User's Guide

VDOT

Using Systems Engineering and Regional ITS Architecture for ITS Projects

Virginia Department of Transportation
Northern Virginia District

August 2006

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1.0 Preface

The Virginia Department of Transportation (VDOT) Northern Virginia District (NoVA) has established a successful Intelligent Transportation Systems / Operations (ITS / Operations) program. Consistent with U.S. Department of Transportation (U.S. DOT) guidelines and rules, VDOT-NoVA has developed a framework (regional architecture) that will guide regional ITS planning, project development, and implementation to achieve increased integration of the region's transportation system. In addition to the regional architecture, VDOT-NoVA has developed a comprehensive process for ITS project planning, including several easy-to-use checklists, templates, databases and websites.

However, a gap exists between the knowledge of the ITS planning process and its application to ITS project development. This user's guide is intended to address the gap and is primarily intended for three groups of VDOT-NoVA employees –

- **Project Managers** – who plan, develop and deploy ITS projects
- **Operations Section Managers** – who are responsible for overall project management within their sections,
- **ITS / Operations Planning Staff** – who are responsible for overall ITS / Operations program direction and deployment

Specifically, the guide identifies what activities need to be performed at different phases of an ITS project and by whom. While all of the groups of users are expected to be familiar with the ITS concepts and terminology used in this guide, it is strongly suggested that they undergo additional training on the use of VDOT-NoVA's Regional ITS Architecture. VDOT-NoVA offers a day-long, hands-on training course at least once a year, depending on resource availability. Please visit the architecture website ***(www.vdot-itsarch.com)*** and click on the training icon in the top-left corner of the page for registration details.

This guide was created to familiarize project managers in the NoVA region with the components and the requirements of VDOT-NoVA's Regional ITS architecture and to assist the project managers in the development of ITS projects and proposals. It currently describes the ITS architecture in VDOT's NoVA District. However, VDOT-NoVA's ITS architecture will soon be expanded to cover the new Northern Operations Region (which includes the entire VDOT-NoVA District along with jurisdictions recently included in the Culpeper and Fredericksburg Districts). After the expansion, the guide can be used by all staff in the "Northern Operations Region."

Please visit ***www.vdot-itsarch.com*** to view the VDOT-NoVA Regional ITS Architecture. For additional details on the history of the VDOT-NoVA ITS program, architecture development, or the VDOT-NoVA Smart Travel Program Plan, click on the "Reading Room" tab on the website.

2.0 Users Guide Organization

This user's guide provides readers with answers to the following questions and more:

- *What is an ITS Project?*
- *What are the FHWA Rule requirements for ITS Architecture?*
- *What is VDOT-NoVA's ITS Planning Process?*
- *How does one use the architecture to develop projects?*
  - *Before funding is obtained?*
  - *After funding is obtained?*
- *How is the regional architecture maintained?*

The user's guide is organized into eight (8) sections to meet the needs of Project Managers, Operations' Section Managers, and ITS / Operations' Planning Staff looking for guidance at various steps in a project's development process, as well as to provide background information on ITS architecture and U.S. DOT rule requirements. Most material in the sections can be categorized as either Definitions / Background () or as activities/steps to be performed. ()

Guidance	Location (Section)	Type of Information	Description
Preface, Organization	1,2		Information on purpose and the organization of the guide
Background	3,4		Information on definitions of ITS projects, Rule 940 requirements
VDOT-NoVa ITS Planning Process	5		Information on how VDOT-NoVa plans for ITS projects
Pre-funding	6		Guidance for project managers looking for concept exploration type activities for project ideas
Post-funding	7		Guidance for project managers looking to demonstrate systems engineering and Rule 940 conformity after funding for the project has been programmed
Guidance on maintaining the architecture	8		Guidance on how to provide implemented project information for regional architecture updates

3.0 Definition of an ITS Project

An ITS project is any project that, in whole or in part, funds the acquisition of technologies or systems of technologies that provide or significantly contribute to the provision of one or more ITS user services as defined in the National ITS Architecture. Developed by the U.S. DOT, the National ITS Architecture is a common framework for planning, defining, and integrating intelligent transportation systems. It is a mature product that reflects the contributions of a broad cross-section of the ITS community.

User services are the part of the National ITS Architecture that document what ITS should do from the user's perspective. A broad range of users are considered, including the traveling public as well as many different types of system operators. The initial user services were jointly defined by U.S. DOT and ITS America, with significant stakeholder input, and were documented in the National Program Plan. New or updated user services have been, and will continue to be addressed, by the National ITS Architecture over time.

Given the broad definition of "ITS" and the wide range of transportation technology projects covered under National ITS Architecture User Services, many, if not most, transportation technology projects will be considered ITS projects. The scope of a project determines whether a project can be termed an ITS project or not. As a rule, a project can be classified as an ITS project if it: addresses a user service in the National ITS Architecture and uses technology to solve the transportation problem. The project examples on page 7 show how the scope can determine whether a project can be termed an ITS project or not.

With ITS applications becoming a common part of traffic operations, it is also important to distinguish between routine projects and non-routine projects from an ITS planning standpoint. Routine projects are typically replacement or maintenance projects which have been carried out before by VDOT-NoVA and involve little to no interaction with any other external agencies. Examples of such projects could be camera replacements and expansion, installation of sensors, traffic signal optimization, etc. For such projects, VDOT-NoVA's Project Managers are familiar with the requirements, the design, and the implementation strategy and can follow the systems engineering process easily.

Tip: The latest version of the National ITS Architecture, version 5.1. Definitions for user services can be found in the National ITS Architecture website: *http:// www.iteris.com/ itsarch*

Non-routine projects, on the other hand, are typically integration and expansion type projects, involving several external agencies and stakeholders. For such projects, development of a concept of operations, requirements identification, detailed design, and implementation often are major tasks. Often, these projects also have regional implications requiring collaboration across multiple jurisdictions and agencies. For these projects, systems engineering is a vital but often times resource intensive activity that occurs throughout the project lifecycle. Examples of such projects include new software for advanced traffic management systems, Computer Aided Dispatch (CAD) integration, video clearinghouses, archived data management systems, etc.

Is it an ITS Project?

