CHAPTER 13 INTELLIGENT TRANSPORTATION SYSTEMS (ITS) PROGRAM

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CHAPTER 13 INTELLIGENT TRANSPORTATION SYSTEMS (ITS) PROGRAM

13.1 INTRODUCTION

These guidelines, "Intelligent Transportation System (ITS) Program", focus on federal-aid Intelligent Transportation Systems (ITS) project development procedures to ensure compliance with the federal ITS regulations, per Code of Federal Regulations (CFR), Chapter 23, Section 940 (23 CFR 940) entitled "Intelligent Transportation System Architecture and Standards." In addition, these procedures establish the roles and responsibilities for all parties who are involved in the federal-aid ITS process.

13.1.1 GUIDELINES OVERVIEW - ROADMAP TO ITS COMPLIANCE

The application and oversight process for ITS projects is different in some significant ways from the traditional roadway construction process. Because of this difference, many ITS projects have **not** been successful. This is especially true of ITS projects that involve something **new**, which the lead agency has not done before. This might include new technology or new software or new communications, or joint efforts with new partners. Because of the high risk of failure for certain ITS projects, a special process is required to help **mitigate those risks** and to avoid the waste of taxpayer's funds that occurs when ITS projects fall short.

The process is summarized immediately below and described in full detail in the following sections. The process varies depending upon degree of **risk** involved. As shown in Figure 13-1, there are three steps in the project funding and delivery process shown in Figure 13-1.

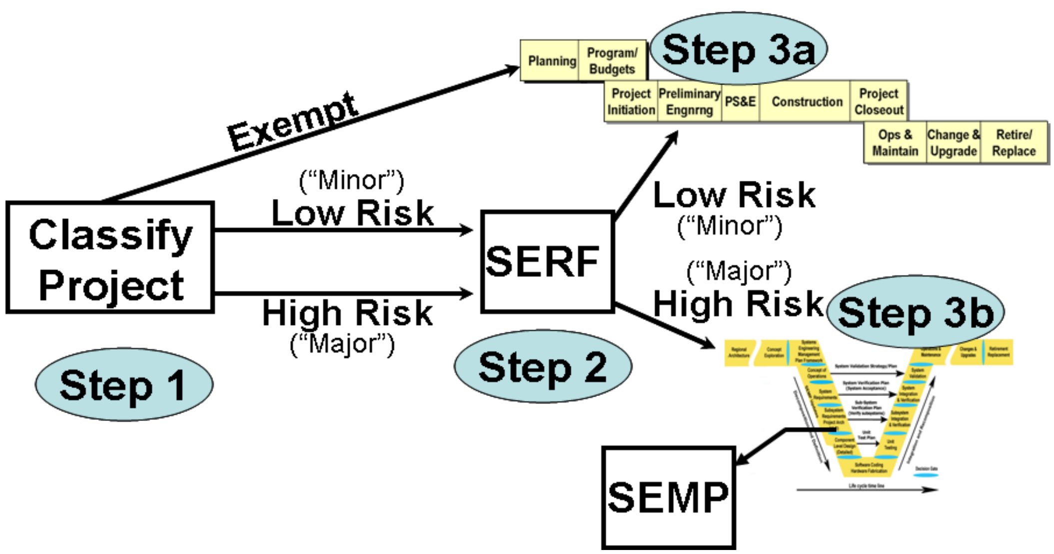

Figure 13-1: Steps to ITS Compliance

Step 1 occurs when the ITS project is added to the Transportation Improvement Program (TIP). The lead agency makes a **preliminary** classification of the project as **High-Risk**, **Low-Risk**, or **Exempt**. If the project is **Exempt**, then the remainder of the process is exactly the same as for a traditional road building project. **Low-Risk** and **High-Risk** projects proceed to Step 2.

Step 2 occurs when initial funding is requested. As part of the E-76 application package, the Project Manager must fill out a Systems Engineering Review Form (SERF), which consists of seven questions. Based on the answers, the project is classified as **Low-Risk** or **High-Risk**, then proceeds accordingly.

Step 3a – For **Low-Risk** projects, the remainder of the process (after the E-76 is approved) is *exactly the same* as for a traditional road building project.

Step 3b – For **High-Risk** projects, the traditional road building process is **not** appropriate. Instead, the best approach is usually a Systems Engineering process. A Systems Engineering Management Plan (SEMP) must be completed early in the process to help manage the detailed system design, implementation, and testing.

13.1.2 How to Use these Guidelines

The ITS Program Guidelines are written for a diverse set of audiences, including: MPO/RTPA planners, local-agency project implementers, Caltrans Division of Local Assistance (DLA), and FHWA ITS staff. Some readers have ITS experience, others none.

For those with experience in using the previous version of these ITS Program Guidelines, significant changes are included in this update. Emphasis is now placed on **management of risk**. This has introduced new definitions of types of ITS projects and associated examples. The approach to compliance with 23 CFR 940 now takes a closer look at characteristics of risk in addressing the SERF requirements. With the experience from implementation of the ITS Program Guidelines in 2004, the resultant approach is more clearly defined and has resulted in the "Roadmap" in Figure 13-1. A new section on Americans with Disabilities Act (ADA) Requirements has also been added. By no means do we suggest that the reader skip any section of these guidelines, but the significant changes will be found in the sections on "Types of ITS Projects," "ITS Project Development and Funding," and "ADA Requirements."

Any new users of these ITS Program Guidelines should familiarize themselves with the entire chapter. Over time the users will likely return to specific sections. For example, to clarify which type category a project falls into, the user may want to revisit section 13.2 on "Types of ITS Projects." To initiate project funding, the user may revisit section 13.5 on "Funding Process Step-By-Step Procedures."

13.1.3 Purpose of these Guidelines

The ITS Program Guidelines describe best professional practices for planning and implementing ITS projects. They also establish the roles and responsibilities for all parties who are involved in the federal-aid ITS process, as well as define the process required for all ITS projects that will utilize federal funds (in any amount). 23 CFR 940 requires that all federal-aid projects:

- be consistent with **the Regional ITS Architecture**,
- use applicable **ITS Standards**,
- perform a **Systems Engineering Analysis** that is commensurate with the scope of the project.

Designing and developing ITS projects represent a paradigm shift in the engineering mindset, compared to traditional highway projects. For example, ITS projects may not have a clear break between the preliminary engineering phase and construction phase. Furthermore, some ITS projects may not include a construction phase and will not be suitable for "low-bid" construction contracts. The nature of the engineering development for ITS projects also implies a greater risk and uncertainties to successful completion.

Although not a requirement, FHWA strongly encourages the use of the FHWA/Caltrans "*Systems Engineering Guidebook for ITS*" (http://www.fhwa.dot.gov/cadiv/segb) as a reference for organizing the ITS project tasks, defining work products, and managing the development. The terminology used in these ITS Program Guidelines is defined fully at the Systems Engineering guidebook website.

13.1.4 Target Audiences

The ITS Program Guidelines will be used by several audiences:

1.) **Planning agencies,** who will program the funds in the TIP and maintain the regional ITS architecture.
2.) **Local agencies,** who will carry out the projects. This includes their consultants, who may provide assistance with project management, and/or provide systems engineering technical assistance.
3.) **Caltrans DLA**, who will be the contracting agency for federal funding.
4.) **FHWA Division Office**, who will obligate federal funding and oversee some aspect of High-Risk projects.

Some of these participants may have little or no expertise in ITS, therefore, every effort is made to simplify the definitions and language in this guideline. A point to make is that no individual is expected to understand everything there is to know about systems, telecommunications, electronics, etc. in order to manage ITS projects.

As a relatively new field for most public-sector transportation managers, the knowledge required to successfully implement these projects varies widely. In particular, highly complex and risky projects require special knowledge and skills, which are often not available with local agencies. A certain amount of education and training will be necessary to comprehend and assure compliance with ITS regulations. Periodic training may also be necessary in order to keep up with technological changes in ITS.

For more information on ITS and Systems Engineering training opportunities, please see the USDOT ITS Professional Capacity Building Program website: http://www.pcb.its.dot.gov.

13.1.5 Definition of ITS

The definition of ITS has changed dramatically over the past decades, and it continues to evolve. Several decades ago, most people considered a computerized traffic signal to be “state-of-the-art” ITS. Today, every traffic signal is computerized and most people do not call them “ITS” – they are just “hardware” now. As state and local agencies have installed more and more electronic equipment over the past two decades, the emphasis of ITS has shifted from **internal** operational improvements to **external** coordination with other agencies, which enable each agency to achieve their mission more effectively. This **inter-agency cooperation** is the major objective of the Regional ITS Architecture (RA).

In 2001, 23 CFR 940 defined ITS as ***“…electronics, communications, or information technology, used singly or in combination, to improve the efficiency or safety of the surface transportation system.”*** This is a broad definition, covering the range from small, simple devices up to large and complex systems. In addition to this legal definition, most people say that **ITS must include comprehensive management strategies and apply technologies in an integrated**

manner. The purpose of ITS integration is to share information and reduce redundant spending between jurisdictions. ITS Integration includes both **technical** and **inter-agency** aspects of system development.

The inter-agency (or "institutional") challenge is to take advantage of the investment in infrastructure that has occurred over the years and use it to tackle **regional** mobility challenges. This means removing the institutional barriers that have existed in order to benefit a region as a whole. One example of institutional integration is sharing information between transit, arterial, and freeway agencies to improve flow for buses on the transportation network. Another type of integration is when agencies use technologies that are compatible with each other, such as traffic signals and emergency vehicle preemption to enable emergency vehicles to respond faster.

These ITS Program Guidelines reflect the latest ITS concepts by emphasizing "best professional practices" and requirements for ITS projects that are more complex and that include external cooperation. In contrast, procedural requirements for simple and Low-Risk projects have been simplified or eliminated.

