Technical Memorandum

Supplement for Florida's Statewide Systems Engineering Management Plan

Writing a Project Systems Engineering Management Plan

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Version 4

Prepared for:

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List of Acronyms

AMBER ...... America's Missing: Broadcast Emergency Response
CFP ...... Cost Feasible Plan
CMB ...... Change Management Board
ConOps ...... Concept of Operations
CPAM ...... *Construction Projects Administration Manual*
CPM ...... Critical Path Method
DMS ...... Dynamic Message Sign
FDOT ...... Florida Department of Transportation
FHWA ...... Federal Highway Administration
I-10 ...... Interstate 10
ICD ...... Interface Control Document
ID ...... Identification
ITN ...... Invitation to Negotiate
ITS ...... Intelligent Transportation System
IV&V ...... Independent Verification and Validation
MOE ...... Measure of Effectiveness
MOP ...... Measure of Performance
MTR ...... Minimum Technical Requirement
MTTR ...... Mean Time to Repair
NTP ...... Notice to Proceed
O&M ...... Operations and Maintenance
PERT ...... Project Evaluation and Review Technique
PITSA ...... Project Intelligent Transportation System (ITS) Architecture
PSEMP ...... Project Systems Engineering Management Plan
QA ...... Quality Assurance
QC ...... Quality Control
QM ...... Quality Management
RITSA ...... Regional Intelligent Transportation System (ITS) Architecture
ROW ...... Right-of-Way
RTMS ...... Remote Traffic Microwave Sensor
RTVM ...... Requirements Traceability Verification Matrix
SEMP ...... (Florida's Statewide) Systems Engineering Management Plan
SEP ...... Systems Engineering Process
SITSA ...... Statewide Intelligent Transportation System (ITS) Architecture
SR ...... State Road
TMC ...... Transportation Management Center
TPM ...... Technical Performance Measure
TSP ...... Technical Special Provision
U.S. ...... United States
UPS ...... Uninterruptible Power Supply
WBS ...... Work Breakdown Structure

CHAPTER 1

DEVELOPING A PROJECT SYSTEMS ENGINEERING MANAGEMENT PLAN

1. Introduction

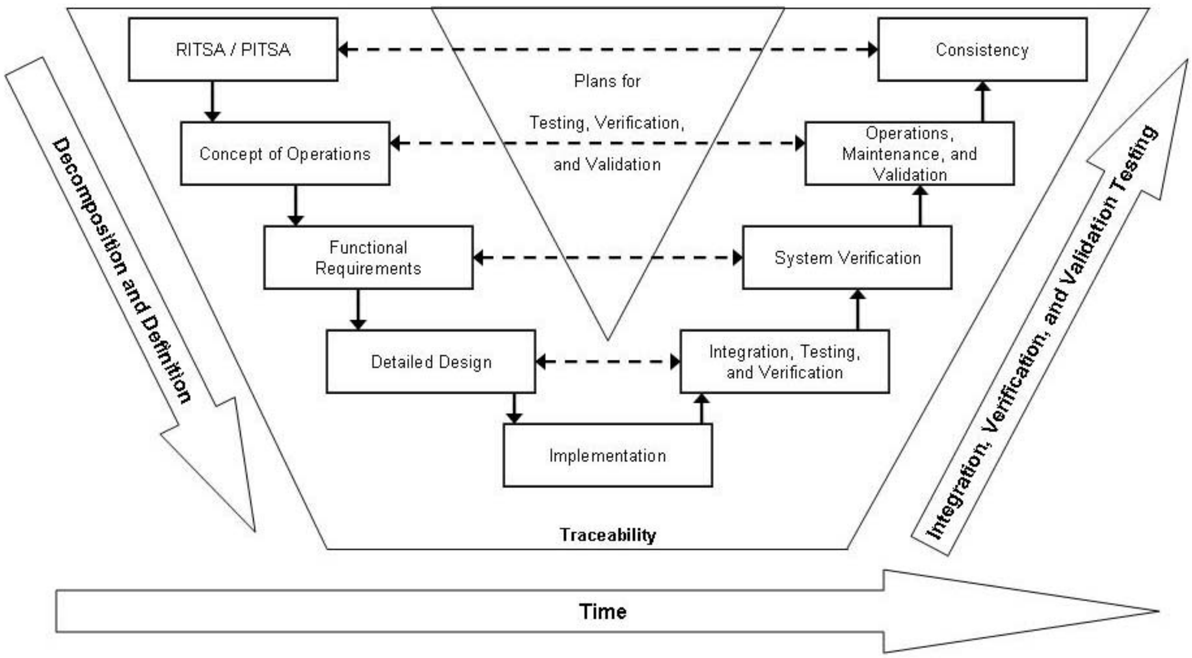
This document is both a tutorial and a template for your project systems engineering management plan (PSEMP). If you remove the number “1” from each paragraph header, you will have the correctly numbered outline for your PSEMP starting with 1.1. Tutorial text is in italics and boilerplate text that can be used as is will be presented in normal text.

