Procedures for Implementing HPDP ITS Systems Engineering Requirement
A Quick Reference Guide

Purpose

MnDOT has developed procedures to ensure 23 CFR Section 940 (Rule 940) is implemented on applicable Trunk Highway projects. Rule 940 requires that all ITS systems or components be developed based on a systems engineering process, and the systems engineering analysis should be on a scale commensurate with the project scope.

The purpose of this guide is to provide step-by-step instructions on how to implement the procedures for ITS projects or projects with ITS components to ensure Rule 940 compliance. The procedures are applicable to the following:

- All ITS projects funded (in whole or in part) with the highway trust fund (including National Highway System (NHS) and non-NHS facilities); and
- All State funded ITS projects in which ITS component(s) will be connected/integrated to another ITS component, project or system.

Useful References
- HPDP ITS Systems Engineering Requirement
  (http://dotapp7.dot.state.mn.us/edms/download?docId=1598710)
- ITS Implementation – Project Classification and Systems Engineering Requirement Decision Tree
  (http://www.dot.state.mn.us/its/docs/decisiontree.pdf)
- FHWA ITS Implementation Memo
  (http://www.dot.state.mn.us/its/docs/fhwaimplementationmemo.pdf)

Stage I: Project Scoping

The primary purpose of project scoping is to identify the resources required to develop and implement a project. During the scoping process, use the HPDP ITS Systems Engineering Requirement and the ITS Implementation – Project Classification and Systems Engineering Requirement Decision Tree to complete the following steps:

Step 1: Identify ITS applications for your project. Refer to the HPDP ITS Systems Engineering Requirement and the Decision Tree for a list of common ITS applications.

Step 2: Request for Internal ITS Design Shared Services. MnDOT Districts shall request assistance from RTMC for ITS project design. The assistance should be requested as early as possible during project scoping. Requests less than twelve (12) months may impact RTMC (or to secure a consultant under contract) to perform work in a timely manner to meet the proposed project letting date. Please refer to the Process Guidance for Internal ITS Design Shared Services (http://ihub/trafficeng/resources.html) and complete the request form.

Step 3: Determine Project Class. Use the project ITS applications along with the HPDP ITS Systems Engineering Requirement and the Decision Tree as a guide to determine the appropriate ITS Class for your project.

Step 4: Identify systems engineering analysis and documentation development required for your project. Use the HPDP ITS Systems Engineering Requirement and the Decision Tree to identify the systems engineering documents that need to be developed for the project.

Step 5: Include cost estimates for systems engineering analysis and documentation during project scoping. Determine and include cost estimates needed for the development of the required systems engineering documents.

Stage II: Project Development and Implementation

Once the project has been programmed into the STIP and during project development and implementation, complete the following steps to ensure compliance with Rule 940 and eligibility for federal and state funding. Please note that this may be an iterative process based on project information available.

Step 1: Review HPDP ITS Systems Engineering Requirement to understand the purpose and requirements, as well as, your roles and responsibility for ITS implementation of your project. Key requirements include:

- Coordination and consistency check with the Minnesota Statewide Regional ITS Architecture
- Systems engineering process, analysis and outputs
- ITS standards for interoperability
- Your roles and responsibilities as a project manager for implementing Rule 940 on ITS projects

Step 2: Identify ITS applications of your projects. Use the HPDP ITS Systems Engineering Requirement and the Decision Tree as references to identify the ITS applications in your project.

Step 3: Determine the ITS class of your project. Once the ITS applications are identified, use the HPDP ITS Systems Engineering Requirement and the Decision Tree to determine the appropriate class for your project. For Minnesota, ITS projects or projects with an ITS component are divided into four classes:

- Class A: Standard ITS Applications
- Class B-1: Freeway Traffic Management
- Class B-2: Arterial Traffic Management
- Class C: Large Scale/Complex ITS Projects

Step 4: Identify and verify your project is consistent with the Minnesota Statewide ITS Architecture.

