass
- All Test Discrepancy Reports (TDRs) are resolved or appropriately dispositioned, if applicable

### **3.5.5 Methods and Tools**

- Concurrent Versions System (CVS)
- IBM Rational Purify
- Microsoft Project
- Serena TeamTrack
- Telelogic DOORS
- Telelogic System Architect
- TRR briefing template
- Xerox DocuShare

### **3.5.6 Exit Criteria**

The exit criterion for the Implementation phase is the successful completion of the TRR. The TRR is a formal peer review of the final system design.

Depending on the scope of the project, the Engineers/Developers may scale the TRR substantially. For large projects, high-risk projects, or where directed by the USGS, a full formal TRR must take place.

To complete a TRR successfully, the MRB must evaluate the following items:

- All Unit Tests and Integration Tests were successfully completed.

- All TDRs from Unit Test (UT) and Integration Test (IT) have been satisfactorily resolved.
- The STP adequately tests all system requirements (traceability).
- The system test schedule and resources are appropriate.
- Interfaces are all ready and agreed to by all stakeholders.
- The system build plan is complete and appropriate.

### **3.6 System Test**

System Test is a key verification step in the system development process. In this phase, the Engineers/Developers implement the verification loop shown in Figure 2-1. The goal is to verify that the completed system meets all of the requirements.

The Engineers/Developers must execute system testing for all development activities completely, as described in the following sections.

#### **3.6.1 Inputs**

- Fully developed systems are ready for testing
- Baselined STP
- Draft Users Guide(s)
- ITP (optional)
- VDDs
- Software Build Guide
- System Configuration Build Guide
- Baselined DBDDs
- Test Cases traced to requirements (traceability)
- Action Items from the Implementation phase
- Lessons Learned from the previous System Test phases

#### **3.6.2 Key Activities**

- Executing STP
- Drafting operational procedures
- Tracking and resolving TDRs
- Training operators

#### **3.6.3 Products**

- Operations Readiness Review (ORR) meeting
  - Results of each test case
  - List of TDRs generated
  - TDR resolutions
- Baselined User Guide(s)
- Baselined Operational Verification Acceptance Document (OVAD) (without Operations sign-off)

- Delivered and Tested System(s)
- Lessons Learned

### **3.6.4 Performance Measures**

- All system test case results are accepted for the release
- All CCRs and TDRs are resolved or appropriately dispositioned

### **3.6.5 Methods and Tools**

- Microsoft Project
- ORR briefing template
- OVAD Template
- Serena TeamTrack
- Xerox DocuShare

### **3.6.6 Exit Criteria**

The exit criterion for the System Test phase is the successful completion of the ORR. The ORR is a formal customer review of the system test results.

Depending on the scope of the project, the Engineers/Developers may scale the ORR substantially. For large projects, high-risk projects, or where directed by the USGS, a full formal ORR must take place. For smaller efforts, an informal review in an office may suffice. In all cases, the ORR must conclude with signoff from the USGS customer.

To complete an ORR successfully, the MRB must agree to the following:

- All requirements have been met
- All tests identified in the STP have been successfully completed
- All TDRs have been satisfactorily dispositioned
- The system is ready for Operations
- The installation/build plan is complete and appropriate
- A drafted version of the OVAD is completed prior to entering the operational verification acceptance period

## **3.7 Project Closure**

The Project Closure phase (also known as the operational verification and acceptance phase) is where the Project verifies new system functionality in the operational environment. All system operators have an opportunity to exercise all of the functions and potentially discover problems that staff may have missed during the testing phases. This period typically lasts two weeks, but can be tailored to the size and scope of the project.

Project Closure may also pertain to releases that the Project closes early. Releases that the Project cancels (for any reason) may end at any point in the process, but still go through the Project Closure phase. In these cases, the inputs, key activities, products, and performance measures may not be applicable. The key steps are to ensure that the GCCB properly dispositioned the open CCRs and that staff has generated the Lessons Learned.