In Florida Department of Transportation (FDOT) intelligent transportation system (ITS) projects, consultants and suppliers in the service/product development process will do the majority of the systems engineering work. Systems engineering processes (SEPs) vary depending on the nature of the project. For software development projects and complicated product development projects, SEPs are very extensive. But for projects where existing products are procured and installed based on user-defined requirements, SEPs are not that extensive. Florida’s Statewide Systems Engineering Management Plan, referred to herein as Florida’s Statewide SEMP,[1] provides an extensive description of SEPs and management control that can be used in software/hardware development projects to design/build or procure/install projects. Hence, Florida’s Statewide SEMP is used as a general reference while embarking on a new ITS project.

This document is an extraction from Florida’s Statewide SEMP in that it documents some basic SEPs that should be followed in all ITS projects that primarily deal with procurement and installation of equipment. The PSEMP will enable the ITS Project Manager to manage a project using systems engineering principles and methods. Systems engineering is a discipline that organizes work in a systematic way. By doing so, it eliminates the need to correct errors during later stages of the project. Figure 1.1 shows a simplified approach that systems engineering adheres to. This diagram is also known as the “V” diagram.

[1] *Florida’s Statewide Systems Engineering Management Plan* (Version 2, March 2005), FDOT Contract No. C-7772. Available online at http://www.dot.state.fl.us/TrafficOperations/ITS/ITS.htm, under the Systems Engineering keyword link.

Figure 1.1 – Simplified Systems Engineering Approach – the "V" Diagram



Following SEPs maximizes the quality of the system being implemented while minimizing the budget and time required for its completion. Hence it is the responsibility of the ITS Project Manager to instruct his/her staff, as well as consultants and suppliers, to adhere to pertinent SEPs as described in Florida's Statewide SEMP or this document, as the case may be.

Although the PSEMP has been created to satisfy a Federal Highway Administration (FHWA) requirement, the main purpose of the document is to guide the ITS Project Manager from project conception to the operations and maintenance (O&M) phases in a systematic way following systems engineering principles. The PSEMP is a living document in that it is updated continuously as various project steps are completed.

1.1 Document Overview

This document is the Project Systems Engineering Management Plan (PSEMP) for the *insert project name*. A PSEMP is a plan that helps manage and control a project utilizing SEPs.

The document is organized as follows:

- Section 1.2 – Need for a PSEMP
- Section 1.3 – Applicable Documents
- Section 1.4 – Applicable Systems Engineering Processes
- Section 1.5 – Project Management and Control

1.2 Need for a Project Systems Engineering Management Plan

The FHWA requires[2] states that desire federal assistance for ITS deployment projects to use a SEP to qualify for financial assistance. The PSEMP documents tasks to be performed for the coordination and control of all ITS device deployments.

Florida's Statewide SEMP is used as a reference guide in the creation of this PSEMP.

1.2.1 Project Identification

Project Name: *Insert the official project name.*

Financial Project Identification (ID): *Insert the financial project identification (ID) code.*

Federal Aid Project Number: *Insert the federal aid project number.*

1.2.2 Purpose and Scope

This document serves as the PSEMP for the *insert project name* of the Florida Department of Transportation (FDOT) District *insert District number, if appropriate, or delete the word "District."* It provides planning guidance for the technical management, procurement, installation, and acceptance of the *insert project name*, which includes *provide a general description of the project scope, such as install and maintain roadway surveillance and roadway information dissemination devices, etc.*

Further details of the project can be obtained by reviewing other documents, such as the project concept of operations (ConOps), quality assurance (QA) plan, O&M plan, etc.

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[2] 23 CODE OF FEDERAL REGULATIONS (CFR) PART 940, *Intelligent Transportation System Architecture and Standards – Final Rule* (January 2001). Available online at http://www.iteris.com/itsarch/.

1.2.3 Technical Project Summary Schedule

Provide an overview of the project's schedule. For example:

- *Advertisement .... February 2006*
- *Letting / Notice to Proceed (NTP)..March 2006*
- *Construction ....July 2006 to January 2007*
- *Fiber / Conduit Install...July 2006 to October 2006*
- *Poles / Cameras Install .... October 2006 to January 2007*
- *Pole / Remote Traffic Microwave Sensor (RTMS) Install . October 2006 to January 2007*
- *Dynamic Message Sign (DMS) Structure Install.............. October 2006 to January 2007*
- *Unit / Subsystem Tests..July 2007 to October 2006*
- *System Acceptance Tests ....January 2007 to March 2007*

Avoid providing a detailed schedule in this section – just an overview of the major events to give a general time perspective for the project should be included. The detailed schedule will be available once the project evaluation and review technique (PERT) chart is prepared as described in Section 1.5.2.

1.2.4 Relationship to Other Plans

Describe where this project fits into the funding organization's strategic plan in this section. At a minimum, refer to the Florida Department of Transportation (FDOT) Ten-Year ITS Cost Feasible Plan (CFP), if the project is identified in that document. Another reference plan includes the regional ITS architecture (RITSA). Specifically identify what part of the RITSA is being implemented. It is desirable that you mention at this stage what other project-specific plans, such as the quality assurance (QA) plan, the operations and maintenance (O&M) plan, etc., are being prepared for this project.