To gain a basic understanding of ITS applications, please see the following USDOT website: http://www.itsoverview.its.dot.gov.

13.1.6 RISK MANAGEMENT

As said above, the application and oversight process for ITS projects is different in some significant ways from the traditional roadway construction process. This is because most ITS projects have **not** been successful. A successful ITS project is one which completes on schedule, within budget, and delivers all capabilities required. Studies of Information Technology (IT) application developments in the U.S. show 24% of projects are cancelled prior to completion. Further results indicate 44% were challenged (late, over budget, and/or with less than the required features and functions. This is especially true of ITS projects that involve something **new**, which the lead agency has not done before. This might include new technology or new software or new communications, or joint efforts with new partners. Because of the high risk of failure for certain ITS projects, special procedures are required to help **mitigate those risks** in order to avoid the waste of taxpayer's funds that occurs when ITS projects fall short.

Project risk may be defined in terms of schedule, cost, quality, and requirements. These risks can increase or decrease significantly based on several identified factors associated with ITS projects. The factors are:

1.) Number of jurisdictions and modes
2.) Extent of software creation
3.) Extent of proven hardware and communications technology used
4.) Number and complexity of new interfaces to other systems
5.) Level of detail in requirements and documentation
6.) Level of detail in operating procedures and documentation
7.) Service life of technology applied to equipment and software

The following Section 13.2 will address the level of each of these risk factors for types of ITS projects. For more information on Risk Management, the reader is encouraged to access the FHWA/Caltrans *Systems Engineering Guidebook for ITS* website at: http://www.fhwa.dot.gov/cadiv/segb/views/process/index.htm.

13.2 TYPES OF ITS PROJECTS

13.2.1 SUMMARY – TYPES OF PROJECTS

For purposes of these Guidelines, ITS projects are divided into three types: **Exempt, Low-Risk, and High-Risk projects**. The planning and development process to be followed is different for these three types. **The previous version of this Guideline referred to Low-Risk projects as "Minor" ITS projects, and High-Risk projects as "Major" ITS projects.** As a transition for the reader, both terms will be noted in these ITS Program Guidelines.

The following attributes can often be used to classify ITS projects as exempt, low, or high risk.

Exempt ITS projects do not require a Systems Engineering Analysis (SEA) and are not covered under these ITS Program Guidelines. All activities of the traditional roadway project development life-cycle process will be followed. No further ITS-specific action is necessary. They can be ***any*** the following:

1.) Upgrades to an existing traffic signal – This may include, for example, adding or revising left-turn phasing or other phasing, adding pedestrian-crossing displays.
2.) Installing an "isolated" traffic signal – This is a signal not connected to any type of external signal-control system, nor likely to be in the future because of its isolation.
3.) Traffic signal timing projects – This includes all "studies" whose purpose is to change the coordination parameters for controlling a group of signals – but with ***no*** installation of new hardware or software.
4.) Studies, Plans, Analyses – This includes ITS Master Plans, Deployment Plans, Technology Studies, etc. whose product is only a document, with no new hardware of software installed.
5.) Routine Operations – This includes operating and maintaining any ITS elements or systems – again with no new hardware or software installed.

Low-Risk (formerly "Minor") ITS projects are often referred to as ITS infrastructure expansion. Standard Plans, Standard Specification, and Standard Special Provisions are well documented. They will have ***all*** of the following characteristics:

1.) Single jurisdiction; single transportation mode (highway, transit or rail)
2.) No software creation; commercial-off-the-shelf (COTS) or proven software
3.) Proven COTS hardware & communications technology
4.) No new interfaces
5.) System requirements fully detailed in writing
6.) Operating procedures fully detailed in writing
7.) Project life-cycle not shortened by technology service life

High-Risk (formerly "Major") ITS projects are often referred to as ITS "System Developments." They have ***one*** **(or more)** of the following characteristics:

1.) Multi-Jurisdictional or Multi-modal
2.) Custom software is required
3.) Hardware and Communications are "cutting-edge" or not in common use
4.) New interfaces to other systems are required
5.) System requirements not detailed or not fully documented
6.) Operating procedures not detailed or not fully documented
7.) Technology service life shortens project life-cycle

These risk factors are discussed in more detail in Table 13-1.

Table 13-1 – Risk Assessment for ITS Projects

	Low-Risk Project Attributes	**High-Risk Project Attributes**	**Risk Factors**
1	Single jurisdiction and single transportation mode (highway, transit or rail)	Multi-Jurisdictional or Multi-modal	With multiple agencies, departments, and disciplines, disagreements can arise about roles, responsibilities, cost sharing, data sharing, schedules, changing priorities, etc. Detailed written agreements are crucial!
2	No software creation; uses commercial-off-the-shelf (COTS) or proven software	Custom software development is required	Custom software requires additional development, testing, training, documentation, maintenance, and product update procedures -- all unique to one installation. This is very expensive, so hidden short-cuts are often taken to keep costs low. Additionally, integration with existing software can be challenging, especially because documentation is often not complete and out-of-date.
3	Proven COTS hardware and communications technology	Hardware or communications technology are "cutting edge" or not in common use.	New technologies are not "proven" until they have been installed and operated in a substantial number of different environments. New environments often uncover unforeseen problems. New technologies or new businesses can sometimes fail completely. Multiple proven technologies combined in the same project would be high risk if there are new interfaces between them.
4	No new interfaces	New interfaces to other systems are required.	New interfaces require that documentation for the "other" system be **complete and up-to-date.** If not (and often they are not), building a new interface can become difficult or impossible. Duplication of existing interfaces reduces the risk. "Open Standard" interfaces are usually well-documented and low risk.
5	System requirements fully-detailed in writing	System Requirements not detailed or not fully documented	System Requirements are critical for an RFP. They must describe in detail all of the functions the system must perform, performance expected, plus the operating environment. Good requirements can be a dozen or more pages for a small system, and hundreds of pages for a large system. When existing systems are upgraded with new capabilities, requirements must be revised and rewritten.
6	Operating procedures fully-detailed in writing	Operating procedures not detailed or not fully documented	Standard Operating Procedures are required for training, operations, and maintenance. For existing systems, they are often out-of-date.
7	None of the technologies used are near end of service life	Some technologies included are near end of service life	Computer technology changes rapidly (e.g. PC's and cell phones become obsolete in 2-4 years). Local area networks using internet standards have had a long life, but in contrast some mobile phones that use proprietary communications became obsolete quickly. Similarly, the useful life of ITS technology (hardware, software, and communications) is short. Whether your project is a new system or expanding an existing one, look carefully at **all** the technology elements to assess remaining cost-effective service life.

13.2.2 Examples of ITS Project Types

An example of an **Exempt** ITS project would be the installation of traffic signal hardware (traffic controller/software, cabinet, detectors, etc) to control an isolated intersection in City A. It meets the signal warrants found in Chapter 4 of the California MUTCD, but there is no current or foreseen need to interconnect to other signals. No software development is needed; merely adjusting programmable settings and parameters for control. Standard plans, specifications, identified special provisions have been well documented over the years for the design and construction of signal control field equipment. The traditional roadway project development process will be used. Typical of this kind of project is for plans, specifications, and estimate (PS&E) to be developed, and construction contracts handled through a low-bid selection.

An example of a **Low-Risk** ITS project is the addition of 30 full matrix changeable message signs to an existing system that has five identical signs already deployed. No changes are needed to the existing central or field equipment. The system was initially designed to accommodate these additional signs so no additional software is needed. Assumptions are: 1) the initial system has been completed and the system is working well, 2) the contractor will deploy the signs, poles and foundations, controllers, and wire the controllers into the signs, and 3) the agency will add configuration information about the signs at the central computer. Updates to the existing plans have been reviewed to ensure that the original design and implementation is not adversely affected as a result of adding the elements.

During the design process, it may be discovered that a number of changes to the existing system are needed in addition to adding the expansion elements. This need could arise because of new and better technologies (or the old hardware is no longer available), or because of the desire to improve or expand the functionality of the “previous” system, or because of the need to use the system in a different way (e.g. sharing control with another party). **Any of these instances would elevate the project to a High-Risk implementation.**

Additional examples of **Low-Risk** ITS projects include:

- Adding five identical CCTV cameras to the existing 20 – with no other changes to the system or how it’s used.
- Adding 50 identical new loops to the existing 200 – no other changes
- Installing an existing parking management system at 2 additional garages – with no changes
- Expanding the pre-existing system/network by adding several more XXXX units – with no changes. (XXXX can be almost any ITS element)
- Expanding existing communications systems – this consists of extending existing fiber-optic or wireless communications systems, using the same technology and specifications as the pre-existing system.
- Leasing turnkey services only (e.g., website-based information service) – with no hardware or software purchases.

High-Risk ITS projects are often referred to as ITS System developments. For example, a High-Risk ITS project will result from adding the following new requirement to the previously described Low-Risk project: “The changeable message signs will have shared control with a partner Agency B.” For this example, Agency B manages events at two activity centers. As part of the installation, Agency A will be installing six signs that would assist agency B for their event management. Agency B would use the CMS to divert traffic to get the attendees in and out of the event faster and more safely. To enable this shared control, new software may need to be developed and integrated into the existing system. With this requirement for new functionality (shared control), new risks and complexity are introduced. Although the traditional roadway

Design/development and construction process is needed for the signs and controllers at each location, there will be a need for systems engineering to address the software development and integration efforts. In this example, revisions to the existing "concept of operations" and development of agreements for interagency coordination will be especially important to clarify expectations and avoid future disputes.

