Chapter 1050 Intelligent Transportation Systems

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1050.01 General

Intelligent Transportation Systems (ITS) have the potential to reduce crashes and increase mobility of transportation facilities. They also enhance productivity through the use of advanced communications technologies and their integration into vehicles and the transportation infrastructure. These systems involve a broad range of wireless and wire line communications-based information, electronics, or information processing technologies. Some of these technologies include cameras, variable message signs, ramp meters, road weather information systems, highway advisory radios, traffic management centers, and adaptive signal control technology (ASCT). ASCT is a traffic signal system that detects traffic conditions and adjusts signal timing remotely in response. More information on ASCT can be found at:
www.fhwa.dot.gov/everydaycounts/technology/adsc

The purpose and direction of ITS for the Washington State Department of Transportation (WSDOT) can be found in the Statewide Intelligent Transportation Systems Plan, which is available upon request from the Headquarters (HQ) Traffic Operations Office. The plan identifies the current and long-term ITS needs to meet the objectives identified in Moving Washington, WSDOT's program to fight traffic congestion.

The Statewide ITS Plan is a comprehensive document that discusses:

- The history of ITS deployment in Washington.
- How ITS meets WSDOT's transportation vision and goals.
- The current state of ITS deployment.
- WSDOT's near-term ITS plans.
- How projects are prioritized.
- What long-term ITS issues WSDOT needs to begin planning for.

Due to the dynamic nature of ITS, printed guidance is soon outdated. Detailed design guidance and current practices are located on the following websites. For additional information and direction, contact the region Traffic Engineer or the HQ Traffic Operations Office:
www.wsdot.wa.gov/design/traffic/

1050.02 References

23 Code of Federal Regulations (CFR), Part 940, Intelligent Transportation System Architecture and Standards
http://www.ecfr.gov

USDOT, *Systems Engineering for Intelligent Transportation Systems*, FHWA-HOP-07 069, January 2007
http://ops.fhwa.dot.gov/publications/seitsguide/index.htm

USDOT/CalTrans, *Systems Engineering Guidebook for Intelligent Transportation Systems*, Version 3, November 2009
http://www.fhwa.dot.gov/cadiv/segb/

USDOT, *Model Systems Engineering Documents for Adaptive Signal Control Technology (ASCT) Systems*, FHWA HOP-11-027, August 2012
http://www.ops.fhwa.dot.gov/publications/fhwahop11027/index.htm

Manual on Uniform Traffic Control Devices for Streets and Highways, USDOT, FHWA; as adopted and modified by Chapter 468-95 WAC "Manual on uniform traffic control devices for streets and highways" (MUTCD)
www.wsdot.wa.gov/publications/manuals/mutcd.htm

SAFETEA-LU (Safe Accountable Flexible Efficient Transportation Equity Act: A Legacy for Users)
http://www.fhwa.dot.gov/safetealu/index.htm

MAP-21 (Moving Ahead for Progress in the 21st Century Act)
http://www.fhwa.dot.gov/map21/

WSDOT Northwest Region Traffic Design
http://www.wsdot.wa.gov/northwest/trafficdesign

WSDOT Traffic Design
http://www.wsdot.wa.gov/design/traffic/

1050.03 Systems Engineering

Systems engineering is a typical part of any ITS project development process. It is required on any federal-aid project that has an ITS work element, per 23 CFR 940.11. Systems engineering is an interdisciplinary step-by-step process for complex projects (such as ITS projects) to:

- Assess a system's needs and its relationship to the regional architecture.
- Plan a project that meets those needs as well as stakeholder needs and expectations.
- Define other specific requirements for the project/system.
- Develop and implement the project/system.
- Define the operations and maintenance requirements for the system.
- Plan for the refinement or replacement of the system.

Using systems engineering on ITS projects has been shown to increase the likelihood of a project's success. A successful project is one that meets the project scope and stakeholder/ project sponsor expectations, is completed on time and within budget, and is efficient and cost-effective to operate and maintain.

The level of systems engineering used for a project should be on a scale commensurate with the scope, cost, and risk of the project. Complete the Intelligent Transportation Systems (ITS) Systems Engineering Analysis Worksheet in Exhibit 1050-2, or a document with the same information, for all federal-aid projects that include ITS elements. Completing the Worksheet will meet the minimum requirements in 23 CFR 940.11 for systems engineering, determine the project's risk, and determine if a more in-depth systems engineering analysis is required. The Worksheet and the four systems engineering documents outlined below are to be completed with coordination between the project engineer and region Traffic Engineer.