1. New computers for STC engineers
   – No. Does not directly address a specific transportation problem.

2. Fare collection equipment for transit buses
   – Yes.

3. Real-time traveler information system
   – Yes.

4. Data management software to assist in payroll
   – No. Does not address transportation problem.

5. Maintenance management software
   – May be an ITS project if it involves technologies to track assets, vehicle maintenance, operations, etc.

6. Software to monitor drug and alcohol testing program
   – No. Does not address a transportation problem.

7. Traffic signal timing optimization
   – Yes, if scope includes adaptive or centralized control. No, if scope involves retiming of isolated signals.

8. Buying new vehicles for Safety Service Patrol
   – Yes, if SSP vehicle procurement includes communication technologies.

9. Replace signal control at an isolated intersection
   – Yes, if a new or upgraded controller is installed or connected to a centralized system. No, if an isolated signal controller unit is replaced with another one.

10. Re-striping city roads
    – No, this is traditional routine infrastructure maintenance.

4.0 Federal Requirements for ITS Projects

FHWA Rule 940 (http://ops.fhwa.dot.gov/its_arch_imp/docs/20010108.pdf) provides policies and procedures for implementing Section 5206(e) of the Transportation Equity Act for the 21st Century (TEA–21), Public Law 105–178, 112 Stat. 457, pertaining to conformance with the National ITS Architecture and Standards.

The rule states that the final design of all ITS projects funded with Highway Trust Funds shall accommodate the interface requirements and information exchanges as specified in the regional ITS architecture. The regional ITS architecture is a specific application of the framework specified in the National ITS Architecture, tailored to the needs of the transportation stakeholders in the region.

If the final design of the ITS project is inconsistent with the regional ITS architecture, then the regional ITS architecture shall be updated. Compliance with the rule needs to be demonstrated prior to authorization of Highway Trust Funds for construction or implementation of ITS projects.

Tip: VDOT-NoVA has developed a checklist for Rule 940 compliance. The checklist assists project managers in ensuring that they follow the National ITS Architecture Rule while designing and implementing their ITS projects. The use of the checklist will be described in Section 7 of this guide.

The rule also states that all ITS projects, funded in whole or in part with funding from the Highway Trust Fund, shall be based on a systems engineering analysis consisting of seven required elements. As shown in the Rule 940 requirements box, systems engineering is not just a set of tools. Systems engineering is a process that occurs throughout the project life-cycle. Typical steps in the systems engineering approach range from conception, requirements analysis, design, testing, acceptance, and operations and maintenance.

While the use of the architecture and the systems engineering approach is mandatory for federally funded projects, project developers are encouraged to use this approach for any ITS project using state or local funds, especially for projects that integrate with other systems in the region.

The rule requirements are applicable for all ITS projects funded through the Highway Trust Fund account. Thus, conformity with the Rule 940 requirements is required for both routine and non-routine projects. However, with routine projects, the effort and the scope of systems engineering analysis should be minimal. For non-routine projects, the scale of the systems engineering analysis depends on the scope of the project.

Rule 940 Requirements

Rule 940 states that the systems engineering analysis shall include, at a minimum:

1. Identification of portions of the regional ITS architecture being implemented (or if a regional ITS architecture does not exist, the applicable portions of the National ITS architecture);
2. Identification of participating agencies roles and responsibilities;
3. Requirements definitions;
4. Analysis of alternative system configurations and technology options to meet requirements;
5. Procurement options;
6. Identification of applicable ITS standards and testing procedures; and
7. Procedures and resources necessary for operations and management of the system.

Source: (http://ops.fhwa.dot.gov/its_arch_imp/docs/20010108.pdf)

5.0 VDOT-NoVA's ITS Planning Process

VDOT-NoVA has integrated the use of its regional ITS architecture and the systems engineering requirements into the traditional transportation planning framework for ITS projects. VDOT-NoVA's ITS planning process identifies the steps that each ITS project must take during its planning lifecycle.

5.1 VDOT-NoVA Regional ITS Architecture

Among the main requirements of Rule 940 is the development and use of a regional ITS Architecture. VDOT-NoVA Regional ITS Architecture focuses on VDOT interfaces to other transportation systems within, and adjacent to, VDOT-NoVA's boundaries. The formal name of the architecture, the VDOT-NoVA-Centric Regional ITS Architecture, highlights this focus on VDOT linkages. The architecture does not identify non-VDOT to non-VDOT interfaces.

VDOT-NoVA Regional ITS Architecture was developed using a collaborative approach engaging major transportation partners in Northern Virginia. The architecture was also developed to be consistent with the Metropolitan Washington Council of Governments' (MWCOG) regional architecture to promote inter-operability across the entire District of Columbia (D.C.) region. The first version of VDOT-NoVA Regional ITS Architecture was developed in May 2002 and updated in December 2005 (Version 2.1)[1] and is available in web-format at www.vdot-itsarch.com.

5.2 VDOT-NoVA's ITS Planning Process

The ITS planning process consists of the following activities:

Project Development – In this phase, ideas for ITS projects are developed and proposed by VDOT-NoVA's Project Managers. VDOT-NoVA's Project Managers submit "Work Plans" to request project funding in a standard format. Ideally, the work plans should use the information in VDOT-NoVA's regional ITS architecture to explore, develop, and refine project ideas. By verifying that project ideas are consistent with the architecture, the project managers can ensure that their ideas are in concurrence with the vision of the other stakeholders in the region. Operations' Section Managers review, compile, and submit the work plans for their respective sections. With these inputs, VDOT-NoVA's ITS / Operations' Planning Staff reviews the work plan submissions and prepares a draft list of projects.

Tip: The VDOT-NoVA Regional ITS Architecture is also available as a "Turbo Architecture© Version 3.0" database version. Turbo Architecture© is a high-level, interactive software program that assists transportation planners and system integrators, both in the public and private sectors, in the development of regional and project architectures using the National ITS Architecture as a starting point.

[1] *The regional architecture is based on the latest version of the National ITS Architecture (version 5.1)*

(See Section 6 for How-to)

Activity	Initiator(s) / Actor(s)
1. Develop project ideas 2. View regional ITS architecture for validation and concept exploration* 3. Submit draft work plan (using template) to Operations' section managers	VDOT-NoVA's Project Managers
4. Review work plans * 5. Compile work plan submissions from Project Managers * 6. Submit work plants to ITS / Operations' Planning staff *	VDOT-NoVA's Operations' Section Managers
7. Review work plans; primarily, to assure consistency w/ regional architecture 8. Compile a draft list of projects	VDOT-NoVA's ITS / Operations' Planning Staff

Project Prioritization – VDOT-NoVA's ITS / Operations' Planning Staff facilitates the prioritization and annual development of the ITS / Operations' work plan (prioritized project list).