Additional examples of **High-Risk** ITS projects include:

- Multi-jurisdictional or multi-modal system implementation -- Because of the external interfaces required, these projects generally include substantial software development. For example:
  - A traveler information system that collects data from multiple agencies or modes
  - A Bus Traffic Signal Priority system between City Traffic and Regional Transit, or one that crosses multiple jurisdictions.
- The first stage of an "umbrella" system implementation. During this first stage, the full system engineering process would be used to develop the overall system framework plus the first implementation of that framework. For example:
  - New Traffic Signal Coordination system design plus implementation at an initial number of signals, with more signals added in later project(s).
  - New Traffic Information System design plus the first implementation in Cities X and Y, with more cities added in later project(s).
  - New Electronic Fare-Payment System design and initial implementation on Metro buses, with other transit agencies added in later project(s).

  If subsequent stages replicate the initial implementation, they would not be high risk. Instead, they fit the definition of a low risk ITS project, expanding the existing system with no new capabilities, and no new interfaces.

13.3 ITS PROJECT DEVELOPMENT AND FUNDING

The three types of ITS projects (Exempt, Low-Risk, and High-Risk) are linked to specific process by way of their risk characteristics. The traditional road building process as shown in Figure 13-2 has been used for many years. Design and installation is well documented. Over the years, requirements have become well defined, product performance is solid, and the technology is proven. As with roadway elements (pavement, drainage), ITS field elements (signals, CMS, CCTV, RWIS) are designed and constructed with Standard Plans, Standard Specifications, and Standard Special Provisions that are well documented. Risk of failure is low for these ITS projects, except when changing to new technology.

For **Exempt and Low-Risk** (formerly "Minor") ITS projects, the traditional single-phase PE obligation and authorization process will be followed. Work will include all activities of the traditional roadway project development life-cycle process leading up to construction. Funding steps for Low-Risk ITS Projects can be seen in Figure 13-2.

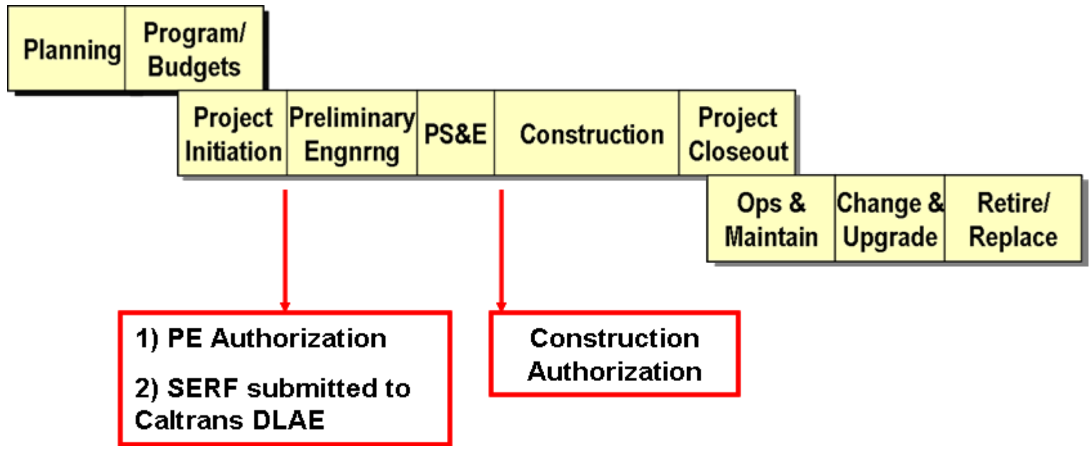

Figure 13-2: Process and Funding Steps for Low-Risk ITS Projects

More complex ITS projects lead to higher risk of failure (termination, time delays or cost increases). Additional elements are needed in the process of development to mitigate the higher risks. These additional elements can be thought of as extensions to the traditional road building process. The systems engineering approach is graphically depicted in Figure 13-3. To learn more about the Systems Engineering process, see the USDOT ITS Professional Capacity Building Program website: http://www.pcb.its.dot.gov, and FHWA/Caltrans "*Systems Engineering Guidebook for ITS*" at: http://www.fhwa.dot.gov/cadiv/segb/views/process/index.htm.

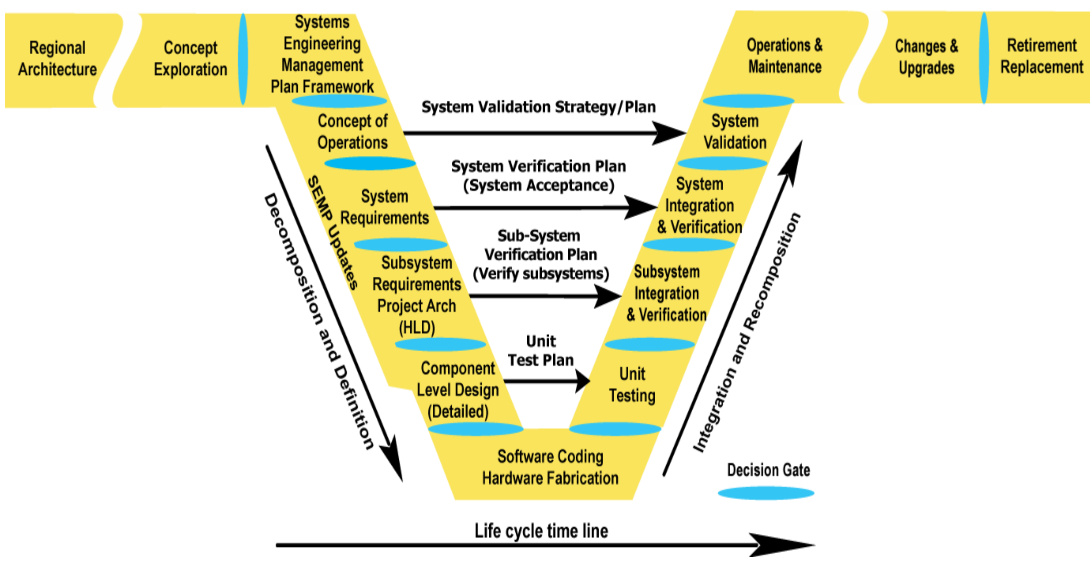

Figure 13-3: Systems Engineering Vee Life Cycle Process

For **High-Risk** (formerly "Major") ITS PE obligation and authorization is followed by two approval actions for project development to proceed. Figure 13-4 pinpoints where each approval occurs. A separate construction obligation and authorization will be needed for traditional roadway (infrastructure) improvements that accompany system development. Figure 13-4 does not infer that work provided by the PE contractor ends with Construction authorization. As shown in Fig 13-6 in Section 13.9, the same PE contractor will often be involved in system engineering activities on the right side of the Vee Life Cycle Process supporting verification and validation.

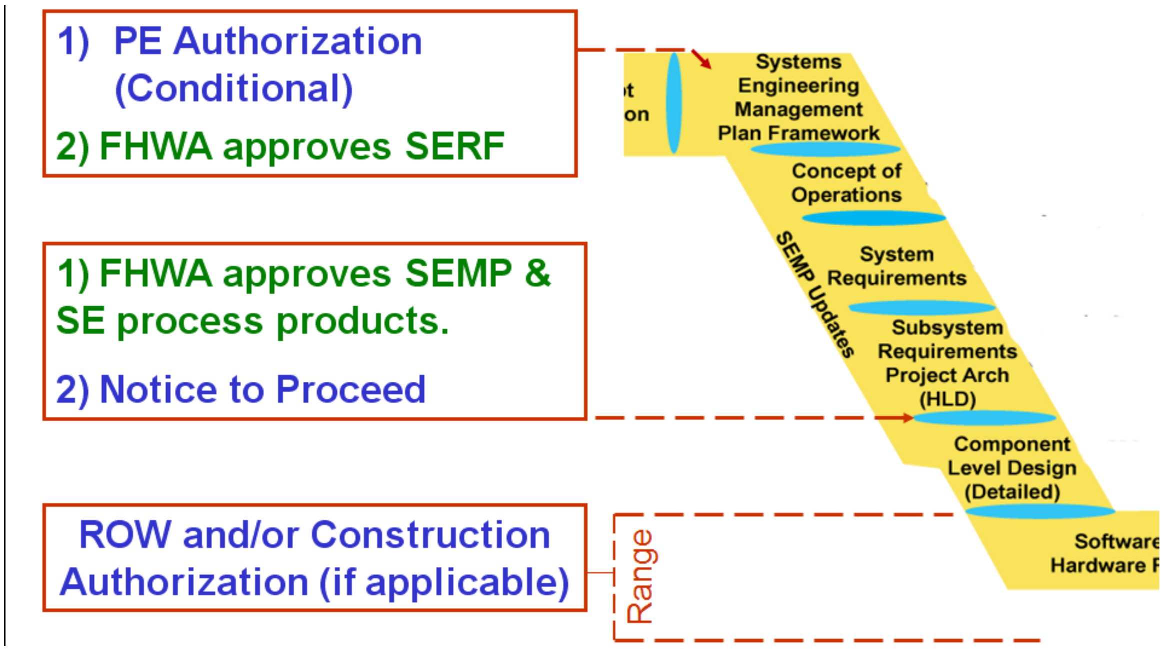

Figure 13-4: Funding Steps for Systems Engineering Process

Early determination of risk leads to early determination of type of ITS project, which leads to an early determination of budgeting approach. The systems engineering Vee process concentrates more time and cost on the up-front engineering activities relative to the traditional road building process that typically concentrates funding and scheduling priorities to the construction (back-end) phase.

For more information on Systems Engineering, the reader is encouraged to access the FHWA/Caltrans *Systems Engineering Guidebook for ITS* website at: http://www.fhwa.dot.gov/cadiv/segb/views/process/index.htm.

13.4 General ITS Responsibilities

This section describes ITS responsibilities, during planning and implementation of the project, from the perspective of four different roles:

1.) Regional/Metropolitan Transportation Planning Agency (RTPA/MPO)
2.) Local agency (including their consultants in a project management role)
3.) Caltrans Division of Local Assistance
4.) FHWA Project Engineer
5.) Communities

The user ***should*** read the section that corresponds to their role. The other sections are optional. For each role, the responsibilities are described for each of the three steps in the Roadmap below in Figure 13-5, which can be briefly described as Planning, Funding, and Implementation.