- Identify and verify if your project is included in the Minnesota Statewide ITS Architecture (http://www.dot.state.mn.us/its/projects/2006-2010/mnitsarchitecture.html). See **Volume 9** of the Minnesota Statewide Regional ITS Architecture (http://www.dot.state.mn.us/its/projects/2006-2010/mnitsarchitecture/its-volume-9.pdf) for a complete list of ITS projects.
  - o Use Table 4-1 or Table 4-2 as a filter to identify a project concept that aligns with your project.
  - o Review the project concept identified above. Verify your project is consistent with the project concept in the architecture. A sample of a project concept write-up is illustrated on the next page. Pay particular attention to three areas in your review and verification: description, project element, and interconnect. The three areas are circled in red in the example.

ID: S05

Initiative: Rest Area Truck Parking Availability

Timeframe: Short Term – Years 2-4

Multimodal Transportation Objective: Traveler Safety, Asset Management

ITS Service Area: ATIS, ATMS

Type: Operational Test, Deployment

Description
MnDOT and the University of Minnesota are currently working on a truck parking availability demonstration project. The initiative targets the development of an automated truck stop management system that can determine the number of occupied parking spaces at MnDOT safety rest areas and commercial truck stops. The system uses a network of cameras to monitor parking availability at truck stops, automatically identifying available spaces in real time. In this initiative, the information will be used to notify drivers and carriers about parking availability via a website, in-cab messaging, and variable message displays a few miles ahead of the rest area on the highway. The system will be installed at three MnDOT rest areas on Interstate 94 (I-94) west and northwest of the Twin Cities during the demonstration.

Upon a successful demonstration, this initiative will expand on the system for further operational test and subsequent deployment at 2 more sites if deemed feasible. The system will provide parking availability information at roadside rest areas and potentially truck stops to truck drivers through multiple forms of currently available traveler information dissemination, such as Dynamic Message Signs (DMS), 511 traveler information web site and phone system, and Highway Advisory Radio (HAR). Parking availability will be detected with in-pavement or non-intrusive detection technologies to ascertain the level of rest area truck parking space availability. This information will then be disseminated through DMS, 511, and/or HAR to commercial vehicles approaching the rest areas. Specific sites under this initiative have yet to be determined.

Champion and Stakeholder
Champion: MnDOT OFCVO
Stakeholders: MnDOT, Minnesota Department of Public Safety (DPS), Private Trucking Companies

Project Element
- 511 Telephone Information Service
- 511 Traveler Information Website
- DMS Roadside Equipment
- HAR Roadside Equipment
- Parking Management Roadside Equipment
- Parking Management System

Service Package
- ATMS16 – Parking Facility Management
- ATIS01 – Broadcast Traveler Information

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Interconnect
- Parking Management Roadside Equipment and Parking Management System
- Parking Management System and 511 Telephone Information Service
- Parking Management System and 511 Traveler Information Website
- Parking Management System and DMS Roadside Equipment
- Parking Management System and HAR Roadside Equipment

Technology Assessment
Traveler information dissemination technology (511, DMS, HAR, etc.) is currently being used. This initiative will also utilize parking management technology that is readily available from vendors. The City of Saint Paul currently uses DMS to disseminate parking availability information at municipal parking ramps. A similar initiative is being conducted by Metro Transit to display parking availability at transit park-and-ride parking lots. The approved ITS standard ITE TM 1.03 – Standard for Functional Level Traffic Management Data Dictionary – is applicable to this initiative.

Dependency
This initiative is not dependent upon any other initiatives. However, the results of the current truck parking availability demonstration may support this initiative.

Cost Estimate
Based on available system cost data for dynamic message signs and entrance/exit ramp meters used to detect and count vehicles at the rest area facility, the total cost for one rest area facility is estimated to be between $70,000 and $120,000.

Needs and Objectives Addressed
Needs:
- TI23 - Provide information on available public and private truck parking and rest facilities
- TM21 - Provide information on parking availability

ITS Objectives:
- C-3-11 - Increase number of 511 calls per year
- C-3-12 - Increase number of visitors to traveler information website per year
- C-3-13 - Increase number of users of notifications for traveler information (e.g., e-mail, text message)
- C-4-04 - Increase the number of parking facilities with automated occupancy counting and space management
- C-4-05 - Increase the number of parking facilities with advanced parking information to customers

Agreement
Agreements may be required between MnDOT and private truck stop owners.