As shown in the Worksheet, a more in-depth analysis requires that the following four documents be completed and used to implement the project. These documents are produced as the result of the steps in the systems engineering process.

1. **Concept of Operations:** This document defines the problem, the project's goals, stakeholder needs and expectations, constraints, and the way the ITS system is required to operate and be maintained.

2. **System Requirements:** This document contains specifications of what the system is required to do, how well it is required to do it, and under what conditions. These requirements are based on the goals, stakeholder needs and expectations, constraints, and operation and maintenance requirements documented in the Concept of Operations.

3. **System Verification Plan:** This document describes how the agency will verify that the system being built meets the requirements in the System Requirements document. The agency will implement the System Verification Plan to ensure all system requirements are verified before it accepts the system.

4. **System Validation Plan:** This document describes how the agency will assess the system's performance against the goals, stakeholder needs and expectations, constraints, and operation and maintenance requirements documented in the Concept of Operations. The goal is for the agency to understand and review the strengths and weaknesses of the system and identify any new opportunities and needs if appropriate. The agency will implement the System Validation Plan after it accepts the system. This evaluation sets the stage for the next time the system/project is changed or expanded.

For specific guidance on developing the four systems engineering plans listed above, see the plan templates in the USDOT/CalTrans document, *Systems Engineering Guidebook for Intelligent Transportation Systems*, Version 3, November 2009. Pertinent page numbers include:

- Concept of Operations Template: Page 254
- System Requirements Template: Page 257
- Verification Documents Plan Template: Page 269
- Validation Documents Plan Template: Page 278

For Adaptive Signal Control Technology Projects (ASCT) using the latest edition of the USDOT *Model Systems Engineering Documents for Adaptive Signal Control Technology (ASCT) Systems*, FHWA-HOP-11-027, August 2012, is required.

As each phase of an ITS project is completed, a report is to be submitted by the Project Engineer to the region Traffic Engineer describing how the project is meeting the requirements outlined in the above systems engineering plans. Approvals for ITS projects are dependent upon project complexity and cost. (See Chapter 300 for ITS project approval requirements.)

Systems engineering costs are to be estimated and incorporated into the construction engineering (CE) and project engineering (PE) portions of the construction estimate.

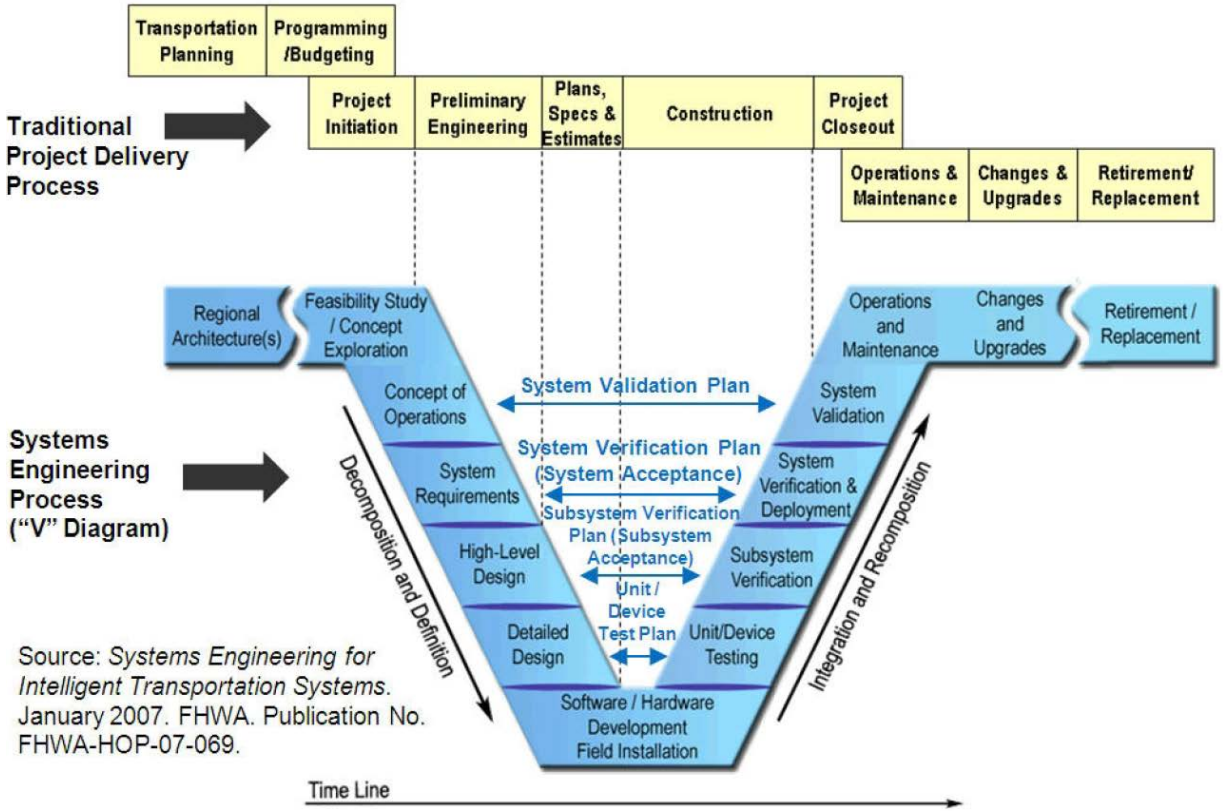
For further project development guidance related to procurement and administration of Federal-Aid Intelligent Transportation System (ITS) contracts, see 1050.04.