Activity	Initiator(s) / Actor(s)
1. Prioritize draft list of projects	VDOT-NoVA's ITS / Operations' Planning Staff
2. Conduct prioritization workshop	VDOT-NoVA's ITS / Operations' Planning Staff VDOT-NoVA's Operations' Section Managers
3. Compile a final list of prioritized projects	VDOT-NoVA's ITS / Operations' Planning Staff

Preparing the Funding Package – VDOT-NoVA's ITS / Operations' Planning Staff identifies potential funding, determines project eligibility for these funds, and prepares a Funding Request plan. The draft is reviewed by VDOT-NoVA's Operations' Section Managers and approved for submission.

Request Funding - The draft work and funding plans are submitted by VDOT-NoVA's ITS / Operations' Planning Staff to VDOT's Central Office and the Smart Travel Oversight Board (STOB) for approval. In the event of shortfalls, VDOT-NoVA's ITS / Operations' Planning Staff lobbies the Central Office for additional funds.

Activity	Initiator(s) / Actor(s)
1. Identify funding sources and determine eligiblity of prioritized projects to qualify for funding	VDOT-NoVA's ITS / Operations' Planning Staff
2. Prepare funding request	VDOT-NoVA's ITS / Operations' Planning Staff VDOT-NoVA's Operations' Section Managers

Finalize Fiscal Year (FY) Investment Plan (Balanced Budget) - Upon review and subsequent revision, VDOT-NoVA's ITS / Operations' Planning Staff formulates the final funding request for State funds and for the inclusion of ITS / Operations' projects in the Six-Year Improvement Program (SYIP). If the final funding request is not accommodated in the SYIP or via the allocation of State administrative funds, VDOT-NoVA's ITS / Operations' Planning Staff works with NoVA's Operations' Section Managers to modify the plan to reflect fiscal reality.

Activity	Initiator(s) / Actor(s)
1. Submit funding request	VDOT-NoVA's ITS / Operations' Planning Staff
2. Receive information on draft allocations	VDOT-NoVA's ITS / Operations' Planning Staff
3. Determine shortfall	VDOT-NoVA's ITS / Operations' Planning Staff
4. Participate in funding meetings with VDOT central office and partners	VDOT-NoVA's ITS / Operations' Planning Staff

Kick-off FY Investment Plan – After approval of the FY investment plan (balanced budget) by the STOB, VDOT-NoVA's ITS / Operations' Planning Staff conducts an FY investment plan initiation workshop with VDOT-NoVA's Operations' Section Managers and Project Managers.

Activity	Initiator(s) / Actor(s)
1. Receive final SYIP, soSYP, SPR etc amounts from Central Office	VDOT-NoVA's ITS / Operations' Planning Staff
2. Develop draft FY Investment Plan	VDOT-NoVA's ITS / Operations' Planning Staff
3. Conduct Investment Plan finalization workshop	VDOT-NoVA's ITS / Operations' Planning Staff VDOT-NoVA's ITS / Operations' Section Managers
4. Finalize FY Investment Plan (Balanced Budget)	VDOT-NoVA's ITS / Operations' Planning Staff

Activity	Initiator(s) / Actor(s)
1. FY Investment Plan initiation workshop(s)	VDOT-NoVA's ITS / Operations' Planning Staff VDOT-NoVA's Operations' Section Managers VDOT-NoVA's Project Managers
2. FHWA identifies projects requiring Rule 940 conformity	VDOT-NoVA's ITS / Operations' Planning Staff

SYIP:
Six-Year Improvement Program

soSYP:
System Operations Six Year Plan

SPR:
State Planning & Research Work Program

TIP:
Transportation Improvement Program

STIP:
State Transportation Improvement Program

CEDAR:
Comprehensive Environmental Data & Reporting System

* The activities (4-7) are explained in detail in Section 7.

ITS Project Initiation – Depending upon the funding sources, different processes need to be followed:

Activity	Initiator(s) / Actor(s)
1. Work with local partners to develop agreements, refine scopes, etc.	VDOT-NoVA's Project Managers
2. If federally funded, projects must be included in the TIP / STIP before authorization can be obtained.	VDOT-NoVA's Project Managers VDOT-NoVA's ITS / Operations' Planning Staff
3. If federally funded, projects must be entered into CEDAR in order to recieve the required environmental approvals	VDOT-NoVA's Project Managers
4. Identify projects that need to demonstrate Rule 940 conformity (federally-funded ITS projects)*	VDOT-NoVA's ITS / Operations' Planning Staff
5. Fill out Rule 940 checklists and send to VDOT-NoVA's Project Managers for additional details *	VDOT-NoVA's ITS / Operations' Planning Staff
6. Complete missing sections of Rule 940 checklists* and return to VDOT-NoVA's ITS / Operations Planning staff	VDOT-NoVA's Project Managers
7. Send completed checklists to FHWA*. After reviewing and approving the checklists, FHWA will authorize funds	VDOT-NoVA's ITS / Operations' Planning Staff FHWA Staff