### **3.7.1 Inputs**

- Delivered and tested the system(s)
- Baselined STP
- Baselined OVAD (without Operations sign-off)
- Action Items from the System Test phase
- Lessons Learned from the previous Project Closure phase

### **3.7.2 Key Activities**

- Operation of the system
- Verification by Operations that all applicable change requests were delivered
- GCCB closes out the release and all related change requests

### **3.7.3 Products**

- OVAD approved by Operations
- Lessons Learned

### **3.7.4 Performance Measures**

- None

### **3.7.5 Methods and Tools**

- Microsoft Project
- Serena TeamTrack
- Xerox DocuShare

### **3.7.6 Exit Criteria**

- Operations approves and signs the OVAD
- The OVAD is delivered to the GCCB to close out the release
- All relevant CCRs are closed

## **3.8 Emergency Deliveries**

The need occasionally arises to make an emergency delivery. An emergency delivery consists of one or more changes to a system that Engineers/Developers must make on a very short time scale to meet customer requirements. For example, a spacecraft

anomaly occurs and software changes are required to support the testing and analysis related to the anomaly. This section outlines the tailored guidelines for emergency deliveries.

The Project may scope the Project Initiation activity down to an e-mail from the USGS customer explicitly listing the requirement(s) that the emergency delivery is to meet. The customer e-mail may satisfy the Requirements Development phase, if the requirements are clearly stated and understood from this e-mail. The customer e-mail serves as the SRR signoff in this case. If the Engineer/Developer must derive the requirements, they shall conduct a brief desk review with the customer.

The Engineer/Developer may combine the Preliminary Design and Detailed Design phases if they understand the changes. The Task Lead may approve Implementation with an e-mail to satisfy the CDR requirements.

Implementation is defined by the work to be performed, as always. Unit Testing and Integration Testing is required. The Engineers/Developers may draw acceptable UT and IT tests from the last set of UTP and ITP documents applied to the system(s) in question. The Task Leads may waive the TRR.

The Engineers/Developers must partially execute the system test phase. They should draw tests from a recent good STP and test critical operational functionality. They may omit STP procedures (recommended by a Systems Engineer, concurred by the Operations Lead, and approved by the Task Lead.)

The USGS customer must approve the move of the system into Operations. The ORR may consist of a desk or sit-down review of the steps and results, but the Engineer/Developer must obtain the USGS customer approval to enter into Operations at least in e-mail form or through a desk review.

The operational verification and acceptance period takes on special importance in an emergency delivery. Systems engineering staff works with Operations staff to follow up with additional system testing to verify that the emergency delivery did not adversely affect non-critical system functions. The OVAD should enumerate the additional system tests run following an emergency delivery.

### **3.9 Stakeholders**

Stakeholders are specific people or groups that have a stake in the outcome of a project. It is important to keep stakeholders informed of project progress during all phases. Milestone reviews are effective tools for communicating project status and schedule with stakeholders.

Project stakeholders are defined at Project Initiation. Common Project stakeholders include:

- USGS Customer

- Landsat Project Management
- Operations Leads
- Systems Engineers
- Crosscuts
- Data and Applications Support (DAS)

A few roles indirectly support each project. Though often overlooked, the team should remember to identify the following as stakeholders as well:

- Mission Systems Engineer (MSE)
- Configuration Management (CM) Lead
- Systems Support (SS) Lead
- Security Lead
- Hardware Engineering Lead

See Section 5 for more detail on these supporting roles and processes.

### **3.9.1 Milestone Review Board (MRB)**

The Project holds milestone reviews at the culmination of each phase. The milestone review is intended to act as a gate to the next phase. The Engineers/Developers invite all stakeholders to the milestone reviews. The MRB reviews the activities of the current phase. The MRB may choose to do one of the following after reviewing all milestone review material:

- Give approval to move the release to the next phase
- Place the release on hold
- Return the release to an earlier phase
- Cancel the release

The MRB consists of the USGS Mission Management Officer, Landsat Ground Segment Manager, and all applicable Landsat Task Leads. If required, the Crosscut Task Leads may also be recognized as part of the board. The Engineer/Developer must deliver the signed milestone briefing signature page to the Technical Writer for filing.