1.2.4.1 Relationship to Florida's *Ten-Year ITS Cost Feasible Plan*

The Ten-Year ITS Cost Feasible Plan (CFP) is a 10-year program and resource plan that identifies ITS projects in the overall context of Florida's ITS Corridor Implementation Plans.[3] It represents a commitment of state- and district-managed funds over a 10-year period to provide ITS funds in a coordinated statewide program to develop ITS infrastructure on Florida's major intrastate highways. The *insert project name* project is included in the Ten-Year ITS CFP.

[3] The FDOT's ITS Corridor Implementation Plans are available online at http://www.dot.state.fl.us/TrafficOperations/ITS/Projects_Deploy/Ten-Year_CFP.htm, under the Legacy Documentation link.

The FDOT's current Ten-Year ITS CFP (revised May 2005) is available online at http://www.dot.state.fl.us/TrafficOperations/ITS/ITS.htm, under the Cost Feasible Plan keyword link.

1.2.4.2 Relationship to Florida's *Statewide ITS Architecture*

The *insert project name* project is included in the District *insert District number (if applicable)* regional ITS architecture (RITSA), which was developed as part of the original Statewide ITS Architecture (SITSA) and updated in 2005. More information on the current SITSA is available online at http://www.consystec.com/florida/default.htm.

1.2.4.3 Relationship to Other "On-project" Plans

Describe other "on-project" plans in this section, such as the project QA plan, O&M plan, etc., that this Project Systems Engineering Management Plan (PSEMP) relates to.

1.3 Applicable Documents

The following documents, of the exact issue shown, form a part of this document to the extent specified herein. In the event of a conflict between the contents of the documents referenced herein and the contents of this document, this document shall be considered the superseding document.

Document #1, including the title, version, and date published	*Provide the name of the publisher or organization that controls document distribution and contact information so a copy can be obtained.*
Document #2, including the title, version, and date published	*Provide the name of the publisher or organization that controls document distribution and contact information so a copy can be obtained.*
Et cetera	*Et cetera*

1.4 Systems Engineering Processes

Describe the systems engineering processes (SEPs) that are typically followed in intelligent transportation system (ITS) deployment projects in this section of the PSEMP. All processes may not be required for every project. Conversely, other processes may be required, depending on the nature of each project. Tailor each PSEMP accordingly. Refer to Chapter 3 of Florida's Statewide SEMP for more details on SEPs.

Key processes that will be used are:

- Developing the project ITS architecture (PITSA)
- Creation of high-level requirements
- Creation of detailed requirements
- Trade-off studies, gap analyses, or technology assessments
- Technical reviews
- Risk identification, assessment, and mitigation
- Creation of the requirements traceability verification matrix (RTVM)
- Creation of performance measure metrics
- System test, integration, and acceptance planning

1.4.1 Developing the Project Intelligent Transportation System Architecture

Each project will most likely be identified in the RITSA. If that is the case, mention the market packages selected from the RITSA to develop the project ITS architecture (PITSA) in this section.

If for some reason a project architecture is not identified in the RITSA, a Turbo Architecture needs to be created for the project. Define the process used to create that architecture. Verify that all interfaces are defined and that interface control documents (ICDs) exist for all interfaces. If the ICDs do not exist, create those documents separately and refer to them here.

1.4.2 Creation of High-level Functional Requirements

The concept of operations (ConOps) document describes high-level project requirements from a customer and stakeholder perspective. This document is a must for all projects. There may exist a feasibility study or something similar that was done prior to the project kick-off. The project ConOps is created as a separate document at this stage and referred to here.

For most ITS projects, the ConOps can serve as the high-level functional requirements for the system; however, for complicated ITS projects, another stage of functional requirements — the system/subsystem requirements — needs to be developed based on the ConOps.

Appendix R of Florida's Statewide SEMP provides a template for the creation of a ConOps.

Appendix G of Florida's Statewide SEMP provides a template for the creation of the system/subsystem requirements.

1.4.3 Creation of Detailed Requirements

For 30 or 60 percent design/build projects, detailed requirements are referred to as minimum technical requirements (MTRs). The MTRs are developed based on high-level requirements as mentioned in Section 1.4.2 herein during the normal design/build process. The Design/Build Consultant develops detailed specifications based on the MTRs. Mention the MTR document that has been created.

For low-bid projects, the detailed requirements are referred to as the specifications and/or technical special provisions (TSPs). Specifications and/or TSPs are developed based on high-level requirements as mentioned in Section 1.4.2 herein for low-bid projects. Mention the specifications and/or the TSP document that has been created

1.4.4 Trade-off Studies, Gap Analyses, or Technology Assessments

As a formal decision analysis method, trade-off studies are used in situations where more than one alternative exists for a given product, system, or technology. For example, there are multiple detection units available to detect vehicle presence and measure traffic parameters. Choosing the best detector in a given situation will require a trade-off study. Trade-off studies can be done at several levels and at different times during the project.

A gap analysis focuses on determining the gap that exists between existing system capabilities and the desired system to be implemented.

When the same product or system can be built using different technologies, a technology assessment is completed to determine the right technology to use to build the product in the given situation.

If the trade-off study, gap analysis, or technology assessment processes are very involved, create a separate document and refer to that document here; however, if the processes are simple, document the information in this section itself.

Some of these studies may have been completed prior to the project kick-off date. If that is the case, mention those documents here.