1050.03(1) Systems Engineering Process "V" Diagram

The systems engineering process contains a number of steps that are not included in a traditional project delivery process. The systems engineering process is often referred to as the "V" diagram (see Exhibit 1050-1). An ITS project begins on the left side of the "V" and progresses down the left side and then up the right side. Then the project is evaluated by validating and verifying the elements on the right side of the "V" with the elements on the left side.

The Federal Highway Administration (FHWA) and WSDOT are in agreement that, for project development and delivery, the most critical portions of the systems engineering process are the Concept of Operations; System Requirements; System Verification; and System Validation. As a result, the Intelligent Transportation Systems (ITS) Systems Engineering Analysis Worksheet in Exhibit 1050-2 is focused on these core areas.

Exhibit 1050-1 Systems Engineering Process "V" Diagram



1050.04 FHWA Washington Division ITS Project Contracting Guidance

1050.04(1) Purpose

The purpose of this document is to provide basic guidance related to the procurement and administration of Federal-Aid ITS contracts.

1050.04(2) Scope

This document is intended to be used by the FHWA Washington Division Office, WSDOT, and local agencies as a guide on the proper types of procurement methods for various types of ITS projects. This guidance is not all-encompassing, as ITS projects can vary significantly in scope. However, it should provide adequate information to address a majority of situations. Specific questions about an individual ITS project should be directed to the Washington Division Office.

1050.043) Construction versus Non-Construction

ITS improvements may be incorporated as part of a traditional federal-aid construction contract, or the contracting agency may elect to procure ITS services under a separate contract (i.e., stand-alone ITS projects). When procured as a separate contract, the scope of an ITS contract will determine the applicability of federal procurement requirements. Title 23 United States Code 101(a)(4) provides a broad definition for construction for federal-aid eligibility purposes. FHWA generally interprets the definition broadly, resulting in many types of projects being classified as construction. Very simply, a contract that incurs costs incidental to the construction or reconstruction of a highway, including improvements that directly facilitate and control traffic flow (e.g., traffic control systems) are by definition construction contracts. This includes rehabilitation of an existing physical ITS infrastructure. Construction contracts must follow the regulatory requirements of 23 CFR 635 or 23 CFR 636 in the case of Design-Build.

Non-construction-type ITS contracts will be either Engineering Contracts or Service Contracts. Engineering is defined as professional services of an engineering nature as defined by state law. If the ITS contract primarily involves engineering, then qualifications-based selection (QBS) procedures, in compliance with the Brooks Act, must be followed. Service contracts (non-construction, non-engineering in nature) are to be procured in accordance with the Common Rule for Grants and Cooperative Agreements to States and Local Governments found at 49 CFR 18.36.

1050.04(4) Types of ITS Projects

Stand-alone ITS projects can generally be categorized into one of the following types of ITS projects: (1) planning/research, (2) preliminary engineering/project development, (3) software development/system integration, (4) system deployments, (5) traditional construction, and (6) operations and maintenance. All Federal-Aid ITS projects, regardless of the type, are directed in 23 CFR 940 to follow a systems engineering process.

Exhibit 1050-3 provides further information about each of these ITS project types.

1050.05 Documentation

Include all ITS systems engineering documentation in the Design Documentation Package (DDP). All systems engineering documentation requires region Traffic Engineer approval.