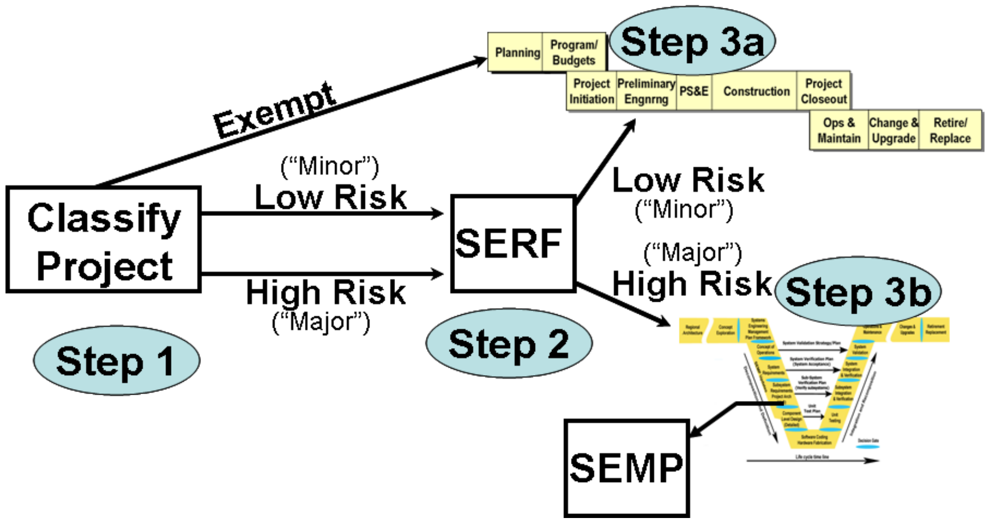

Figure 13-5: Steps to ITS Compliance

13.4.1 Regional/Metropolitan Transportation Planning Agency

Step 1 Roadmap Step 1

All ITS projects must be listed on the FTIP prior to obligation of funds. However, many ITS projects are not required to be listed individually, since they are classed as air quality exempt. Such projects may be lumped together in the FTIP. If a traditional roadway design project contains an ITS element, then the requirement for FTIP listing is determined by the overall project.

Because of this variation in project classification, projects with ITS elements may not be identified. For this reason, the MPO or RTPA is encouraged to coordinate with the local agencies (project sponsors) to "flag" ITS projects, or at least note the High-Risk (formerly "Major") ITS projects, within their FTIP submittal to Caltrans/FHWA. This may be a symbol designation within the current FTIP format, a separate page listing, or some other reporting means.

By delineating operational improvements from the rest of the capital program, this gives FHWA ITS Engineers opportunity to make pre-authorization outreach visits to project sponsors to assess degree of education, technical assistance, and oversight that will be needed before the project reaches its funding year. This can reduce risk of project failure.

Step 2 Roadmap Step 2

The regional planning agency (RTPA or MPO), as owner/maintainer of the regional ITS architecture, will assist the ITS project sponsor (local agency) to address the architecture aspects of the Systems Engineering Review Form (SERF).

For more information on regional ITS architectures, the reader is encouraged to access USDOT ITS Architecture website at: http://www.its.dot.gov/arch/index.htm.

Step 3 Roadmap Step 3

As each ITS project is implemented, the regional ITS architecture will need to be updated to account for any expansion in ITS scope, and to allow for the evolution and incorporation of new ideas. When actually defined or implemented, a project may add, subtract or modify elements, interfaces, or information flows from the regional ITS architecture. Because the regional ITS architecture is meant to describe the current (as well as future) regional implementation of ITS, it must be updated to correctly reflect how the developed projects integrate into the region.

Updates will be submitted by the local agency project manager. This can occur at two points in time during project development process. The first time is upon documentation of the project architecture at completion of the High-Level (functional) Design. Additionally, during implementation, project architectures may change. If so, the project manager will submit those changes at project completion.

A regional ITS architecture maintenance process is documented in the region, and used to make any changes.

13.4.2 Local agency (include consultants in project management role)

Step 1 **Roadmap Step 1**

The local agency is responsible for submitting their projects to the MPO/RTPA for inclusion in the State Transportation Improvement Program for Federal approval (FTIP). For projects that include ITS elements, the local agency makes a **preliminary** classification of the project's risk as exempt, low, or high. It may take a number of months for the project to be added to the FTIP, so Step 1 should be performed well ahead of the expected project start date.

If the project is considered **Exempt**, then all activities of the traditional roadway project development life-cycle process will be followed. Exempt projects are not considered "ITS" for purposes of these procedures and no further ITS-specific action is necessary.

Step 2 **Roadmap Step 2**

To initiate federal funding of the ITS project, the local agency verifies that the project is listed in the FSTIP and submits to Caltrans District Local Assistance Engineer (DLAE) the "Request For Authorization To Proceed With Preliminary Engineering" (LAPM Exhibit 3-A and associated data sheets (LAPM Exhibit 3-E). This is often referred to as the "E-76 Package" and the process of submitting and approving it is often referred to as the "E-76 Process."

This PE request will often include the completed Field Review Form (*LAPM* Exhibit 7-B) and associated Data Sheets (*LAPM* Exhibit 3-C to 3-I). This Field Review Form will include ITS administrative and financial elements to be addressed when applicable. To accommodate agencies with limited staffing, the Field Review Form may be submitted separate from the request for authorization to proceed, but within four (4) months after the Federal PE authorization date. See Chapters 3, "Project Authorization" and Chapter 7, "Field Review," of the *LAPM* for more information.

The completed Field Review Form includes an ITS Systems Engineering Review Form (SERF) that is required for all ITS projects. The SERF (LAPM Exhibit 7-I) provides responses to the seven requirements for systems engineering analysis within 23 CFR 940 Part 11. The SERF will assist the local agency in determining if the project is Low-Risk or High-Risk. If the local agency does not have enough information to answer all seven questions, the project is probably high risk.

This determination of risk is delegated to the local agency (project sponsor). Completion of the SERF is an opportunity to verify (or perhaps change) the preliminary determination of risk made during project programming in the Roadmap Step 1.

If the ITS project is **Low-Risk** (formerly "Minor"), the response to the SERF will be complete and will document conformance to 23 CFR 940. If DLAE agrees that the project is Low-Risk, then the PE obligation and authorization process is used.

IF the ITS project is **High-Risk** (formerly "Major"), response to some of the seven questions in the SERF can not be decided at this early stage. Responses in the SERF will identify the tasks when each question will be answered during the systems engineering process. PE is conditionally authorized after submittal of the initial request for authorization by the local agency. The condition specifies that a SEMP be approved and a Notice-to-Proceed (NTP) be granted by FHWA before the local agency may proceed with project implementation. Expenditures for such work prior to NTP are NOT eligible for reimbursement.

Step 3 **Roadmap Step 3**

Step 3a For **Low-Risk** ITS projects, the agency's project development process used for regular roadway projects will be followed. These activities are denoted as Step 3a in the "Roadmap to ITS Compliance". For purposes of these procedures, no further ITS-specific action is necessary. Refer to *Section 13.9 Procurement/Construction* for more information on procurement options.

Step 3b For **High-Risk** ITS projects, conformance to 23 CFR 940 will be completed in Step 3b of the "Roadmap of ITS Compliance" as the systems engineering tasks on the left side of the Vee process are undertaken (i.e., Concept of Operations thru High-Level Design).

If the project architecture - defined as part of the High-Level (functional) Design - adds, subtracts or modifies elements, interfaces, or information flows from the regional ITS architecture, these changes need to be submitted to the RTPA/MPO who maintains the regional ITS architecture. This can be done upon completion of the SEMP. In addition, if similar changes occur during implementation, the project manager should submit those changes at project completion.

Prior to the Component-Level Design task within the SE Vee process, the local agency submits to DLAE the Systems Engineering Management Plan (SEMP) and Systems Engineering process products. Upon receiving final SEMP approval and Notice-to-Proceed, the local agency may proceed with project implementation. Expenditures for such work prior to NTP are NOT eligible for reimbursement.

13.4.3 Caltrans Division of Local Assistance

13.4.3.1 District Local Assistance Engineer (DLAE) –

Step 1 **Roadmap Step 1**

The DLAE has no responsibilities during Step 1.

Step 2 **Roadmap Step 2**

The DLAE reviews the request from the local agency for PE authorization to assure satisfactory completion. For those local agencies that require additional time to process the Field Review Form, the DLAE will prepare and submit the E-76 for PE to Headquarters DLA Implementation.

Upon receipt of the Field Review Form, including the SERF, the DLAE verifies that the risk determination made by the local agency is correct. If the DLAE agrees that the project is **Low-Risk** (formerly "Minor"), the PE obligation and authorization process will be used and no further ITS-specific action is necessary.

If the project is determined to be **High-Risk** (formerly "Major"), the DLAE forwards the SERF to DLA Implementation and FHWA concurrently for review and approval. The DLAE verifies from the E-76 system that PE is conditionally authorized and that FHWA has obligated the funds before issuing authorization to proceed with PE. The condition specifies that a SEMP be approved and a Notice-to-Proceed (NTP) be granted by FHWA before the local agency may proceed with project implementation.

In the instance where the Field Review Form follows Federal PE authorization, further verification of the earlier determination of risk is performed. Where the information leads to a change in project type (Low to High or vice-versa), a corrected E-76 is submitted to DLA Implementation. In the instance of a Low- to High-Risk change, the corrected E-76 will either de-obligate the PE dollar amount for system design and implementation or will include a conditional statement that limits Notice-to-Proceed (NTP) to only the systems engineering tasks (Concept of Operations to High-Level Design) on the left side of the SE Vee.