1.4.5 Technical Reviews

A SEP requires several reviews to properly accomplish the various work items that are to be completed in a project. Section 4.6.1.1 of Florida's Statewide SEMP describes various reviews that can be performed for a project. Not all reviews are needed for all projects. Depending on the scope of the project, only a few reviews may be necessary. The ITS Project Manager should follow the District's design review process for design/build and low-bid projects. System engineers attend these reviews and document changes, which could be applicable to requirements and schedules. A requirement change that modifies stakeholder requirements is reported to the ITS Project Manager for a decision. Schedule changes are reported at the monthly project status review meetings as described in Section 1.5.7 herein.

Document planned project reviews in this section.

1.4.6 Risk Identification, Assessment, and Mitigation

Describe how various project risks will be identified and document them in this section. Risks are assessed as low, medium, or high. Begin with high-risk items and describe the measures that can be taken to mitigate the risks. Completion of these tasks will yield a risk matrix. Risks are evaluated throughout a project's life cycle, as risks may change during the course of the project. The following areas are specifically considered for risk identification:

- *Known problems in the existing system*
- *Operational danger*
- *Current technology*
- *Critical path tasks in the project schedule*
- *Et cetera*

1.4.7 Creation of the Requirements Traceability Verification Matrix

Once all requirements have been defined, create the requirements traceability verification matrix (RTVM). A sample RTVM is provided in Appendix A. The requirements will be derived from the ConOps, and the specifications and/or TSPs. The first column in the RTVM is the requirement ID, which is a sequential listing of requirements. The second column lists the section number where the requirement is mentioned in the requirements document. The third column gives the section heading for the section where the requirement originated. The fourth column states the requirement. The fifth column lists the verification method that will be used to verify the requirement. The sixth column lists the test case number, which may be a sequential number, for the test. The last column lists the compliancy of the requirement based on the test. The Test Manager will use the RTVM to ensure that each requirement is properly tested. The organization that defines the detailed requirements also creates the RTVM.

Appendix A is the RTVM for the project.

1.4.8 Creation of Performance Measure Metrics

The systems engineering team must define system effectiveness measures that reflect overall stakeholder expectations and satisfactions. Relate the measures to project stakeholder goals and objectives.

The performance measures can be categorized as follows:

- *Safety measures*
- *Protection of public investment measures*
- *Interconnected transportation measures*
- *Travel choice measures*

There are two ways to evaluate how well a system design meets its requirements. One is by defining measures of effectiveness (MOEs) and the other is by defining measures of performance (MOPs).

Customers or stakeholders will use MOEs to measure satisfaction with products produced by the technical effort.

The MOPs are the engineering performance measures that provide the design requirements needed to satisfy the MOEs. There could be several MOPs, which are sometimes referred to as technical performance measures (TPMs), for each MOE.

After functional system requirements are defined and low-level requirements are allocated by the Systems Engineer to the subsystems, components, and elements of the system, the Systems Engineer will select or specify the requirements that are testable. Testable requirements are MOPs that can be traced to stakeholder requirements and their MOEs.

The RTVM prepared in the previous section will already include some of the MOPs, depending on the depth of requirement included.

Describe the MOEs and MOPs that will be used during the project in this section, or create a separate document and refer to it here. The Test Manager will use these during system acceptance.

For construction projects, a separate set of performance parameters are developed as described in Section 13.1 of the Construction Project Administration Manual (CPAM), available online at http://www.dot.state.fl.us/Construction/ under the Forms & Manuals link.

1.4.9 System Testing, Integration, and Acceptance Planning

Describe the system test and evaluation methodology in this section. Include the system integration testing methodology here, too. It is recommended that a phased integration approach be used. Refer to Section 3.3.10.3 of Florida's Statewide SEMP for details on this subject.

Describe the process that will be used for the FDOT to accept the system. If the FDOT is the Systems Integrator, then describe how the FDOT will accept the subsystems.

Typically, this section includes the following:

- *Test approach*
- *Test schedules*
- *Test tools*
- *Test facility*
- *In-process test plans*
- *System integration test plan*
- *System acceptance criteria*
- *Integration and testing organizational responsibilities*

The Construction Consultant will provide the test plan. The Construction, Engineering, and Inspection (CEI) Consultant will use the RTVM and the test plan to determine if a test should be accepted or rejected based on results.