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Vertical tab labels: Data Management, Transit Management, Traveler Information, Traffic Management, Vehicle Safety, Commercial Vehicle, Emergency Management, Maintenance and Construction

- If the project is included in the architecture and is consistent with the project concept, proceed with **Step 5**.
- If the project is included in the architecture, but the current project concept in the architecture is not completely consistent with the proposed project, then a revision or update will be required for inclusion. Contact and submit request via email to Rashmi Brewer (Rashmi.Brewer@state.mn.us) of MnDOT OTST ITS Unit to update the architecture.
- If the Minnesota Statewide Regional ITS Architecture does not contain your project, create a project-level architecture and contact Rashmi Brewer (Rashmi.Brewer@state.mn.us) of MnDOT OTST ITS Unit for guidance and assistance.

Step 5: Determine systems engineering analysis and documentation needs. Use the Decision Tree to determine the ITS class of your project, then identify and verify the systems engineering documentation needs.

1) If your project belongs to **Class A Standard ITS Applications**, visit the Systems Engineering for Standard ITS Applications web page at http://www.dot.state.mn.us/its/projects/2006-2010/systemsengforstandarditsapplications.html. Review the concept of operations and functional requirements documents that correspond to your project.
   - If your project is consistent with the concept of operations and functional requirements for Standard ITS Applications, proceed with **Step 6**.
   - If the project is **not** consistent with the concept of operations and/or functional requirements for Standard ITS Applications, use the standard concept of operations/functional requirements above as a base and develop a project specific concept of operations and/or functional

requirements for your project. Contact Rashmi Brewer (Rashmi.Brewer@state.mn.us) of MnDOT OTST ITS Unit for guidance and assistance as needed.

2) If your project belongs to **Class B-1 Freeway Traffic Management** or **Class B-2 Arterial Traffic Management**, review the concept of operations document at http://www.dot.state.mn.us/its/projects/2006-2010/itssystemsengarterialfreeway/freewayconops.pdf or http://www.dot.state.mn.us/its/projects/2006-2010/itssystemsengarterialfreeway/arterialconops.pdf, respectively.

   - If your project is consistent with the concept of operations, proceed with the development of functional requirements and a test plan for the project.
   - If the project is not consistent with the concept of operations, use the standard concept of operations above as a base and develop and tailor a project specific concept of operations for your project. Then, develop functional requirements and a test plan based on the project specific concept of operations. Contact Rashmi Brewer (Rashmi.Brewer@state.mn.us) of MnDOT OTST ITS Unit for guidance and assistance as needed.

3) If your project belongs to **Class C Large Scale/Complex ITS Projects**, perform a full systems engineering analysis following the systems engineering process described on pages 3 and 4 of the HPDP ITS Systems Engineering Requirement.

4) If your project consists of **only** applications of **Class A** and **Class B-1**, or **Class A** and **Class B-2**, use the systems engineering documents for both classes as resources to build upon and perform a full systems engineering analysis following the systems engineering process described on pages 3 and 4 of the HPDP ITS Systems Engineering Requirement.

5) If your project consists of any application(s) not listed in Classes A, B-1 and B-2, then the project belongs to Class C, and a full systems engineering analysis should be performed. See 3) above.

Step 6: Complete the ITS Systems Engineering Checklist(s).
   - Use the Decision Tree as a guide to identify the appropriate ITS Systems Engineering Checklist(s) for your project.
   - Complete the checklist(s) and obtain signatory approval(s). Refer to page 7 of the HPDP ITS Systems Engineering Requirement for a list of approval agencies.
   - Save the approved checklist(s) in the project file, both electronically and paper copy.
   - Submit the approved checklist(s) along with the Project Memo for approval.
   - For questions regarding the completion of the checklist, contact Rashmi Brewer, P.E., MnDOT OTST via e-mail at Rashmi.Brewer@state.mn.us.