Step 3 **Roadmap Step 3**

Step 3a For **Low-Risk** ITS projects, the project development process used for regular roadway projects will be followed by DLAE, noted as Step 3a in the "Roadmap to ITS Compliance." Refer to *Section 13.9 Procurement/Construction* for more information on procurement options.

Step 3b For **High-Risk** ITS projects, the systems engineering tasks on the left side of the Vee process are undertaken (i.e., Concept of Operations thru High-Level Design). The Systems Engineering Management Plan (SEMP) is sent to DLA Implementation and FHWA concurrently for review and approval. The DLAE transmits the SEMP approval and Notice-to-Proceed from FHWA to the local agency. System implementation can begin with receipt of the Notice-to-Proceed. Expenditures for such work prior to NTP are NOT eligible for reimbursement.

<u>13.4.3.2</u> Headquarters DLA Implementation –

Step 1 HQ DLA Implementation has no responsibilities during Step 1.

Step 2 For High-Risk ITS projects, DLA Implementation forwards the SERF to the FHWA ITS Engineer for review and approval. Upon notification of FHWA approval, DLA Implementation notifies DLAE, and PE may be authorized.

Step 3b DLA Implementation forwards the SEMP to FHWA for review and approval. Upon notification of FHWA approval and NTP granted, DLA Implementation notifies DLAE, who in turn notifies the local agency.

13.4.4 FHWA ITS Engineer

Step 1 **Roadmap Step 1**

The FHWA Project Engineer has no responsibilities during Step 1.

Step 2 **Roadmap Step 2**

If the project is a **High-Risk** (formerly "Major") ITS project, the SERF is submitted to FHWA for review and determination of level of federal oversight of the systems engineering process.

The following information defines the FHWA oversight of the Systems Engineering (SE) process for **High-Risk** ITS projects. Please note that **this oversight is limited to the ITS portions of the project only**. General oversight for all other aspects of the federal aid process will continue to be handled through the *Caltrans/FHWA Joint Stewardship & Oversight Agreement.*

The FHWA oversight process is built upon the common SE practice of using "control gates" as a project-management tool. It assumes that implementation of the ITS project (or the ITS elements within a larger construction project) will follow a pre-determined sequence of steps, with each step (or "milestone") being judged by the project manager to be satisfactorily completed before substantive work begins on the next step.

FHWA will exercise its oversight responsibilities primarily via review of deliverable(s) produced at each of the milestones in the SE process (e.g. Concept of Operations, Acceptance Tests, etc.). They will do this in a manner that avoids unnecessary delays to the project. The action at each step will take ONE of the following forms: a.) Review and approval, b.) Review and comment, or c.) Information only. These terms are explained below.

- Review and Approval - FHWA shall receive the final version of the milestone document for review and approval. They will respond within one week -- whenever given at least two weeks advanced notice of the document's arrival. Otherwise, turnaround time will be two to three weeks. If they do not respond within the applicable time period the document is automatically deemed approved.

- Review and Comment - FHWA shall participate in the normal review process that the agency uses at the "final draft" stage of developing the milestone document. They will abide by the same schedule that is given to all other reviewers. If they do not provide comments within the given schedule, project work may proceed without them. Their comments will be treated as suggestions that will be given the same consideration as comments from other reviewers.

- Information Only - Upon completion of the milestone, the project manager shall email the associated document to FHWA. No "approval" by FHWA will be needed. Upon emailing the document, the project may begin the next task immediately (but not before).

This determination of level of oversight, along with SERF approval, will be transmitted to DLA Implementation and DLAE concurrently.

Step 3b **Roadmap Step 3b**

Regardless of the level of oversight determined for each SE process milestone deliverable, the completed Systems Engineering Management Plan (SEMP) must always be submitted to FHWA for review and approval at completion of the system definition tasks (generally after the "High-Level Design" task). This approval and the Notice-to-Proceed will allow for the local agency to proceed with system design and implementation. Specific SEMP development and documentation guidance can be found at the "*Systems Engineering Guidebook for ITS"* website (www.fhwa.dot.gov/cadiv/segb/).

The FHWA review process can be expedited by documents being sent via email to FHWA simultaneously with distribution to Caltrans and/or other stakeholders involved in the project development. Paper copies are **not** required, unless the materials cannot be sent electronically.

13.5 FUNDING PROCESS STEP-BY-STEP PROCEDURES

This section presents an **integrated view** of the funding process, combining all four of the perspectives described separately above. Thus, it presents a more comprehensive picture of all activities and responsibilities during each step of the funding process. As before, the steps are discussed chronologically. The chronological steps for **High-Risk** projects are discussed first, followed by the procedures for **Low-Risk** and then **Exempt** ITS projects.

13.5.1 High-Risk (formerly "Major") ITS Projects

High-Risk federal-aid ITS projects shall follow the regular federal-aid procedures outlined in the LAPM, with the inclusion of two approval actions by FHWA to assure conformity with the federal regulation 23-CFR-940. Application and control of the Systems Engineering process is a key reason for the approval actions as specified below.

Step 1 **Roadmap Step 1 -**
Transportation Planning:

1. The local agency submits project to the regional planning agency for inclusion in the Federal Approved State Transportation Improvement Program (FSTIP). The local agency makes a ***preliminary*** designation of risk for the project.

2. The MPO or RTPA is encouraged to coordinate with the local agencies (project sponsors) to "flag" ITS projects, or at least note the High-Risk ITS projects, within their FTIP submittal to Caltrans. This may be a symbol designation within the current FTIP format, a separate page listing, or some other reporting means.

3. The regional planning organization reviews the project for consistency with the Caltrans transportation planning process before submitting the FTIP to Caltrans HQ.

4. Caltrans HQ incorporates the FTIP in the FSTIP, and submits the FSTIP to the FHWA Division for review and approval.

5. The FHWA Division reviews and approves the FSTIP.

Step 2 **Roadmap Step 2 -**
Project Development (PE):

6. The local agency verifies that the project is listed in the FSTIP, and then submits a PE request package to the DLAE.

7. The DLAE enters a conditional approval statement into the E-76 system that states:
"No work for ITS system component detailed design, integration, and testing will be undertaken until FHWA approval of Systems Engineering Management Plan (SEMP) and Notice to Proceed by FHWA is granted. Expenditures for such work prior to NTP are NOT eligible for reimbursement."

8. When the PE package is satisfactory, the DLAE forwards the package, and submits E-76 for PE to DLA Implementation.

9. When the PE package is satisfactory, DLA Implementation executes the E-76, and submits it to the FHWA for obligation, with a copy to the DLA ITS Coordinator.

10. The DLAE verifies from the E-76 system that FHWA has obligated the funds before issuing authorization to proceed with PE.

11. If not submitted with the PE request package, soon after PE begins the local agency submits the completed Field Review form with SERF (Exhibit 7-I System Engineering Report Form) to the DLAE.

    In the SERF, the local agency must provide as much information as possible for each of the following ITS requirements. If any of these items are not known at this time, the Local Agency must include a commitment to address them in detail during system design.

    a) Identification of portions of the RA being implemented
    b) Identification of stakeholders, communities and participating agencies roles and responsibilities
    c) Requirements definitions
    d) Analysis of alternative system configurations and technology options to meet requirements
    e) Procurement options
    f) Identification of applicable ITS standards and testing procedures
    g) Procedures and resources necessary for operations and management of the system

12. The DLAE forwards the field review package including SERF to DLA Implementation with a copy to the DLA ITS Coordinator.

13. The DLA Implementation forwards the package to FHWA.

14. FHWA reviews the SERF for FHWA oversight determination, comments on the SERF, and sends the information back to the DLA Implementation.

    FHWA oversight will consist of approval of the Systems Engineering Management Plan (SEMP). That oversight can also consist of approval of products from each step of the Systems Engineering process, or portions thereof, or merely participation in scheduled process technical review points. FHWA is also available to provide the local agencies with additional ITS technical assistance and guidance as needed.

15. The DLA Implementation relays the information to the DLAE, who relays it to the local agency.

16. Upon receipt of the Field Review package, the DLA Implementation prepares a Program Supplement, with ITS covenants added. After approval by Caltrans Local Program Accounting, the Program Supplement is transmitted directly to the local agency for signature.

17. The local agency signs the Program Supplement and returns it to DLA Implementation.

Step 3b **Roadmap Step 3b –**

18. Prior to component detailed design, the local agency submits the completed SEMP as well as the Systems Engineering process product(s) mentioned in Step #14 above, through the DLAE and DLA Implementation (with a copy to DLA ITS Coordinator) for FHWA's review and approval.

19. FHWA notifies the DLA Implementation that they approved the SEMP, and grants the Notice-to-Proceed (NTP) with project implementation.

20. The DLA Implementation relays the approval and NTP to the local agency thru the DLAE with a copy to the DLA ITS Coordinator.

21. The DLAE checks for environmental clearance before transmitting the SEMP approval and NTP to the local agency.

22. Upon receiving final SEMP approval and NTP, the local agency may proceed with project implementation. Expenditures for such work prior to NTP are NOT eligible for reimbursement.

Construction:

23. If the ITS project includes activities defined as construction; the local agency must submit a PS&E package requesting construction authorization. The request includes the necessary federal-aid paperwork and clearances.

24. Beyond this point, normal federal-aid procedures apply for completing the project. Use Form 17-C "Final Inspection Form" of the LAPM to finalize the project.

13.5.2 Low-Risk (formerly "Minor") ITS Projects

Processing Low-Risk ITS projects will follow the traditional federal-aid PE procedures (see Exhibit 13-B for detail). The SERF (Exhibit 7-I, System Engineering Report Form) must be filled out as part of the field review package. However, SERF review and approval by FHWA are **not** required.