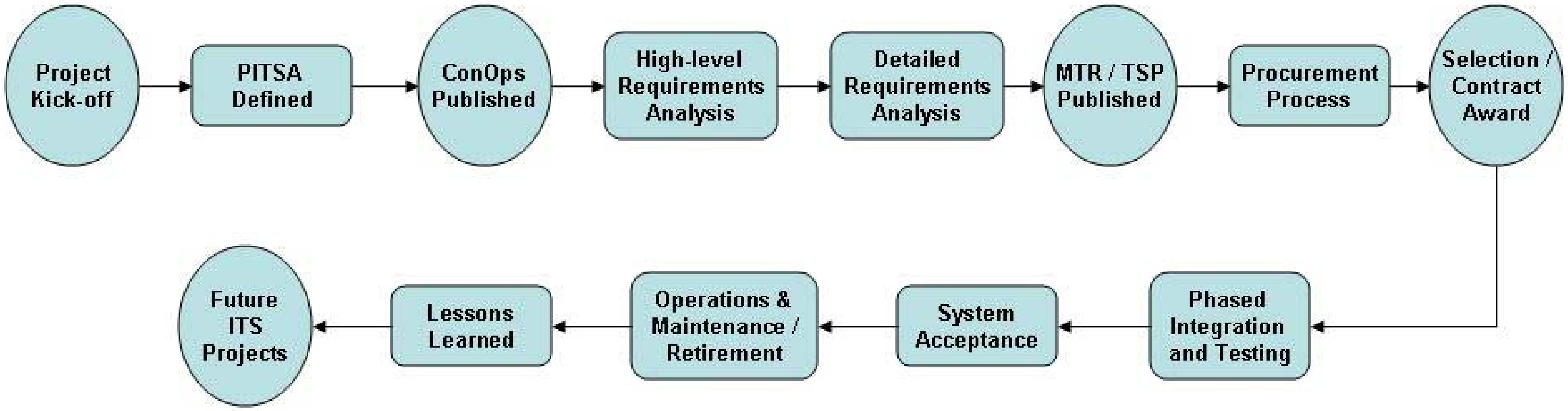
1.5 Project Management and Control

Describe the project management and control needed to successfully complete the project in this section. Also, identify the tasks that need to be performed to achieve these goals and define the organizational responsibilities required for accountability in the project.

The successful completion of SEPs described in Section 1.4 herein form the backbone for project success. The ITS Project Manager's responsibility is to ensure that tasks are completed on schedule and at cost. Hence, the ITS Project Manager's responsibility is to put in place proper controls that help achieve this goal.

Figure 1.2 shows stages for an ITS project. The ITS Project Manager's responsibility starts with project kick off and ends with O&M. There will be various people and organizations that help throughout this process. The Systems Engineer will typically select the RITSA market packages to define the PITSA. The Consultant will typically perform duties including, but not limited to, the high-level requirements analysis to publication of the MTRs/TSPs. The District office will be responsible for the procurement process, and selection and award of the contract. A Consultant will perform construction/installation, which will be supervised by the Construction Project Manager on behalf of the ITS Project Manager. System acceptance will be supervised by the District office or an independent verification and validation (IV&V) team. The maintenance department will take over after the system has been accepted.

Figure 1.2 – Intelligent Transportation System Project Stages



The following areas will be covered in this section:

- Organization structure
- Managing the schedule with a project evaluation and review technique (PERT) chart, and the critical path method (CPM)
- Procurement management
- Risk management
- Subcontractor management
- Engineering specialty integration
- Monthly project status reviews
- Change management
- Quality management (QM)
- Systems acceptance
- Operations and Maintenance / Upgrade / Retirement
- Lessons learned

1.5.1 Organization Structure

Describe project organization and responsibilities as they relate to the specific tasks to be performed in this section. List the names of functional managers and delineate their responsibilities in this section. Provide a description and diagram of the interaction between functional organizations, including the structure of the systems engineering organization and the responsibilities of all organizations. The ITS Project Manager is in charge of the project overall, and may designate other people from time to time to manage certain aspects of the project on his behalf. But the responsibility still lies with the ITS Project Manager.

Describe the organizational structure of the project here and clearly define responsibilities. Include items such as:

- *Who will get environmental permits*
- *Who will perform surveying and geotechnical investigation*
- *Who will get roadway permits, etc.*