Exhibit 1050-2 Intelligent Transportation Systems (ITS) Systems Engineering Analysis Worksheet

Intelligent Transportation Systems
Systems Engineering Analysis Worksheet

This worksheet, or a document with the same information, must be completed for all federal-aid projects that include Intelligent Transportation Systems (ITS) elements. This worksheet must be completed prior to submitting a construction authorization request and must be kept in the project file for the entire document retention period of the project. If Concept of Operations, System Requirements, Verification Plan, and Validation Plan documents are required for the project, as determined by this spreadsheet, these documents must be submitted for review prior to submitting a construction authorization request and must be kept in the project file for the entire document retention period.

1. **Project Name:** Click here to enter text.

2. **Contract Number:** Click here to enter text.

3. **Total project cost (includes preliminary engineering/design, right of way, and construction phases):** Click here to enter text.

4. **Amount of total project cost for ITS elements:** Click here to enter text.

5. Will this project implement a new or expand an existing adaptive signal control technology (ASCT) system?

   ☐ Yes FHWA and WSDOT consider the project to be high risk. Four additional systems engineering documents (Concept of Operations, System Requirements, Verification Plan, and Validation Plan) are required. (See definitions in 1050.03 Systems Engineering.) These documents must be produced using the latest edition of the USDOT *Model Systems Engineering Documents for Adaptive Signal Control Technology (ASCT) Systems*, FHWA-HOP-11-027, August 2012. *Please skip questions 6 and 7.*

   ☐ No

Exhibit 1050-2 Intelligent Transportation Systems (ITS) Systems Engineering Analysis Worksheet (continued)

6. Select which of the following items, if any, apply to this project:

☐ The project includes new and unproven hardware and/or communications technology that is considered "cutting edge" or not in common use. This could include custom-developed or unproven commercial-off-the-shelf (COTS) technology that has not been used by the agency previously. *Please explain why you selected or did not select this item.*

Click here to enter text.

☐ The project will add new software that will be custom developed for this project or will make major modifications to existing custom-developed software. *Please explain why you selected or did not select this item.*

Click here to enter text.

☐ The project will add new interfaces to systems operated or maintained by other agencies. *Please explain why you selected or did not select this item.*

Click here to enter text.

☐ The project will develop new system requirements or require revisions to existing system requirements that are not well understood within the agency and/or well documented at this time. These system requirements will be included in a request for proposal, or plans, specifications, and estimate bid document package. Therefore, it will require significant stakeholder involvement and/or technical expertise to develop these items during the project delivery process. *Please explain why you selected or did not select this item.*

Click here to enter text.

☐ Multiple agencies will be responsible for one or more aspects of the project design, construction, deployment, and/or the ongoing operations and maintenance of the system. *Please explain why you selected or did not select this item.*

Click here to enter text.

Exhibit 1050-2 Intelligent Transportation Systems (ITS) Systems Engineering Analysis Worksheet (continued)

7. If you answered yes to any of the items in question 6, FHWA and WSDOT consider the project to be high risk. See the following table for additional requirements.

Project Risk Level	Total Project Cost for ITS Elements	
	Less than $1,000,000[3]	**Equal or Greater than $1,000,000**[3]
High-Risk ITS	Additional systems engineering documents (Concept of Operations, System Requirements, Verification Plan, and Validation Plan)[2] are recommended.[1]	Additional systems engineering documents (Concept of Operations, System Requirements, Verification Plan, and Validation Plan)[2] are required.

Notes:
[1] A decision not to complete the additional systems engineering documents for high-risk projects that have less than $1,000,000 of ITS elements requires FHWA concurrence prior to submitting a construction authorization request.
[2] See definitions in 1050.03, Systems Engineering.
[3] Use the amount from question 4.

8. What is the name of the regional ITS architecture and which portions of the architecture will be implemented? Is the project consistent with the architecture? Are revisions to the architecture required? Also, which user services, physical subsystem elements, information flows, and market/service packages will be completed, and how will these pieces be part of the architecture?

   Click here to enter text.

9. Identify the participating agencies, their roles and responsibilities, and the concept of operations. For the elements and market/service packages to be implemented, define the high-level operations of the system. This includes where the system will be used, its performance parameters, its life cycle, and who will operate and maintain it. Discuss the established requirements or agreements on information sharing and traffic device control responsibilities. The regional ITS architecture operational concept is a good starting point for discussion.

   If this is a high-risk project and a more extensive Concept of Operations document is being prepared for this project (see question 7), this answer can be a simple reference to that document.

   Click here to enter text.

Exhibit 1050-2 Intelligent Transportation Systems (ITS) Systems Engineering Analysis Worksheet (continued)

10. Define the system requirements. Based on the concept of operations, define the "what" and not the "how" of the system. Define the detailed requirements for eventual detailed design. The applicable high-level functional requirements from the regional architecture are a good starting point for discussion. A review of the requirements by the project stakeholders is recommended.