## **Section 4 Organizational Roles**

---

This section provides a general indication of the responsibilities of key organizational positions. On a smaller project, one staff member may fill part or all of several roles. On a large activity, a staff member may specialize and only perform a portion of the activities listed here. As individuals train and prepare to advance to new positions, they may take on additional responsibilities. Thus, this section remains only a general guide to help orient those new to the Project. Please see the Position Descriptions (PDs) in DocuShare to obtain a more detailed description of each position.

### **4.1 Systems Engineer**

In general, the Systems Engineer (SE) performs a broad range of activities, including leading the development of operations concepts, requirements, and architectures. The SE leads the preparation of all milestone reviews (except PKO) and is responsible for all of the system-level products such as ICDs, requirements trace matrixes, trade studies, risk assessments, hardware specifications, and STPs. The SE acts as the release manager for deliveries. The SE is responsible for handling most of the CM-related tasks for the project. (The SE coordinates the builds and other tasks with CM staff.)

### **4.2 Software Engineering Lead**

The Software Engineering Lead (SEL) manages the software-related processes for the project. For most projects involving significant software development, this begins with writing the Software Development Plan. The SEL leads the development of software requirements; unit and integration test plans and reports, the SDD, VDD, users guides, and build guides for CM.

### **4.3 Task Lead**

The Task Lead acts as the Project Manager for all development activities. The Tasks Lead applies project management principles and practices to help ensure that all of the projects are successful. This includes leading the development of the PKO presentation and leading the PKO meeting. The Task Leads have primary responsibility as keepers of the schedule and budget for each project.

### **4.4 Customer**

The customer provides the original need statements that lead to a task or project. The customer works closely with the team during the Project Initiation phase to provide feedback and ensure that the project goals are correct. The customer also sets the expectations for the process (acceptable risk, budgets, and required process steps) that shape the scope of the project. After Concept & Planning, the customer participates in key milestone reviews to verify that the project is proceeding as desired.

### **4.5 Operations Lead**

The Operations Lead has two primary roles. The first is the technical interaction in the development process: writing the OVAD, operating and validating system performance, and helping with the testing process. The second role is as an active participant in the

project from the earliest phases, to ensure that Operations needs are being folded effectively into the system concept and requirements.

#### **4.6 CM Analyst**

The CM Analyst is the shepherd of the configuration management and change control process for the Project. The CM Analyst builds the system for System Test (ST) and Operations in accordance with the VDD and applicable build guide(s). In addition, the CM Analyst enforces the CM process throughout all phases of the SDLC.

## **Section 5 Additional Processes**

---

This section describes other processes applied within the Landsat Ground Segment.

### **5.1 Configuration Management**

The Landsat Project shall apply a formal CM process. The CM Lead shall develop this process, and document it in a project configuration management plan (and other subsidiary documents as required). See CM-05 Configuration Management Plan, CM-04 Configuration Change Process, and CM-03 Configuration Control Board Charter for more information on Configuration Management guidelines.

### **5.2 Requirements Management**

Development of good requirements is the key to the success of all development activities. Therefore, the Mission Systems Engineer (MSE) is responsible for developing and updating the Project's Requirements Management Plan (RM-09). This plan establishes the procedures and requirements associated with requirements management. The MSE is also responsible for developing and maintaining the Level 1-3 documentation and assisting Level 4 engineers with Level 4 requirements questions.

### **5.3 Risk Management**

The Landsat Project has implemented a Continuous Risk Management Plan (LS-DIR-10). This plan sets guidelines for the risk management activities of the USGS and their responsibilities within the Landsat Project. Its intent is to help the Project identify risk and provide direction on how to develop mitigation strategies (including the risk-related items listed throughout Section 3 of this document).