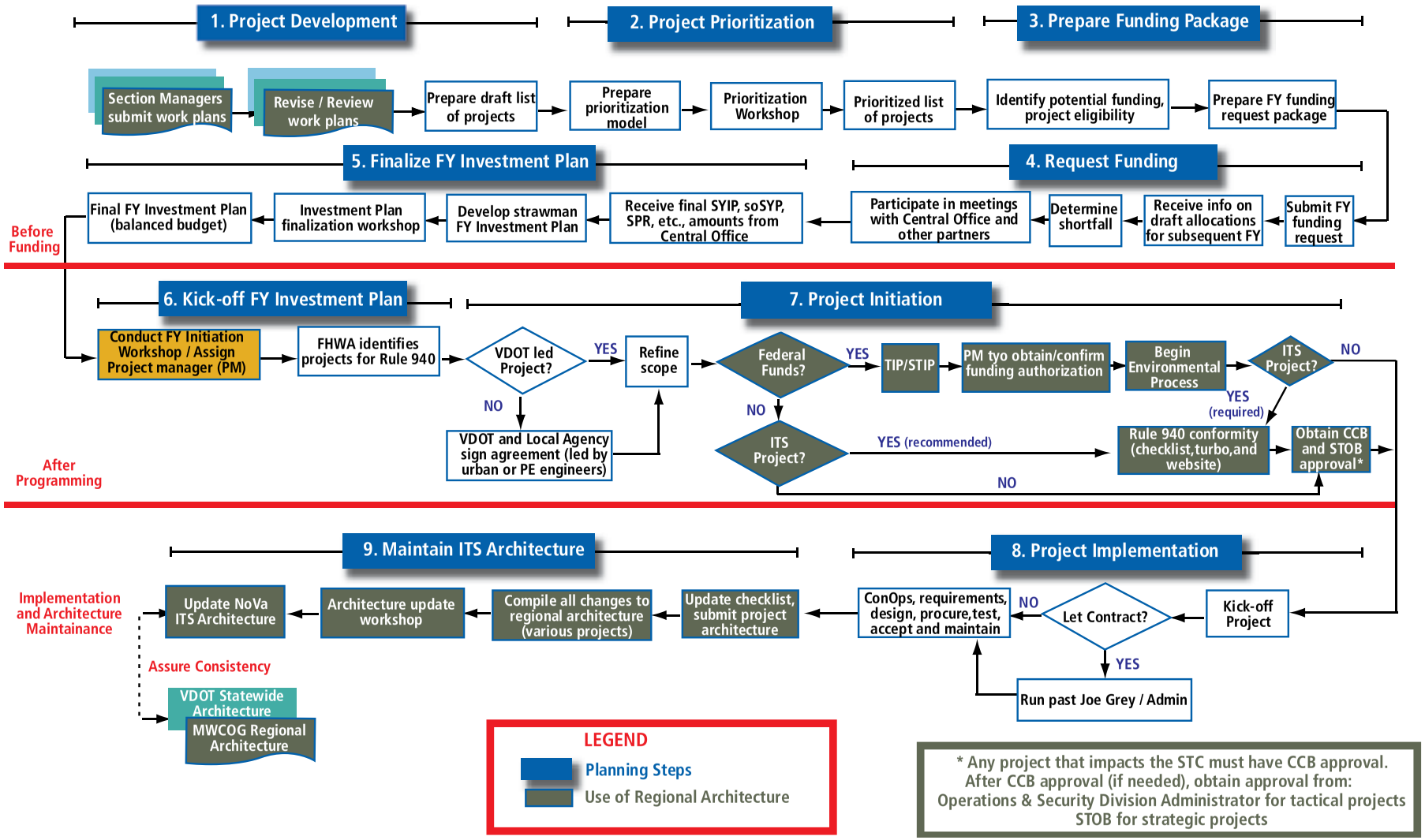
Project Implementation – Once the TIP/STIP is adopted, the funding is authorized and the environmental review is complete, the Project Manager can start implementing ITS projects funded by federal funds.

Activity	Initiator(s) / Actor(s)
1. Kick-off project 2. Implement Project 3. Revisit checklist as project progresses to ensure all the system engineering steps are followed	VDOT-NoVA's Project Managers

Tip: The three main tools available to NoVA project managers to assure conformance to the federal requirements for ITS architecture are the NoVA regional architecture website (www.vdot-itsarch.com), the Turbo database for the NoVA architecture, and the Rule 940 checklist. The checklist can be downloaded from the website.

Maintain ITS Architecture – Once the project is complete, the project manager submits an updated checklist and project architecture to VDOT-NoVA's ITS / Operations' Planning Staff, who will compile changes to the regional architecture that require inclusion during future updates of the regional architecture.

Activity	Initiator(s) / Actor(s)
1. Submit final checklist to VDOT-NoVA's ITS / Operations Planning Staff	VDOT-NoVA's Project Managers
2. Identify project components that require changes to the regional ITS architecture 3. Compile changes 4. Conduct regional ITS architecture update workshop 5. Update regional ITS architecture	VDOT-NoVA's ITS / Operations' Planning Staff



Graphically, the planning process is summarized in Figure-1 with the boxes shaded in light gray representing steps in the process where the regional architecture and systems engineering steps are used.

6.0 Project Development Pre-Funding

The following are the steps in project development before funding is requested or obtained.

Activity	Initiator(s) / Actor(s)
1. Develop project ideas 2. View regional ITS architecture for validation and refinement of project ideas 3. Submit draft work plan (using template) to Operations' Section Managers	VDOT-NoVA's Project Managers
4. Review work plans 5. Compile work plan submissions from Project Managers 6. Submit work plants to ITS / Operations' Planning staff	VDOT-NoVA's Operations' Section Managers
7. Review work plans; primarily, to assure consistency w/ regional architecture 8. Compile a draft list of projects	VDOT-NoVA's ITS / Operations' Planning Staff

Step 1: Develop Project Ideas: As VDOT-NoVA's Project Managers consider ITS deployments in the region, it is important that regional implications and possibilities be considered. Because it was developed using a collaborative approach, VDOT-NoVA's Regional ITS Architecture serves as a valuable repository of the various ITS-related needs of stakeholders in the northern Virginia region. The regional operating concept tab, which describes a high-level vision for ITS in the region, and the market packages tab, which identifies the services desired by the region, are two locations of interest on the architecture website for project managers developing new project ideas.

Tip: Question: When should VDOT-NoVA's Regional ITS Architecture be explored when evaluating a project idea, and when should the Metropolitan Washington Regional ITS Architecture be explored?
The answer depends on which stakeholders are involved in the project. If the project involves all or some VDOT-NoVA systems, it is recommended that the Project Manager use the VDOT-NoVA Regional ITS Architecture. If the project mainly involves non-VDOT-NoVA systems, then the project manager should use the MWCOG architecture.