1.5.2 Managing the Schedule with the Project Evaluation and Review Technique and the Critical Path Method

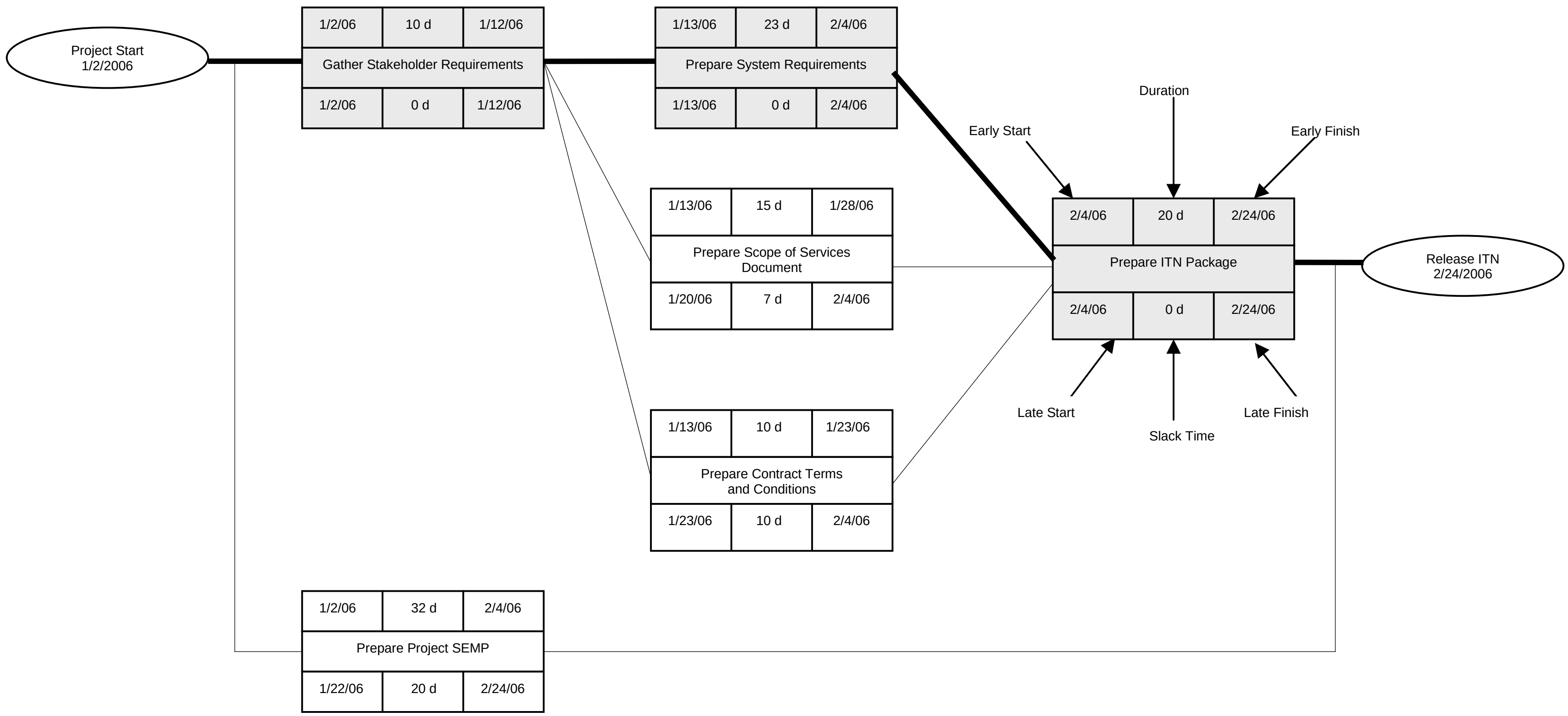
The PERT/CPM is one of the most efficient methods available for managing a project schedule. Before a schedule can be prepared, high-level task items or product elements are broken down into smaller manageable units in a hierarchical fashion. Breaking down tasks in this fashion is sometimes called the work breakdown structure (WBS).

Prepare a PERT chart that shows all project tasks and task dependencies. It is critical that these dependencies are identified accurately and that no task is left open ended. It is the ITS Project Manager's responsibility to prepare this chart after receiving task details (either in the form of a segment of the PERT chart, or as start and end dates for individual tasks, staffing requirements, and task dependencies) from each responsible member of the project team, including consultants and contractors. The ITS Project Manager may delegate the creation of the PERT chart to the District Scheduling Engineer or a Consultant. Figure 1.3 shows a sample PERT chart. Further details on how to create a PERT chart are provided in Section 4.6.1.2.1 of Florida's Statewide SEMP.

The way a project schedule is managed is referred to as the critical path method (CPM). A critical path is the longest path in the PERT chart from start to finish. It is called the critical path because any delay in the activities on this path pushes forward the project completion date. The tasks on the critical path have no slacks. This means that their early/late start dates are the same and so are the early/late finish dates. In Figure 1.3, this path is indicated by bold lines and shadowed task boxes. All tasks are reviewed in the project review process and any date changes are entered in the PERT chart. Any time there is a delay in any task on the critical path, a flag is raised that this issue needs to be addressed immediately because this signals a delay in the project completion date. For this reason, the tasks on the critical path are reviewed more frequently than other tasks that have slacks — in other words, tasks that are not on the critical path.

Create your project PERT chart as soon as possible. Refer to the document where this chart can be found or attach the chart to this document if the chart is not very elaborate.

Figure 1.3 – Sample Project Evaluation and Review Technique Chart



1.5.3 Procurement Management

The FDOT does not perform software/hardware development or construction. For most projects, the FDOT will procure products or services from outside vendors and consultants. Therefore, the procurement process is very critical to overall project success. Section 4.4 of Florida's Statewide SEMP describes this procurement process in detail. The process varies depending on the nature of the products/services to be procured.

Describe the planned management process for the procurement of systems, products, and services in this section.

1.5.4 Risk Management

The preliminary risk identification, assessment, and mitigation strategies have been completed by the Systems Engineer as described in Section 1.4.6 herein. The ITS Project Manager reviews the matrix created by the Systems Engineer, and adds some project-level or external risks that he may think are important. This provides a new risk matrix. The new risk matrix is evaluated by the ITS Project Manger and the Systems Engineer on a regular basis, especially during or after major reviews.

Document the project's risk matrix in this section.

1.5.5 Subcontractor Management

Describe how the ITS Project Manager will manage the Subcontractor's technical work to ensure product control in this section. In most instances, a Prime Consultant or a Systems Integrator and not the FDOT will manage Subcontractor activities. The Systems Integrator or Prime Consultant assigns appropriate people to coordinate with the Subcontractor working teams. These people will oversee design reviews, system testing, etc. The ITS Project Manager requests PERT charts for the major tasks to be completed, either from the Prime Consultant or the Systems Integrator, and uses them to better oversee the processes.

Document who will manage the project's subcontractor activities in this section, as well as the scheduled reviews and how often the reviews are planned.