13.5.3 Exempt Projects

Processing Exempt ITS projects will follow the traditional federal-aid PE procedures. The **SERF will not be required** as part of the field review package.

13.6 ENVIRONMENT

The environmental process and environmental clearances for ITS projects are processed under normal federal-aid regulations and procedures. For environmental guidance, see Chapter 6 "Environmental Procedures" of the LAPM. With few exceptions, most ITS projects can be classified as either Programmatic Categorical Exclusion (PCE) or Categorical Exclusion (CE). PCE and CE approvals are performed by Caltrans.

Generally, ITS projects involve little to no disturbance of the ground. The ground disturbance that normally occurs on ITS projects is related to digging foundations for utility, signal, camera, or message sign poles and excavation of trenches for communications cabling. Occasionally ITS projects involve the construction of transportation management center buildings or information kiosks. Such projects are not likely to cause any negative environmental impacts, except in rare cases where they might encounter an archaeological site, a historic site or an endangered species habitat.

13.7 AMERICANS WITH DISABILITIES ACT (ADA) REQUIREMENTS

ADA standards which deal with the public right of way (such as curb ramps, sidewalks, etc.) apply to ITS projects. Common elements in ITS projects in California are computer hardware/software, Changeable Message Signs (CMS) and Closed-Circuit Television (CCTV), Communications, and public websites. These elements are discussed individually below.

1.) Computer Hardware and Software
Computer hardware and software that is used **internally** by public agencies are generally not subject to ADA requirements. This includes computer equipment at traffic/transit management centers, or other locations. However, one key exception is websites or kiosks that are accessible to the general public (see item 4 below).

2.) Changeable Message Sign and Closed-Circuit Television
ITS projects sometimes include one or several Changeable Message Signs (CMS) or Closed-Circuit Television cameras (CCTV). These are often mounted on poles near a roadway. One key question for analyzing this element for ADA requirements is, “Does the installation or operation of a CMS or CCTV unit disturb any pedestrian facilities or travel routes”? The term "disturb" includes partial or complete removal as well as damage to the pedestrian facility or travel route that was caused by tunneling underneath. If a pedestrian facility or travel route is disturbed in any of these ways, then that portion disturbed **must be re-built in compliance with ADA standards**. If the installation of CMS or CCTV units do not disturb pedestrian facilities or travel routes, then they do not have to be rebuilt. Note that CMS and CCTV units generally require communications (see below).

3.) Communications
Communications systems are sometimes installed as part of ITS Integration projects. For both Wireline and Wireless communications, a key question in determining ADA requirements is, “Does the installation or operation of this ITS communication system disturb any pedestrian walkways”?

These systems can take several forms:

a) "Wireline" (e.g. fiber-optic, coax, other types of cables) **-** If these are installed above ground using existing facilities (e.g. telephone or cable-TV poles) or underground in existing conduit, and if no pedestrian walkways are disturbed during the installation process, then the ADA standards do not require any changes to nearby walkways. If installation requires digging trenches in the ground and those trenches disturb a pedestrian facility or travel route, then that facility or travel route must be rebuilt to ADA standards. If the trench is within the roadway itself, all legal crossings and crosswalks are considered pedestrian facilities or travel routes and the portion of the roadway that is disturbed must be rebuilt to ADA standards.

b) "Wireless" communications require antennas, which can be mounted on poles, buildings, roadside signs, or other structures. If these structures already exist and ***no*** pedestrian walkways are disturbed during installation or operation of these communications systems, then ADA does not require any changes to nearby walkways.

4.) Public Websites or Kiosks
ITS Integration Projects sometimes include a website, which may be accessible to the public or restricted to designated parties. If the website (or kiosk) will be available to the public (e.g. for distributing traveler information), then it must meet the requirements of Section 508 of the Rehabilitation Act of 1973 (as amended in 1998). This means that the website must include features that enable the use of "assistive technology", by people with certain types of disabilities. Section 508 is a requirement for recipients of federal funds and for federal agencies. If the kiosk or website is not intended for public use, then both the recipient and the federal agency must ensure that accessibility for the information on the technological device is available for any employees.

For more information on ADA Requirements, please see the following websites: www.ADA.gov and www.section508.gov.

13.8 Right of Way

Generally, new right of way is rarely needed for ITS projects. Easements may be needed for communications cabling. Occasionally, an ITS project may involve utility relocations or the purchase of right of way for construction of a traffic management center building or information kiosk. For guidance on right of way procedures, see Chapter 13, “Right of Way” of the LAPM.

13.9 Procurement / Construction

The federal-aid procurement regulations as set forth in 23 CFR 172, 635, 655, and 49 CFR 18, define the requirements that state and local agencies must adhere to when procuring projects with federal-aid highway funds. These procurement regulations identify possible contracting options available for designing and constructing projects including such contracts as “engineering and design related services,” “construction,” and “non-engineering/non-architectural.” The regulations also require use of competitive contract award procedures for any project financed by federal highway funds.

The regulations require state and local agencies to award:

- Construction contracts on the basis of competitive bidding,
- Engineering and Design services contracts on the basis of qualifications-based selection,
- Non-engineering/non-architectural contracts use state approved procurement procedures in accordance with 49 CFR 18.

The procurement approach required for construction projects (as defined by 23 USC 101 and the related FHWA regulations) does **NOT** always apply to ITS projects. Many standalone ITS projects do not meet the FHWA definition of construction.

- **ITS Construction** – If field devices and/or communications infrastructure are being physically installed in the roadway, then that work and required equipment usually meets the definition of construction. Examples are the purchase and installation of new traffic signals, new controller cabinets, vehicle detectors, and conduit for cabling.

- **ITS Engineering & Design** – The purchase and installation of **electronic** equipment (as long as it does not involve "construction" as defined above), **can** be performed as part of P.E. This includes the computers and electronic equipment at a central site, and also the electronic components within the field equipment. Examples are the controller inside a signal cabinet, or the electronic tolling pricing display panels and associated electronics inserted into panel cutouts of changeable message signs already in place.

An agency also has the option of procuring electronic equipment as part of a construction contract (e.g. a complete changeable message sign including electronics). This might be useful when the project is primarily construction, and the electronic equipment is a minor element. However, development of new software should never be included in a "construction" contract.

The Engineering and Design Services contracting mechanism has been successfully used to retain System Engineers and System Integrators that can provide the entire spectrum of services required to implement an ITS project, such as a traffic management center. This might include the specification, procurement, configuration and installation of all hardware and software to provide the functionality required. For these types of services, the consultant selection procedures (qualifications-based) in Chapter 10 of the LAPM must be followed. Figure 13-6 depicts typical contracting arrangements for most High-Risk ITS projects.

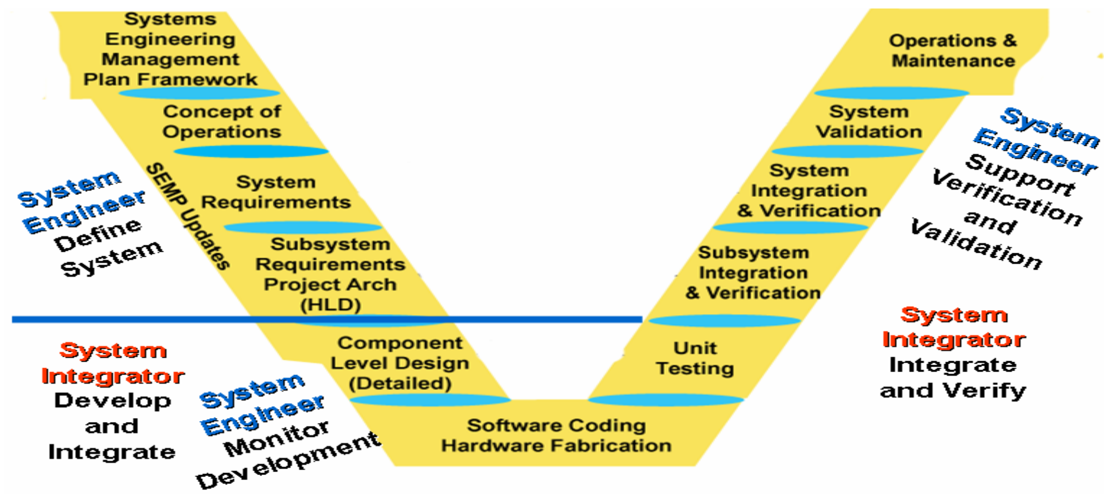

Figure 13-6: Contracting Systems Engineering Services

If an ITS project includes ***minor*** amounts of construction, up to approximately 10% of the cost of the project, then ***flexibility is allowed to have the entire project deployed in the PE phase, without a separate construction phase.*** This option can be very valuable to many ITS projects.

If the construction portion is significant, and a significant amount of system (software procurement and/or software/hardware integration) development is involved, care should be taken to coordinate closely the completion of the system portion with the construction portion to avoid any contract delays. This will be typically performed by different procurement methods - system development by consultant services and construction by low-bid contract.

ITS projects that include a state contribution of funds (STIP funds) have relatively short PE and construction deadlines. These state-mandated deadlines are too short to account for the services of a System Engineer or System Integrator. Therefore, the local agencies must be aware of the need to request time extensions in advance of the deadline in order to be reimbursed for these services, or classify the construction phase of the consultant's activities as construction engineering. See Chapter 23.2.1, "Timely Use of Funds" of the LAPG for information on STIP deadlines and time extension.

13.10 RECORD KEEPING

The U.S. DOT and the Comptroller General of the United States have the right to access all documents pertaining to federal-aid projects. Nonfederal partners must maintain sufficient documentation to substantiate the costs. Such items as direct labor, fringe benefits, material costs, consultant costs, public involvement costs, subcontract costs, and travel costs should be included in that documentation. **This includes any local-agency costs that are to be reimbursed or used to satisfy matching requirements.** The records for each project must be kept on file for a minimum of three (3) years beyond the payment date of the final voucher.