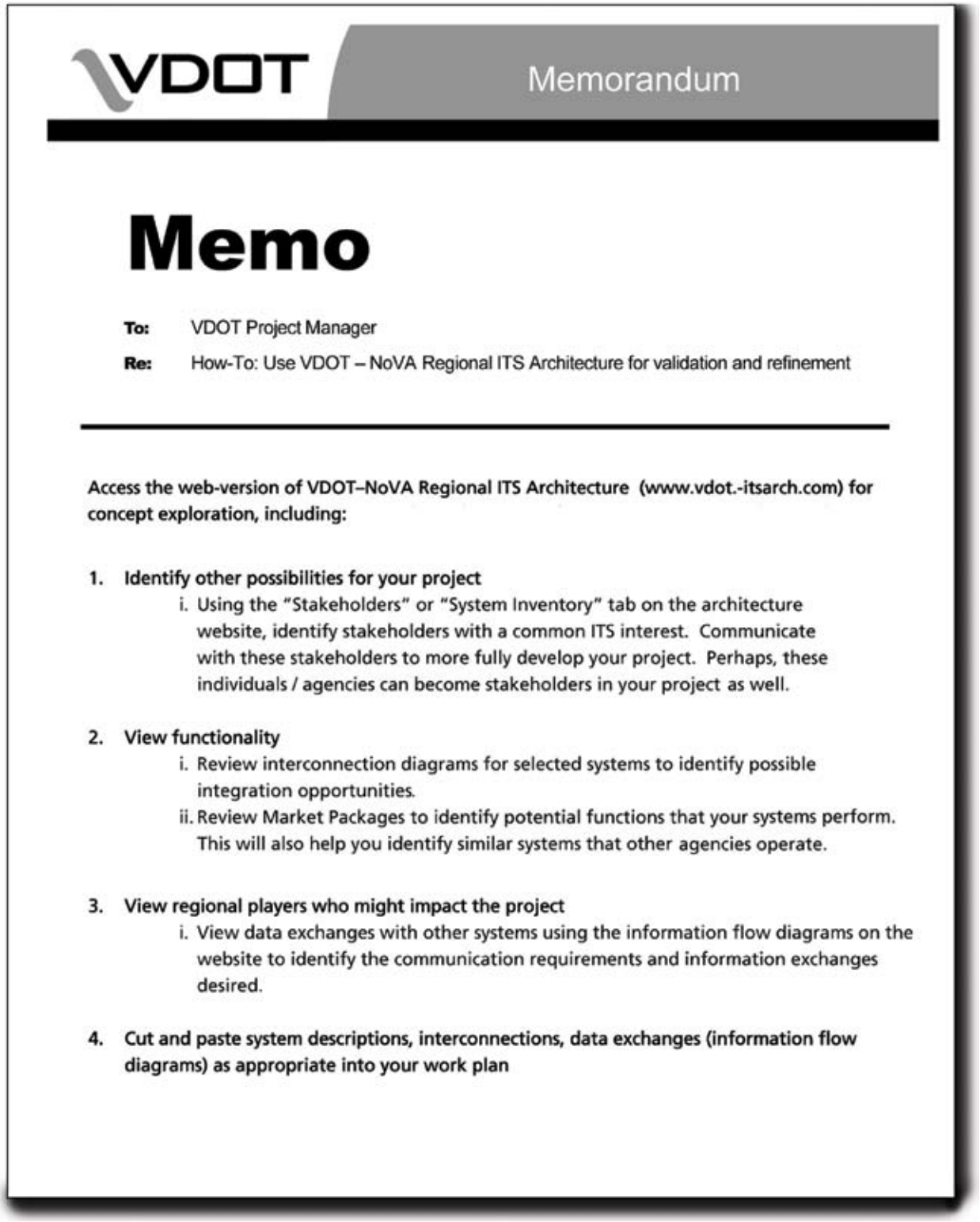
Step 2: View Regional ITS Architecture for Validation and Refinement of Project Ideas: Reviewing VDOT-NoVA Regional ITS Architecture website for project ideas and validation is a critical step in identifying the "big picture"; that is, where does the specific project idea fit within the overall regional ITS system, and what are the potential interconnects between the project and other ITS systems at VDOT-NoVA.

Resources are limited during early project development before funding has been designated for a project. Therefore, a simple, non-resource intensive approach to utilizing the architecture is recommended. The steps identified in the box on page 15 will help the Project Manager explore the different possibilities for particular project ideas. The broader the spectrum of support for a project, the greater is its chance of being funded.

Step 3: Submit Draft Work Plan: VDOT-NoVA has created a standard work plan template (included in Appendix A) for Project Managers to use for submission of project ideas. The template maps the project ideas to the overall ITS program goals and objectives, identifies roles and responsibilities, and any interdependencies with other projects.

Steps 4-6: Review, Compile Work Plans: VDOT-NoVA's Operations' Section Managers will review and compile the work plans and submit it to VDOT-NoVA's ITS / Operations' Planning Staff.

Steps 7-8 – Draft List of Projects: VDOT-NoVA's ITS / Operations' Planning Staff will review the Work Plans provided by the Operations Section Managers, primarily, to assure consistency with regional architecture, and compile a list of projects for input into the prioritization phase.



VDOT Memorandum

Memo

To: VDOT Project Manager

Re: How-To: Use VDOT – NoVA Regional ITS Architecture for validation and refinement

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Access the web-version of VDOT–NoVA Regional ITS Architecture (www.vdot.-itsarch.com) for concept exploration, including:

1. **Identify other possibilities for your project**
   i. Using the "Stakeholders" or "System Inventory" tab on the architecture website, identify stakeholders with a common ITS interest. Communicate with these stakeholders to more fully develop your project. Perhaps, these individuals / agencies can become stakeholders in your project as well.

2. **View functionality**
   i. Review interconnection diagrams for selected systems to identify possible integration opportunities.
   ii. Review Market Packages to identify potential functions that your systems perform. This will also help you identify similar systems that other agencies operate.

3. **View regional players who might impact the project**
   i. View data exchanges with other systems using the information flow diagrams on the website to identify the communication requirements and information exchanges desired.

4. **Cut and paste system descriptions, interconnections, data exchanges (information flow diagrams) as appropriate into your work plan**

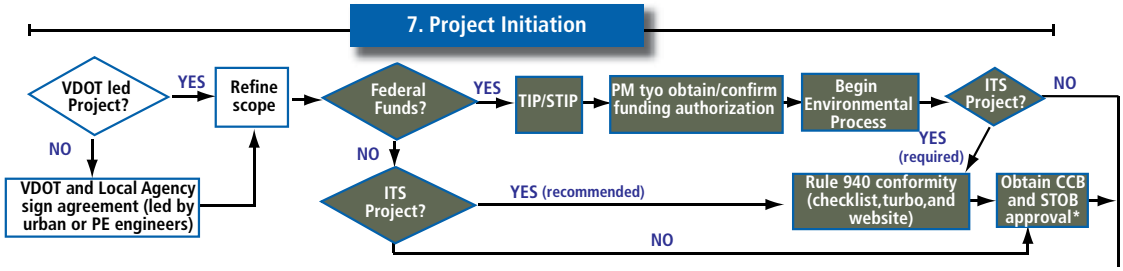
7.0 Project Initiation and Implementation – Post Funding

** Any project that impacts the STC must have CCB approval from:*

Operations and Security Division Administrator for tactical projects

STOB for strategic projects

After funding has been programmed for the project, the focus is on having the project implementation follow a sound systems engineering process. The following are the activities after funding for the project has been programmed into the FY investment plan.