1.5.6 Engineering Specialty Integration

Engineering specialties are the highly specialized engineering disciplines needed in projects because the ITS Project Manager may not be an expert in all disciplines of a project or in successfully maintaining the system throughout its life cycle. The idea is to get members from different specialties involved in the project at an early stage and make them aware of their project responsibilities. There are various specialty engineering disciplines that may be required, depending on the complexity and nature of the project. Section 6.1 of Florida's Statewide SEMP details these specialties. Most of the specialties described in Section 6.1 are needed in system/product/process development phases, so they are the responsibility of the Systems Integrator or Consultant. Only one essential specialty is described here. If a project requires the involvement of more disciplines, more information is available in Section 6.1 of Florida's Statewide SEMP.

1.5.6.1 Integrated Logistics Support and Maintenance Engineering

This engineering specialty is responsible for determining the total support required for a system to ensure operational readiness and sustainability throughout its life cycle.

This specialty provides the following project input:

- Defines support requirements — for example, the mean time to repair (MTTR)
- Supports considerations that influence requirements and design
- Provides the necessary support package
- Provides operational support at a minimum cost

Mention the engineering specialties that will be used by a project in this section.

1.5.7 Monthly Project Status Reviews

The ITS Project Manager assesses project health based on technical progress, budget, and schedule performances, as well as risk status, at monthly project status reviews. Information from Systems Engineers, Systems Integrators, and/or Consultants is gathered, depending on the nature of a project. Various issues may be discussed at these meetings, but the following items must be discussed in detail:

- *Action item reviews and resolution*
- *Critical path item status reviews*
- *Major risk item reviews*

After each review, the schedule should be updated to reflect the project's latest status. Keep minutes from the reviews and the PERT chart in a separate document.

Describe how monthly reviews are conducted in this section. Refer to the document containing the review minutes and the PERT chart.

1.5.8 Change Management

The ITS Project Manager addresses changes in schedule and the subsequent impacts by adjusting the PERT chart and cost metrics. Sometimes changes in task durations give rise to a new critical path for the project, which must be monitored as the project proceeds.

Changes in some basic requirements need careful review. The ITS Project Manager informs stakeholders of changes to basic requirements and the subsequent outcomes. The ITS Project Manager decides if design changes will be accepted and the Construction Project Manager generally makes a decision regarding construction changes. If there are substantial construction changes, the ITS Project Manager, the CEI Consultant, and the Construction Project Manager generally make a decision regarding acceptance.

When dealing with a software project or other standard-related issues that will have statewide impact, the ITS Project Manager presents the issue to the Change Management Board (CMB) for resolution.

Follow the normal change order process for all changes on construction projects.

1.5.9 Quality Management

The ITS Project Manager must establish a quality management (QM) plan not only for internal project processes, but also for quality systems from vendors and consultants. A QM plan should contain both a plan to implement quality control (QC), and a plan to monitor and verify that quality standards are being achieved. Quality control is the process whereby quality is engineered into the products being deployed using inspection, testing, and audits of documentation. Quality assurance is the process of verifying that the product meets the quality standards established by the QM plan.

Describe the project's QM plan in this section. For construction projects, follow the statewide and District-specific QC/QA process that has already been established.

1.5.10 Systems Acceptance

The systems acceptance process is critical because this is where the FDOT becomes responsible for the continued maintenance and management of the systems, products, and processes delivered.

The ITS Project Manager must assign a Test Manager right after the requirements have been written. For construction projects, the Test Manager is part of the CEI team. The Test Manager uses the plans described in Section 1.4.9; the RTVM created in Section 1.4.7; and the MOEs and MOPs discussed in Section 1.4.8 to supervise the entire testing process. The Test Manager provides the status of all tests in report form to the ITS Project Manager, who carefully reviews the reports and decides on the final acceptance of the system.

Document the process included in the project for the FDOT to accept the system in this section. Describe in detail where the system developer or supplier obligation ends, and the system transitions to maintenance mode by the FDOT.

1.5.11 Operations and Maintenance, Upgrade, and Retirement

Once a system has been through the acceptance testing process and has been accepted, it moves into the O&M phase. In this phase, system problems could be resolved in one of many ways. An FDOT employee trained on the system could repair it. The manufacturer's warranty could be used to get it fixed. In some cases, the FDOT could contract with an outside agency to maintain the system. In any case an O&M plan should be written to spell out the details of how the system will be maintained and operated.

Once a system has been in operation for some years, it may be upgraded. The need for upgrade could be due to the availability of new technology that makes the existing system function better and extends its life. Refer to Section 7.2.5 of Florida's Statewide SEMP for more details on this subject.

Finally, there comes a time when the system is no longer able to function as it was intended to. This could be caused by normal wear and tear on the system; system maintenance has become too costly; and technological obsolescence because better and cheaper systems have become available, or because the equipment is no longer supported by the manufacturer. The time has come for the system to be retired. There are expenses involved in retiring a system that need to be considered during the project planning stage. Refer to Section 7.2.6 of Florida's Statewide SEMP for more details on this subject.

Mention the O&M plan that has been created for the project to support system operations, maintenance, upgrade, and retirement here.

1.5.12 Lessons Learned

In every project, there are lessons to be learned. Document the lessons learned for future guidance. Sometimes, it is feasible to have lessons learned from the project applied to the same project but, usually, lessons learned during a project will be valuable guidance for future projects.

Mention the lessons learned depository that has been created for the project.