13.11 REFERENCES

- Title 23 USC Part 103(b)(6), Eligibility for NHS Program
- Title 23 USC Part 133(b), Eligibility for STP Program
- Title 23 CFR Part 172, Administration of Engineering and Design Related Service Contracts
- Title 23 CFR Part 635, Construction and Maintenance
- Title 23 CFR Part 655, Traffic Operations
- Title 23 CFR Part 940, Intelligent Transportation System Architecture and Standards
- Title 28 CFR Part 35, Nondiscrimination on the Basis of Disability in State and Local Government Services (See especially Section 151(b)
- Title 29 USC Part 794d, Rehabilitation Act, Section 508, Electronic and Information Technology
- Title 49 CFR Part 18, Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments
- FHWA Memorandum dated March 22, 2002, Guidance on Federal-aid Eligibility of Operating Costs for Transportation Management Systems
- 2007 Joint Stewardship and Oversight Agreement (FHWA and Caltrans)
- 2007 Systems Engineering Guidebook for ITS, Version 2.0
- LAPM, Chapter 2, Roles and Responsibilities
- LAPM, Chapter 3, Project Authorizations
- LAPM, Chapter 6, Environmental Procedures
- LAPM, Chapter 7, Field Review
- LAPM, Chapter 10, Consultant Selection Procedures
- LAPM, Chapter 11, Design Standards
- LAPM, Chapter 12, Plans, Specifications & Estimate
- LAPM, Chapter 13, Right-of-Way
- LAPM, Chapter 15, Advertise and Award Project
- LAPM, Chapter 16, Administer Construction Contracts
- LAPM, Chapter 17, Project Completion

13.12 WEB SITES

USDOT ITS Websites:

- ITS Overview: www.its.dot.gov/its_overview.htm
- ITS Applications: www.itsoverview.its.dot.gov/
- ITS Benefits: www.itsbenefits.its.dot.gov/
- ITS Costs: www.itscosts.its.dot.gov/
- ITS Lessons Learned: www.itslessons.its.dot.gov/
- ITS Deployments: www.itsdeployment.its.dot.gov/
- ITS Library: www.its.dot.gov/library.htm
- ITS Research: www.tfhrc.gov/its/its.htm

ITS Architecture Resources:

- National ITS Architecture: http://www.its.dot.gov/arch/index.htm
- CA Statewide ITS Architecture: http://www.kimley-horn.com/CAArchitecture/index.htm

Systems Engineering Resources:

- S.E. Handbook – Introduction: http://ops.fhwa.dot.gov/publications/seitsguide/index.htm
- S.E. Guidebook – Comprehensive “how to” guide: http://www.fhwa.dot.gov/cadiv/segb/

ITS Training Websites:

- ITS Prof. Capacity Building: http://www.pcb.its.dot.gov
- National Highway Institute: www.nhi.fhwa.dot.gov/training/brows_catalog.aspx
- (then click on topic #137 – ITS)
- UC Berkeley Tech Transfer: www.techtransfer.berkeley.edu/itstraining
- CITE (training via Internet): www.citeconsortium.org/curriculum.html

Americans with Disabilities Act Websites:

- USDOJ Americans with Disabilities Act website: www.ADA.gov
- USGSA website: www.section508.gov

FHWA Federal-aid Procurement Regulations and Contracting Options Website:
http://www.its.dot.gov/jpodocs/repts_te/3029/chap3.htm#2

13.13 DEFINITIONS

Configuration Management - A process developed to control change in complex information technology based systems.

Center Subsystems - Subsystems that provide management, administrative and support functions for the transportation system. One of four general subsystems defined in the NA.

Data Dictionary Entry (DDE) - Contains definitions and description of every data flow included in the logical architecture view of the NA as well as identification of lower level data elements that make up the data flow.

Data Flows - They represent data flowing between processes or between processes and a terminator. A data flow is shown as an arrow on a data flow diagram and is defined in a data dictionary entry. Data flows are aggregated together to form high-level architecture flows in the physical architecture view of the NA. See Data Flow diagram.

Data Flow Diagram - The diagrams in the logical architecture view of the NA that show the functions that are required for ITS and the data that moves between these functions.

Dedicated Short Range Communications (DSRC)- A wireless communications channel used for close-proximity communications between vehicles and the immediate infrastructure. It supports location-specific communications for ITS services such as toll collection, transit vehicle management, driver information, and automated commercial vehicle operations. One of four types of interconnects defined in the NA.

Equipment Packages - They are electronic equipment that has already been developed by manufacturers, which are ready for interconnection. A number of them need to be grouped and interconnected before the system can perform one or more user services. Such group is known as market package.

Functional Requirements - What a system must do to address the needs or provide the services that have been identified for the region. In a regional ITS architecture, the functional requirements focus on the high-level requirements for providing desired service to the user.

Institutional Integration- Represents the process of combining existing and emerging institutional constraints and arrangements.

Interchangeability - The capability to exchange devices of the same type from any vendor without changing the software.

Interconnect - See architecture interconnect. Also applies to traffic signal interconnect.

Interoperability - The capability to operate devices from different manufacturers or different device types (e.g., signal controllers and dynamic message signs on the same communication channel).

ITS Architecture - Defines how systems functionally operate and the interconnection of information exchanges that must take place between these systems to accomplish transportation services.

***ITS Strategic Plan* -** A guide for long-term implementation of ITS in the state, metropolitan area or region. It normally includes identifying regional transportation needs and then defining ITS elements to be implemented over time, aimed at meeting those needs. RA is typically a core component of an ITS strategic plan.

***Legacy System* -** Existing transportation systems, communication systems or institutional systems.

***Life cycle* -** Denotes the strategic cycle or sequencing of a specific process.

***Logical Architecture* -** This is primarily the software part of the system. It defines the thought or logic processes that perform ITS functions and the information or data flows that are shared between these processes.

***Maintenance Plan* -** A description of configuration control and update guidelines for regional and/or project ITS architectures. The primary purpose of the maintenance plan is to maintain an architecture baseline.

***Market Packages* -** They are groups of electronic equipment that are already manufactured and ready to be interconnected to perform one or more user services.

***National ITS Architecture (NA)*-** A common established national framework for ITS interconnectivity and interoperability. It comprises the logical architecture and physical architecture that satisfy a defined set of user services. Maintained by the U.S. Department of Transportation (USDOT), under contract at: http://itsarch.iteris.com/itsarch.

***Physical Architecture* -** This is primarily the hardware part of the system. The part of the NA that provides a physical representation of the important ITS interfaces and major system components. The principal elements of the physical architecture are the subsystems, terminators and the communication interface between them.

***Process Specification (PSpec)*-** The textual definition of the most detailed process identified in the logical architecture view of the NA. The PSpec includes an overview, a set of functional requirements, a complete set of inputs and outputs, and a list of user service requirements that are satisfied by the PSpec.

***Project ITS Architecture (PIA)*-** A framework that identifies the institutional agreement and technical integration necessary to define an ITS project and its interface with other ITS projects and systems.

***Protocol Communications* -** A set of rules for how messages are coded and transmitted between electronic devices. The equipment at each end of a data transmission must use the same protocol to successfully communicate. It is like human language that has an alphabet, vocabulary, and grammar rules used by everyone who speaks that language.

***Regional ITS Architecture (RA)* -** A regional or state level framework for ensuring institutional agreement and technical integration for the implementation of ITS projects or groups of projects. It defines what pieces of the system are linked to others and what information is exchanged between them.

***Requirements Definitions* -** A total set of considerations that govern what is to be accomplished, how well and under what conditions.

***Roadside Subsystems* -** One of four general classes of subsystems defined in the NA. This class is distributed along the transportation network, which performs surveillance, information provision, and control functions. Located on roadway facilities, parking facilities, toll systems, and commercial vehicle check systems that are at or near the roadside.

***Sausage Diagram* -** A top-level diagram, which depicts all subsystems in the NA and the basic communication, interconnects between the subsystems. It can be used as a template for the physical architecture portion of a RA.

***Service Boundaries* -** The geographic boundary of a specific service or agency that provides a service. An example is the service area of a transit agency. The transit agency provides services within a defined boundary.

***Standards* -** Established and documented technical specifications sponsored by a Standards Development Organization (SDO) to be used consistently by industries or government for interoperability, compatibility, interconnect ability, interchangeability and expandability. Already developed ITS standards can be found in the NA web site by selecting an Architecture Flow.

***Subsystem* -** The principal structural elements of the physical architecture view of the NA. Subsystems are grouped in four classes: centers, roadside, vehicles and travelers.

***System Inventory* -** The collection of all ITS related elements in a RA.

***Systems Engineering Analysis* -** Is a structured process for arriving at a final design of a system. The final design is selected from a number of alternatives that would accomplish the same objectives and considers the total life-cycle of the project including not only the technical merits of potential solutions but also the costs and relative value of alternatives.

***Traveler Subsystems* -** Equipment used by travelers to access ITS services pre-trip and en route. This includes services owned and operated by the traveler as well as services that are owned by transportation and information providers. One of four general subsystem classes defined in the NA.

***Turbo Architecture* -** An automated software tool used to input and manage system inventory, market packages, interconnects and architecture flows with regards to RA. The Turbo Architecture is an excellent software tool for developing RA, PIA, development and design of an ITS project. However, the Turbo Architecture must be purchased since it is not a public domain.

***User Services* -** A service that ITS provides the user from the user's perspective. A broad range of users are considered, include the traveling public as well as many different types of system operators. User Services form the basis for the National ITS Architecture development effort. Currently, 33 user services are defined in the NA.