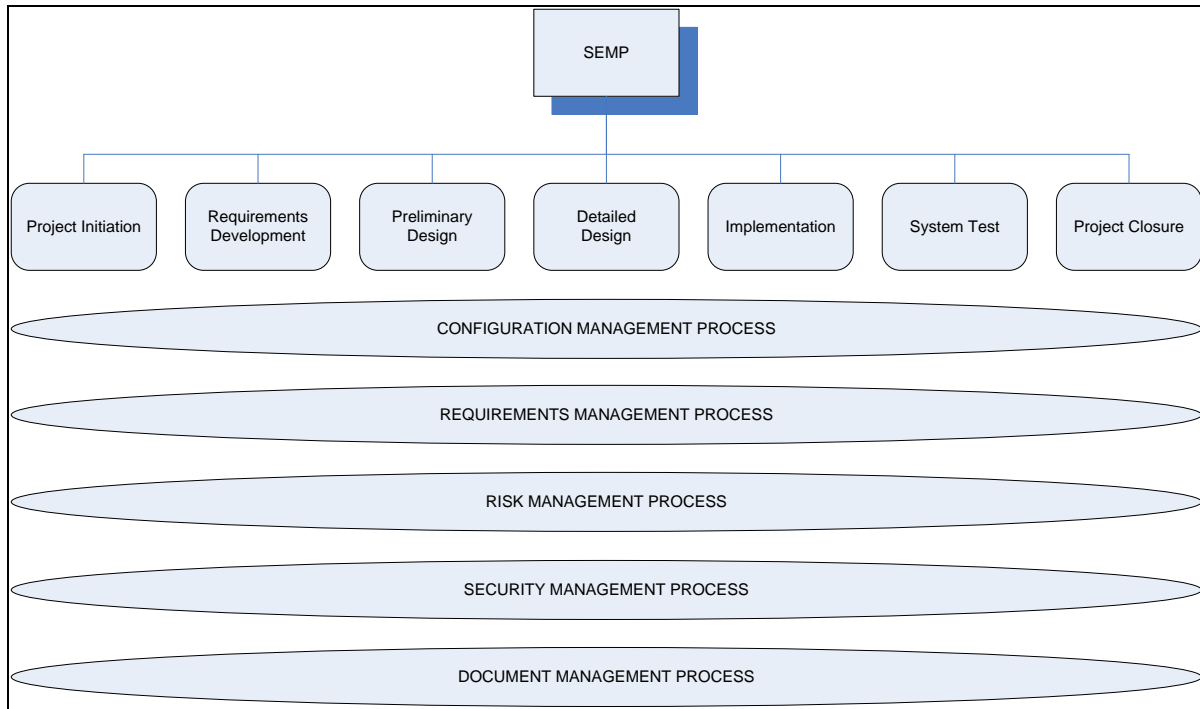
### **5.4 Security Management**

The Security Manager is the primary point of contact for all information technology security issues. The Security Manager shall follow prescribed information technology security methodology to ensure that the Landsat Project complies with all Government (Departmental and Bureau) laws, regulations, and policies. The Security Manager shall ensure that the Project develops, implements, and maintains the required security documentation. Refer to LS-SEC-04 Landsat System Security Plan for more details.

### **5.5 Document Management**

Document management is another integral part of the engineering process. The Technical Writer is responsible for updating and managing the Document Plan (LS-DM-01). The Document Plan explains the documentation management guidelines in detail and the tools used to manage documentation. LS-DM-02 Peer Review Process gives users a step-by-step walkthrough on how to conduct a document peer review.

All documentation shall conform to the Documentation Plan. The Task Lead may waive this requirement on a case-by-case basis.



**Figure 5-1. Additional Processes**

Figure 5-1 shows how different management processes apply to all stages of the systems engineering life cycle. Configuration management, requirements management, risk management, security management, and document management all play an important role in the successful implementation of the systems engineering life cycle. The Project must consider these processes at every stage.