    If this is a high-risk project, and a more extensive System Requirements document is being prepared for this project (see question 7), this answer can be a simple reference to that document.

    Click here to enter text.

11. Provide an analysis of alternative system configurations and technology options to meet requirements. This analysis should outline the strengths and weaknesses, technical feasibility, institutional compatibility, and life cycle costs of each alternative. The project stakeholders should have had input in choosing the preferred solution.

    Click here to enter text.

12. Identify procurement/contracting options. Since there are different procurement methods for different types of projects, the decision regarding the best procurement option should consider the level of agency participation, compatibility with existing procurement methods, the role of the system integrator, and life cycle costs. Some options to consider include: consultant design/low-bid contractor, systems manager, systems integrator, task order, and design/build.

    If the ITS portions of the project significantly meet the definition of construction, then construction by low-bid contract would be used. Non-construction ITS portions of the project, such as services for software development, systems integration, systems deployment, systems management, or design, will be either engineering or service contracts. In these cases, a qualifications-based selection (QBS) or best value procurement may be more appropriate. For guidance on procurement options for ASCT systems, refer to Pages 15-20 of USDOT's *Model Systems Engineering Documents for Adaptive Signal Control Technology (ASCT) Systems*, FHWA-HOP-11-027, August 2012.

    Click here to enter text.

Exhibit 1050-2 Intelligent Transportation Systems (ITS) Systems Engineering Analysis Worksheet (continued)

13. Identify the applicable ITS standards and testing procedures. Include documentation on which standards will be incorporated into the system design. Also, include justification for any applicable standards not incorporated. The standards discussion in the regional architecture is a good starting point for discussion.

    Click here to enter text.

14. Outline the procedures and resources necessary for operations and management of the system. In addition to the concept of operations, document any internal policies or procedures necessary to recognize and incorporate the new system into the current operations and decision-making processes. Also, resources necessary to support continued operations, including staffing and training, must be recognized early and be provided for. Such resources must also be provided to support necessary maintenance and upkeep to ensure continued system viability.

    Click here to enter text.

Exhibit 1050-3 FHWA Washington Division – ITS Project Contracting Guidance

ITS Project Type	Description	Examples
Planning/Research	Generally, involves studies that research new concepts or develop plans or procedures at a broader agency- or region-wide level. These are generally not construction and are often done by agency personnel.	• Regional ITS architecture development and maintenance • Regional Concept of Operation • Traffic incident management planning • Standards testing and specification development • Public outreach and communication
Preliminary Engineering/Project Development	Generally, a project, or phase of a larger project, that leads to some type of ITS deployment/construction. Typically involve some type of service or engineering contact, or work done by agency personnel, and are generally not considered construction.	• Scoping/field surveys • Project-level Concept of Operation • Environmental Review • Development of RFPs • Development of PS&Es • Evaluation of technology, networking, systems architecture alternatives
Software Development/System Integration	Generally, involves projects that develop new or upgraded ITS-related software or involve integrating ITS services and equipment. These are typically not construction and often fall under a service contract.	• Traffic Management Center (TMC) central software design, development, installation • Modifying existing central system software to communicate with new field equipment • Incorporation of device control software into central systems • Acceptance testing and configuration management
System Deployments	Generally, includes total system implementation involving design, equipment, computer systems, telecommunications, and integration. Contracts are often non-construction in nature, depending on the amount and type of field work relative to the overall project. These types of projects will often be the least cut-and-dried in terms of the appropriate contracting method.	• Road-weather information systems (RWIS) • Surveillance camera procurement and installation on existing poles (non-construction when limited in scope) • Non-intrusive sensor procurement and installation on existing poles (non-construction when limited in scope) • Adaptive Signal Control Systems
Traditional Construction	Typical construction projects involving considerable installation of equipment or work in the field. Design-Bid-Build (low bid) or Design-Build contracting are appropriate for this type of work.	• Installation of variable message signs • Installation of poles, controller cabinets, foundations, guardrail, gantries • Installation of radio towers and civil infrastructure for wireless systems • Installation of tolling field equipment (tag readers, video cameras, etc.) • Installation of underground infrastructure (trenching, cable installation, etc.)
Operations/ Maintenance	Ongoing operations and/or maintenance of ITS services, software, and equipment. Typically is a service contract (non-construction).	• Operating costs for traffic monitoring, management, control systems (e.g., rent, communications, labor, utilities) • Preventative maintenance