***User Service Requirements* -** Specific statements specifying what must be done to support the ITS user services. The user services requirements were developed specifically to serve as a baseline to drive NA development. The user service requirements are not requirements to system/architecture implementers, but rather are directions to the NA development team.

***Vehicle Subsystems* -** They are subsystems located in vehicles, which include driver information and safety systems. One of four general subsystem classes defined in the NA.

Vehicle-to-Vehicle Communications **-** Dedicated wireless system handling high data rate, low probability of error, line-of-sight communications between vehicles. Advanced vehicle services may use this link in the future to support advanced collision avoidance implementations, road condition information sharing, and active coordination to advanced control systems. One of four types of architecture interconnects defined in the NA.

Wireline Communications **-** A communications link serving fixed locations. It uses a variety of public or private communications networks that may physically include wireless (e.g. microwave) as well as wireline infrastructure. One of four types of architecture interconnects defined in the NA.

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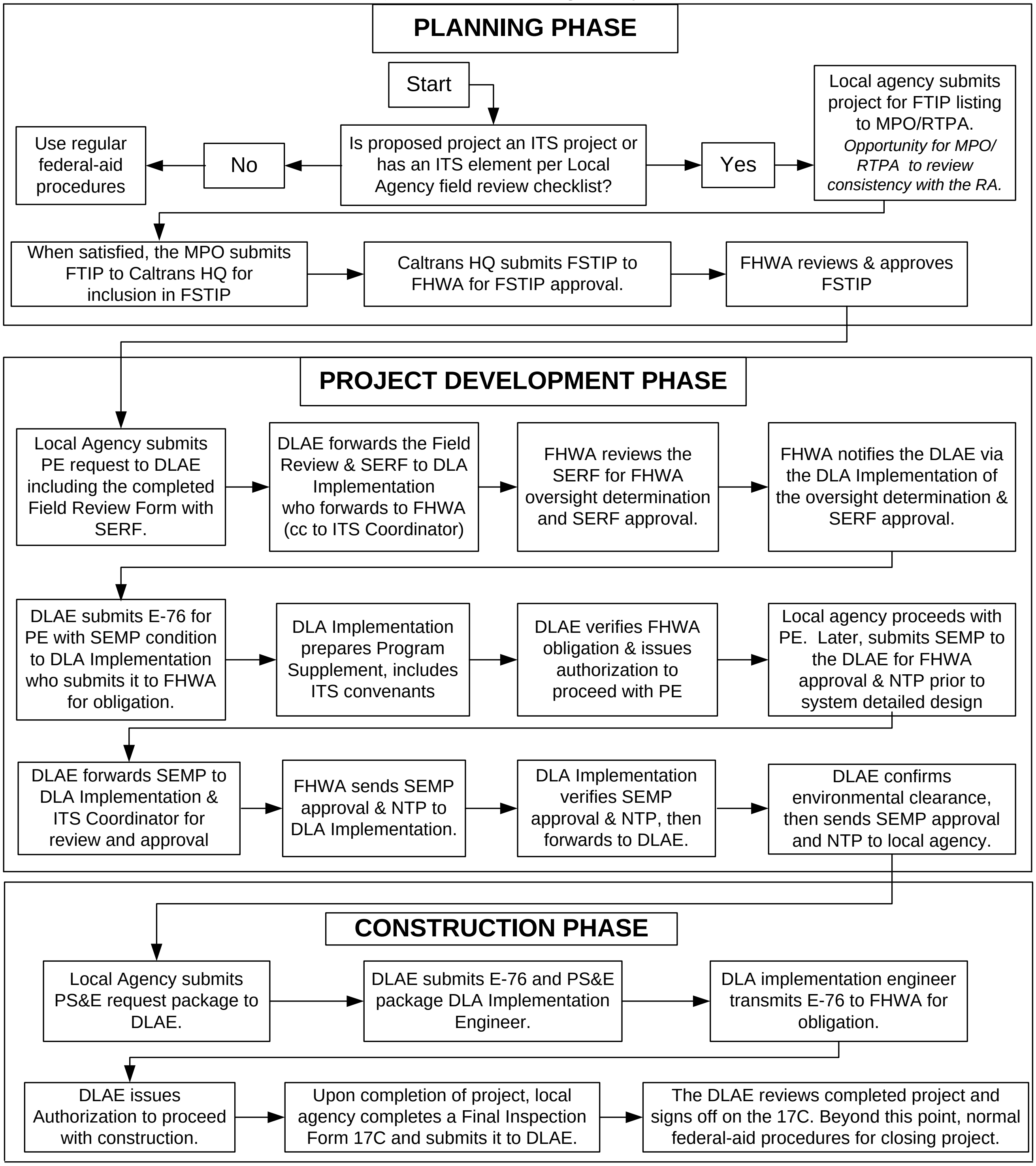
Exhibit 13-A Process Flowchart – High-Risk (Formerly "Major") ITS Projects

(FHWA Full Oversight Projects)



Note:

- This PE procedure requires FHWA review of the SERF, approval of the SEMP, and Notice-to-Proceed (NTP) granted. **Expenditures for system detailed design, implementation, and testing prior to NTP are not eligible for FHWA reimbursement.**
- FHWA Full Oversight for PE phases on all major ITS projects.
- FHWA Full Oversight for E-76 purposes.
- For simplicity, the right of way phase is not shown in this chart. If right of way is involved, refer to Chapter 13,"Right of Way," of the LAPM for information and procedures.
- For FHWA list of criteria for full oversight projects, refer to Section 2.4 of the LAPM.

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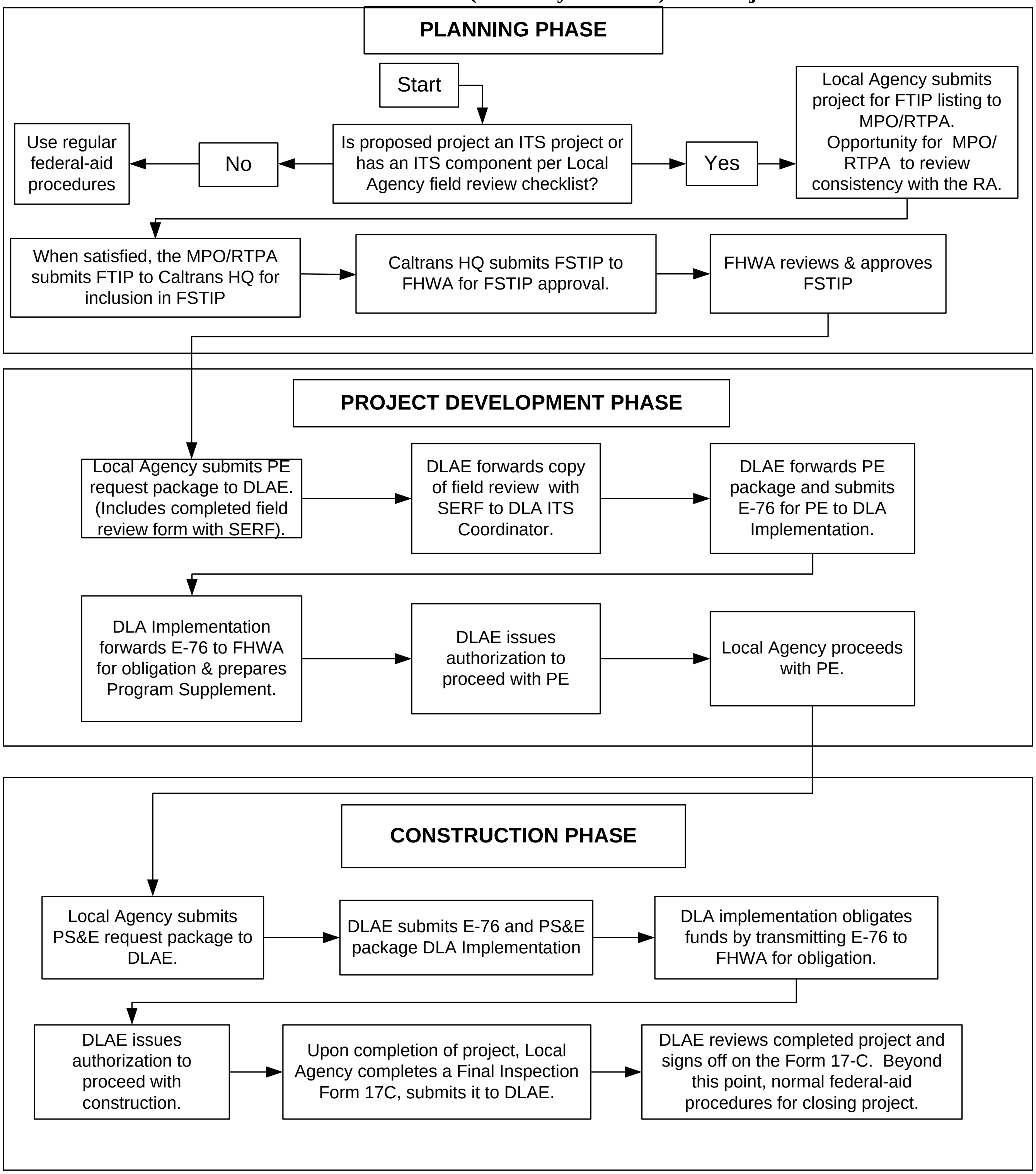
Exhibit 13-B Low-Risk (Formerly "Minor") ITS Projects



Note:

- This flow chart process does not apply to the earmarked ITS Deployment Projects (QT80 projects).
- Minor ITS projects will follow the above traditional single phased PE procedures.
- No FHWA oversight for procedure shown on this flowchart (SERF review and SEMP approval not required).
- State-Authorized for E-76.
- For simplicity, the right of way phase is not shown in this chart. If right of way is involved, refer to Chapter 13, "Right of Way," of the LAPM *f*or information and procedures.

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