Activity	Initiator(s) / Actor(s)
1. Work with local partners to develop agreements, refine scopes, etc.	VDOT-NoVA's Project Managers
2. If federally funded, projects must be included in the TIP / STIP before authorization can be obtained.	VDOT-NoVA's Project Managers VDOT-NoVA's ITS / Operations' Planning Staff
3. If federally funded, projects must be entered into CEDAR in order to recieve the required environmental approvals.	VDOT-NoVA's Project Managers
4. Identify projects that need to demonstrate Rule 940 conformity (federally-funded ITS projects).	VDOT-NoVA's ITS / Operations' Planning Staff
5. Fill out Rule 940 checklists and send to VDOT-NoVA's Project Managers for additional details.	VDOT-NoVA's ITS / Operations' Planning Staff
6. Complete missing sections of Rule 940 checklists and return to VDOT-NoVA's ITS / Operations Planning staff.	VDOT-NoVA's Project Managers
7. Send completed checklists to FHWA. After reviewing and approving the checklists, FHWA will authorize funds.	VDOT-NoVA's ITS / Operations' Planning Staff FHWA Staff

CCB:
Change Configuration Board

STOB:
Smart Travel Oversight Board

Steps 1-2: Scope Revisions, TIP / STIP Authorization: VDOT-NoVA's ITS / Operations' Planning Staff will assist VDOT Project Managers to ensure that all the paperwork and approvals are in place for project initiation.

Step 3 – Obtain Environmental Approvals: NoVA's Project Managers should work with NoVA's environmental staff to ensure that the environmental processes are followed that are necessary to receive environmental approvals.

Step 4 – Identification of Projects to Demonstrate Rule 940 Conformity: For federally funded ITS projects, several steps need to be followed as part of the systems engineering analysis and Rule 940 requirements. VDOT-NoVA's ITS / Operations' Planning Staff will work with the FHWA's representatives to determine which projects need to demonstrate Rule 940 conformity and share the information with the appropriate Project Managers.

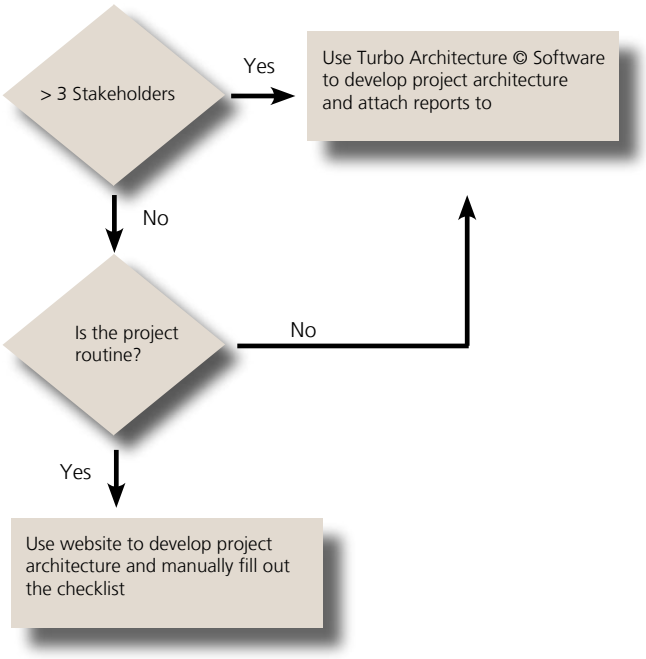
Step 5 – Fill out Rule 940 Checklist: The most important tool for VDOT-NoVA's Project Managers at this stage is the Rule 940 Checklist. The checklist is a guide for project managers to determine what documents, steps, and analyses need to be developed over the life of the project. The checklist is broken down into 11 sections (see page 18). These sections were adapted from the federal guidance on using systems engineering for ITS projects, as well as from the Caltrans Systems Engineering Guidebook[2]. Most of the activities on the checklist are self-explanatory and will require minimal effort on the part of Project Managers.

A completed checklist for a sample project is included in Appendix B, and a blank checklist is provided in Appendix C. VDOT-NoVA's ITS/Operations' Planning Staff will initiate completion of the checklist based on information already available to them, and then send the checklist to the project managers for full completion. For projects utilizing no federal funds, it is recommended that a similar process be followed, if the project is non-routine, that is, projects which involve new technology or integration with new systems. Examples of such projects include integration of computer-aided dispatch systems among various law enforcement agencies and with traffic management agencies, setting up a video clearinghouse, provision of regional traveler information, etc.

Step 6 – Completing the Checklist: VDOT-NoVA's Project Managers will receive a partially completed checklist from the ITS / Operations' Planning Staff.

While sections 1, 2, 8, 9, 10 and 11 need to be filled in manually, a Project Manager can fill out the remaining sections of the checklist (which pertain primarily to the project architecture) in two ways:

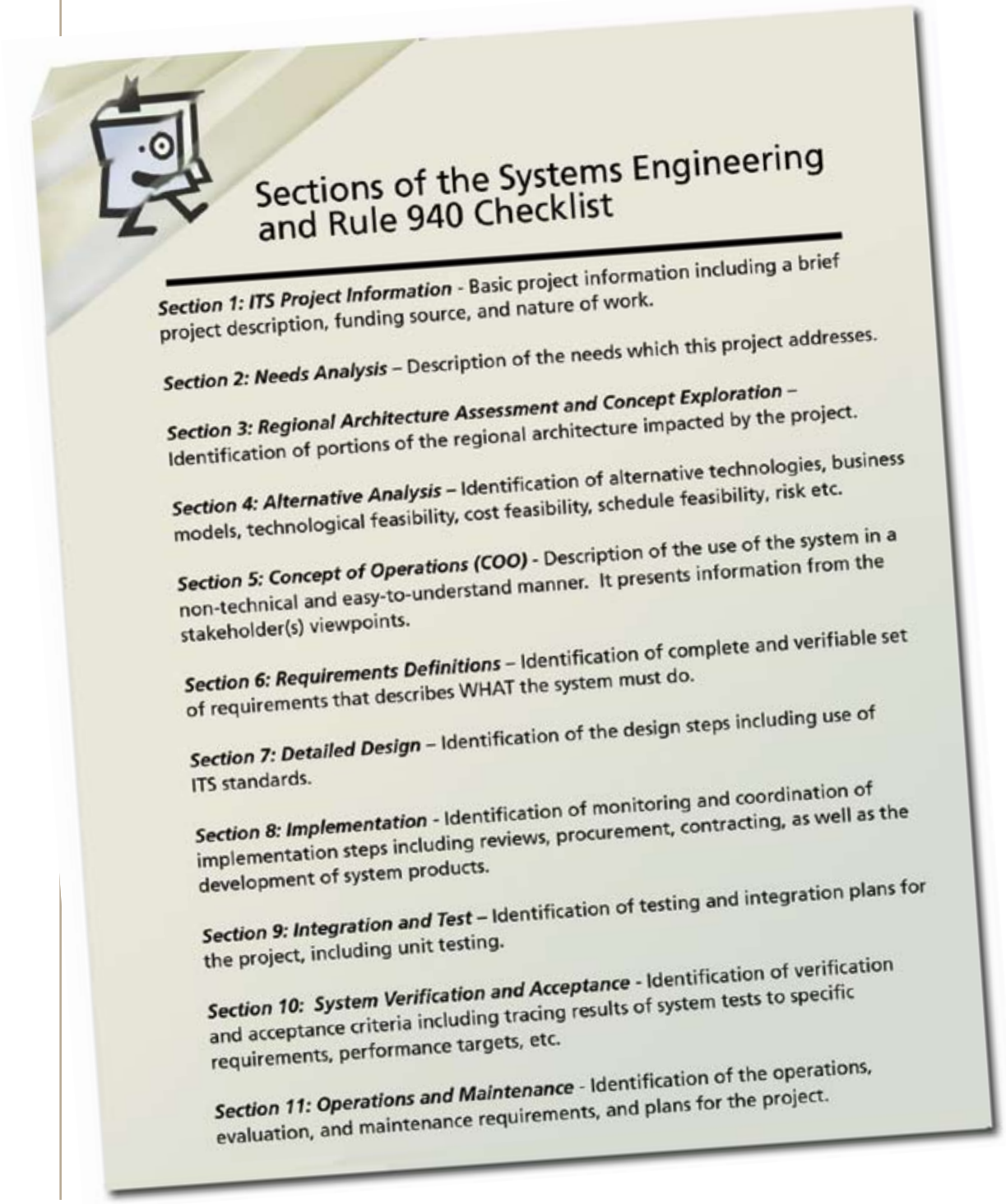
1. Use the website for architecture exploration
2. Use the Turbo Architecture© software tool



The choice between the two approaches depends entirely on the nature of the project. If the number of systems and / or stakeholders is less than three or if the project is a routine project, the use of the website is sufficient. Examples of such projects could be camera or dynamic message sign replacement or new installations, traffic monitoring device installation, etc. If the number of stakeholders and / or systems is greater than three or if the project is one-of-a-kind involving new technology or systems, the use of the Turbo Architecture© software tool is strongly encouraged.

[2] available online at http://www.dot.ca.gov/hq/research/ (under documents on the left side of the screen)

As a general rule, as project complexity increases, it is easier to use the Turbo Architecture© database to fill out sections of the checklist. However, Project Managers are strongly encouraged to take a training class in the use of Turbo Architecture© prior to using the database. VDOT-NoVA's ITS / Operations' Planning Staff can also provide guidance and support if the Turbo Architecture© option is selected.



Sections of the Systems Engineering and Rule 940 Checklist

Section 1: ITS Project Information - Basic project information including a brief project description, funding source, and nature of work.

Section 2: Needs Analysis – Description of the needs which this project addresses.

Section 3: Regional Architecture Assessment and Concept Exploration – Identification of portions of the regional architecture impacted by the project.

Section 4: Alternative Analysis – Identification of alternative technologies, business models, technological feasibility, cost feasibility, schedule feasibility, risk etc.

Section 5: Concept of Operations (COO) - Description of the use of the system in a non-technical and easy-to-understand manner. It presents information from the stakeholder(s) viewpoints.

Section 6: Requirements Definitions – Identification of complete and verifiable set of requirements that describes WHAT the system must do.

Section 7: Detailed Design – Identification of the design steps including use of ITS standards.

Section 8: Implementation - Identification of monitoring and coordination of implementation steps including reviews, procurement, contracting, as well as the development of system products.

Section 9: Integration and Test – Identification of testing and integration plans for the project, including unit testing.

Section 10: System Verification and Acceptance - Identification of verification and acceptance criteria including tracing results of system tests to specific requirements, performance targets, etc.

Section 11: Operations and Maintenance - Identification of the operations, evaluation, and maintenance requirements, and plans for the project.

Using the Website for Project Architectures

VDOT-NoVA Regional ITS Architecture website is located at www.vdot-itsarch.com, and it can be accessed from the website through four different pathways depending on the user's interest. All of the pathways lead to the same information and they are:

- **Stakeholders** – View the architecture from an agency's perspective
  (example – VDOT-NoVA)
- **Inventory** – View the architecture from a system perspective
  (example - VDOT-NoVA's Smart Traffic Center)
- **Market Package** – View the architecture from a services perspective
  (example – Regional Traffic Control)
- **Entity** – View the architecture from a "subsystem" or functional perspective.
  Sub-systems are types of centers, field equipment, vehicles involved in a function such as traffic management or traveler information.
  (example – Traveler Information)

The following is a simple, hypothetical example to illustrate the use of the website by the Project Manager for developing project architecture using the stakeholder pathway. Consider that VDOT is interested in upgrading its Closed Circuit Television Cameras to a newer model from the same vendor. The process that the Project Manager would follow is:

1. Go to the stakeholder section of the website
   - Identify VDOT-NoVA District as the impacted stakeholder and click on it.
2. Look under VDOT-NoVA District for inventory elements of interest:
   – VDOT-NoVA's Smart Traffic Center (STC)
   – VDOT-NoVA's STC Field Equipment
4. Click on any one of the inventory elements.
5. Under information flow diagrams – See if the data exchanges suggested by the architecture are accurate and include the project scope.
6. Ensure that this project does not affect other regional architectures.