## 5.6 Trade Studies

The Ground Segment may conduct trade studies, if required, at the beginning of the Preliminary Design stage. Trade studies help Engineers/Developers and project management evaluate the advantages and disadvantages of proposed products or approaches. The final result of a trade study is a recommendation of the most suited product or alternative with regard to cost, schedule, and risk.

## Appendix A Glossary of Products

---

| Product                                     | Description  | Primary Responsibility                                   |
|---|--|--|
| Algorithm Theoretical Basis Document (ATBD) | Algorithms used by a system for radiometric processing.  | Cal/Val Analyst  |
| Configuration Change Request (CCR)          | An electronic document (in TeamTrack) that summarizes a configuration change to a configuration-controlled system. It initially describes the problem / solution at a high level and is updated eventually to describe the required changes in moderate detail.  | SE (anyone can submit a CCR, but the SE is responsible.) |
| Data Format Control Book (DFCB)             | Defines specific data formats that the Project uses.   | SE   |
| Database Administration Guide (DAG)         | Contains information concerning the database administration of a system. It is based on the system's database design.  | Database Administrator (DBA)                             |
| Database Description Document (DBDD)        | Documents the database-related elements of the system design. It includes table schemas, constraints, indexes, sequences, synonyms, stored procedures, mappings, and database links.   | SEL  |
| Entity Relationship Diagram (ERD)           | Data model for high-level descriptions of conceptual data models. It provides a graphical notation for representing complex ideas.   | SEL  |
| Functional Architecture                     | Representation of the system at the functional level, typically found within the operations concept. Individual elements (boxes) within a functional architecture represent major functions, and do not necessarily map one-to-one into software and hardware elements. A functional architecture is an intermediate design step on the path to the physical architecture. | SE   |
| Integration Test Case                       | A step-by-step test evaluation of a particular system function. Integration test cases may reside in the Integration Test Plan. Otherwise, each integration test case may stand as its own document and simply be referenced by the ITP.   | SEL  |
| Integration Test Plan (ITP)                 | A detailed set of tests required to verify the functionality of a system within the larger system context. It typically emphasizes interface tests.  | SEL  |
| Interface Control Document (ICD)            | Detailed description of all aspects of the interfaces between two systems. It may include information on formats, timing, electrical specifications, and mechanical specifications.  | SE   |
| Interface Distribution                      | An allocation of interfaces between high-level entities to design elements. It may be part of a system description in an operations concept.   | SE   |

| <b>Product</b>                                      | <b>Description</b>  | <b>Primary Responsibility</b>    |
|---|---|----------------------------------|
| Landsat Metadata Description Document (LMDD)        | Defines all Landsat metadata and provides consistency across all systems to improve support and communication with customers. This document eliminates the potential differences between parameter names and parameter values. It also defines ground rules for naming, storing, and displaying Landsat metadata. | SE                               |
| Operational Verification Acceptance Document (OVAD) | Includes a brief summary of all functionality included in a delivery. Enumerates any problems uncovered during testing and (by signature of Operations staff) certifies that the functionality works as expected.   | Operations Lead                  |
| Operations Agreement (OA)                           | An agreement between two separate entities that outlines how the two entities will coordinate development and operational activities.   | SE                               |
| Operations Concept Document (OCD)                   | A document describing a system, including users, operational states, data flows, key requirements (not in requirements form), and use cases or operational scenarios to describe how the system operates.   | SE                               |
| Physical Architecture                               | The implementation architecture of the system, found in low-level operations concepts and system design documents. Individual elements represent discrete hardware and software modules.  | SE                               |
| Project Charter                                     | A succinct summary of the key objectives, stakeholders, resources, and high-level risks for a specific project.   | Task Lead                        |
| Prototype   | A rapidly developed system (hardware and/or software) that is developed to help refine elements of requirements and/or design.  | SEL                              |
| Requirements  | A set of detailed specifications for a system.  | SE                               |
| Requirements Traceability Matrix                    | A document (may be in document form or database form, e.g., DOORS) that describes the relationship between requirements, between requirements and test cases, and between requirements and architecture (systems).  | SE or SEL, depending on the type |
| Risk Assessment Database                            | A document identifying risks to a project, and mitigation strategies for significant risks.   | SE                               |
| Software Build Guide                                | A detailed procedure that describes how to build a software release using version management tools, compilers, and associated tools.  | SEL                              |
| Software Design Document (SDD)                      | For software projects, it describes the software design in detail. It may include database design (if not in a separate DBDD). Describes high-level code structure and COTS components, major operating states, etc.  | SEL                              |
| Software Development Plan (SDP)                     | A plan describing personnel resources, development tools (software tools and systems), and the philosophical approach and procedures to be used to achieve a specific software deliverable.   | SEL                              |
| System Administration Guide (SAG)                   | Contains information concerning the system administration of a system.  | System Administrator (SA)        |