Appendix A

Sample Requirements Traceability Verification Matrix

Table A.1 – Sample Requirements Traceability Verification Matrix

REQ ID	DOCUMENT AND SECTION	SECTION HEADING	REQUIREMENT SUMMARY	VERIFICATION METHOD	TEST CASE	COMPLIANT? YES / NO / PARTIAL / NA
1-1	1.3.1	System Purpose	Dynamic message sign (DMS) devices shall support America's Missing: Broadcast Emergency Response (AMBER) Alert program, supplement the work zone maintenance plan during construction of Interstate 10 (I-10) improvements, and provide an effective means of distributing information to motorists.	Inspection	TC1	
2-1	4.2	Description of the Desired Changes	Three DMS devices are to be located prior to key intersections in the Tallahassee area: • Two along I-10 (referred to herein as DMS #1 and DMS #2) • One on United States (U.S.) Highway 27 (referred to herein as DMS #3)	Inspection	TC2	
2-2	4.2	Description of the Desired Changes	DMS #1 shall be located less than one mile to the west of State Road (SR) 263 on I-10 right-of-way (ROW).	Inspection	TC3	
2-3	4.2	Description of the Desired Changes	DMS #1 shall be visible to eastbound traffic.	Inspection	TC3	
2-4	4.2	Description of the Desired Changes	DMS #2 shall be located slightly east of Exit 209 on I-10 ROW.	Inspection	TC4	
2-5	4.2	Description of the Desired Changes	DMS #2 shall be visible to westbound traffic.	Inspection	TC5	
2-6	4.2	Description of the Desired Changes	DMS #3 shall be located prior to John Knox Road on U.S. Highway 27 (Monroe Street) ROW.	Inspection	TC6	
2-7	4.2	Description of the Desired Changes	DMS #3 shall be visible to southbound traffic.	Inspection	TC7	
2-8	4.2	Description of the Desired Changes	The DMS devices shall be operated and controlled from the City of Tallahassee' transportation management center (TMC).	Inspection	TC8	
3-1	5.1	Description of the Proposed System	Communication with DMS devices shall be through dial-up connections or private fiber optic.	Inspection	TC9	

Table A.1
(CONTINUED)

REQ ID	DOCUMENT AND SECTION	SECTION HEADING	REQUIREMENT SUMMARY	VERIFICATION METHOD	TEST CASE	COMPLIANT? YES / NO / PARTIAL / NA
3-2	5.1.1	DMS Control Software	The project shall include DMS control software that allows each sign to be independently configured and operated from the Tallahassee TMC.	Inspection	TC10	
3-3	5.1.1	DMS Control Software	The DMS control protocols should conform to *National Transportation Communications for Intelligent Transportation Systems (ITS) Protocol (NTCIP)* standards that ensure that signs will be compatible with the SunGuide software system.	Test	TC11	
3-4	5.1.3	Reliability	An uninterruptible power supply (UPS) shall be provided for the AMBER DMS computer and its associated communication devices.	Test	TC12	
3-5	5.1.3	Reliability	A UPS shall be provided for each of the DMS devices.	Test	TC13	
3-6	5.3	User Involvement and Interaction	The DMS devices will also be used to support traffic incident management when they are not handling an AMBER Alert or construction alert. The AMBER Alert will have a lower priority than a traffic incident, but higher priority than a construction alert.	Inspection	TC14	
3-7	5.4	Support Environment	The manufacturer's software used to control the DMS devices will offer diagnostic capability, as well as operation and control.	Test	TC15	
TECHNICAL SPECIAL PROVISIONS (TSPs)						
Fiber Optic Cable						
4-1	633	Fiber Optic Cable	All materials furnished, assembled, fabricated, or installed shall be as per Section 633 of the Technical Special Provisions (TSPs).	Inspection, Test	TC16	
Detector Cabinet						
5-1	668	Detector Cabinet	All materials furnished, assembled, fabricated, or installed shall be as per TSP Section 668.	Inspection, Test	TC17	
America's Missing: Broadcast Emergency Response (AMBER) Alert System						
6-1	680	AMBER Alert System	All materials furnished, assembled, fabricated, or installed shall be as per TSP Section 680.	Inspection, Test	TC18	

Table A.1
(CONTINUED)

REQ ID	DOCUMENT AND SECTION	SECTION HEADING	REQUIREMENT SUMMARY	VERIFICATION METHOD	TEST CASE	COMPLIANT? YES / NO / PARTIAL / NA
System Communications Carrier						
7-1	684	System Communications Carrier	All materials furnished, assembled, fabricated, or installed shall be as per TSP Section 684.	Inspection, Test	TC19	
System Auxiliaries						
8-1	685	System Auxiliaries	All materials furnished, assembled, fabricated, or installed shall be as per TSP Section 685.	Inspection, Test	TC20	
Highway Signing (Dynamic Message Signs [DMSs])						
9-1	700	Highway Signing	All materials furnished, assembled, fabricated, or installed shall be as per TSP Section 700.	Inspection, Test	TC21	
Intelligent Transportation System (ITS) Infrastructure)						
10-1	785	ITS Infrastructure	All materials furnished, assembled, fabricated, or installed shall be as per TSP Section 785.	Inspection, Test	TC22	