| <b>Product</b>                       | <b>Description</b>  | <b>Primary Responsibility</b>                          |
|--------------------------------------|---|--|
| System Configuration and Build Guide | Detailed specification document for a hardware system. Includes mechanical, electrical, environmental, and other requirements that a hardware unit must satisfy.  | SE   |
| System Test Case                     | A step-by-step test evaluation of a particular system function. System test cases may reside in the System Test Plan. Otherwise, each integration test case may stand as its own document and simply be referenced by the STP.  | SE   |
| System Test Plan (STP)               | A detailed plan (procedures) of all tests required in order to verify that system requirements were met.  | SE   |
| Work Plan                            | A document describing key plans for the Landsat Project activities for a given fiscal year, including objectives, milestones, resources, budgets, etc.  | Task Lead  |
| Test Discrepancy Report (TDR)        | An electronic document (in TeamTrack) that identifies a problem uncovered during testing.   | SE (anyone can submit one, but the SE is responsible.) |
| Trade Study                          | Trade studies help Engineers/Developers and project management evaluate the advantages and disadvantages of proposed products or approaches. The final result of a trade study is a recommendation of the most suited product or alternative with regard to cost, schedule, and risk. | SE   |
| Unit Test Plan (UTP)                 | A detailed set of tests required to verify functionality within a system. Unit testing typically occurs in isolation and does not include testing of the target system in the larger system context.  | SEL  |
| Users Guide                          | A comprehensive guide to system operations for the system end users.  | SEL  |
| Version Description Document (VDD)   | A document that lists the changed software units, database configuration changes, operational changes, installation instructions, COTS/GOTS packages, and documentation impacts for a software release.   | SEL  |

## References

---

Please see <http://landsat.usgs.gov/resources/acronyms.php> for a list of acronyms.

USGS/EROS. CM-03. Ground Systems Configuration Control Board Charter. Version 6.0. August 2006.

USGS/EROS. CM-04. Configuration Change Process. Version 9.0. August 2007.

USGS/EROS. CM-05. Landsat Ground Segment Configuration Management Plan. Version 5.0. August 2006.

USGS/EROS. LS-DM-01. Document Plan. Version 2.0. February 2006.

USGS/EROS. LS-DM-02. Peer Review Process. Version 2.0. February 2006.

USGS/EROS. TPL-08. Data Format Control Book Template.

USGS/EROS. TPL-02. Interface Control Document Template.

USGS/EROS. LS-DIR-05. Landsat Metadata Description Document. Version 2.0. March 2007.

USGS/EROS. LS-DIR-07. Landsat Mission Level Requirements. Version 2.0. August 2006.

USGS/EROS. LS-DIR-10. Landsat Continuous Risk Management Plan (CRMP). Version 1.0. March 2007.

USGS/EROS. LS-SEC-04. Landsat System Security Plan. Version 2.0. June 2007.

USGS/EROS. RM-01. Requirements Management Tool User Guide. Version 5.0. April 2007.

USGS/EROS. RM-09. Requirements Management Plan. Version 1.0. December 2005.