For first-time users of the website, VDOT-NoVA's ITS / Operations' Planning Staff can help with a walkthrough of the website for the project.

Using Turbo Architecture© to Define Project Architectures

As projects get more complex, the use of the website becomes cumbersome. Also, the website is easier for routine projects for which information exchanges are already captured in the architecture. With access to the Turbo Architecture© software tool, the regional architecture can be viewed in a database format, and, as the software provides several features that simplify the design of an architecture, more complex project architecture can be developed. Using the software tool ensures consistency with the regional architecture and with the National ITS Architecture. The software also does the "homework" on identification of ITS Standards and their applicability to the particular project.

To the inexperienced, viewing the architecture using Turbo Architecture© can be intimidating. However, once experience is gained, Turbo Architecture© is easy to use, with powerful reporting capabilities. VDOT-NoVA's Project Managers who manage ITS projects should avail themselves of training opportunities on Turbo Architecture© within VDOT-NoVA and elsewhere.

To begin using Turbo Architecture©, the Project Manager needs to download VDOT-NoVA Regional ITS Architecture Turbo Architecture© database from the website. To download the database, click on the "Turbo db" icon on the website, fill in the form, and click on the "submit" button. An email will be sent to the address provided in the form with a hyperlink to download the database. The Project Manager should also have Turbo Architecture© (version 3.0 or higher) installed on their computer.

Development of a project architecture using Turbo Architecture© involves the user going through a series of selections (tabs) on the software. The process requires the user to identify which systems are involved in the project (inventory), to identify which ITS user services the project will provide or help provide (services), to specify high-level requirements, and to identify the systems with information exchange connections (build & customize). Turbo Architecture© reports can be attached to the checklist. These reports can also be used in developing RFPs, or addressing ITS standards. See the "suggested reports" box for useful outputs from Turbo.

Step 7 – Submitting the checklist: Once the Rule 940 checklist is completed, VDOT-NoVA's ITS / Operations' Planning Staff will review and forward the checklist along with supporting documents to FHWA. FHWA staff will review the checklist and supporting documentation and make a determination as to whether the proposed project demonstrates compliance with Rule 940.

Suggested Turbo Reports to attach with your Rule 940 Checklist:

- ***Section 3.1*** – Stakeholder Report
- ***Section 3.2*** – Inventory Report
- ***Section 3.3*** – Project Architecture Report
- – Interconnect and flow diagrams
- ***Section 3.5*** – Region to Project Comparison (tabular form)
- ***Section 5.1*** – Market Packages Report
- – Roles and Responsibilities Report
- ***Section 6*** – Functional Requirements Report
- ***Section 7.3*** – Standards Report
- ***Section 8.1*** – List of Agreements

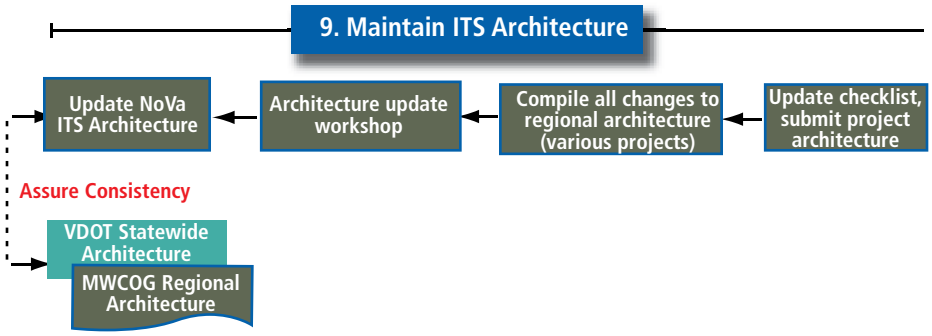
Tip: Check VDOT–NoVA Regional ITS Architecture website for announcements regarding training classes on how to use the NoVA architecture. These classes include hands-on exercises on how to use Turbo Architecture© for project architecture development.

8.0 Maintaining the Architecture – After Completion of the Project

It is important that VDOT-NoVA Regional ITS Architecture remain accurate and current as ITS projects are planned, designed and implemented. The following activities ensure that VDOT-NoVA Regional ITS Architecture is updated periodically.

Step 1. Submit checklists to VDOT-NoVA's ITS / Operations' Planning Staff: To ensure that VDOT-NoVA Regional ITS Architecture reflects recently implemented ITS projects, the Project Manager, upon completion of the project, should update the Rule 940 checklist and submit it to the ITS / Operations' Planning Staff. If the Turbo Architecture© files are available, the Project Manager can send the architecture details by selecting the "Maintain Architecture" link on NoVA's architecture website.

Steps 2-5 – Compile, review and update the architecture: VDOT-NoVA's ITS / Operations' Planning Staff is responsible for the update and maintenance of the VDOT-NoVA Regional ITS Architecture. The ITS / Operations' Planning Staff will periodically conduct architecture update workshops with major stakeholders in the region to review changes to the system due to project implementation, and other causes. Approved changes will be incorporated into VDOT-NoVA Regional ITS Architecture. VDOT-NoVA's ITS / Operations' Planning Staff will also ensure that there is consistency between VDOT-NoVA Regional ITS Architecture and the Metropolitan Washington Regional ITS Architecture. This process allows for the evolution of both regional architecture and maintains its usefulness to the stakeholders.



Activity	Initiator(s) / Actor(s)
1. Submit final checklist to VDOT-NoVA's ITS / Operations Planning Staff	VDOT-NoVA's Project Managers
2. Identify project components that require changes to the regional ITS architecture 3. Compile changes 4. Conduct regional ITS architecture update workshop 5. Update regional ITS architecture	VDOT-NoVA's ITS / Operations' Planning Staff

Appendix A: Work Plan Template

VDOT Virginia Department of Transportation

Work Plan - Template

1. Title

2. Scope

2.1 Problem / Need Statement

2.2 Background Information

2.3 Description of Problems Caused by Existing Systems

2.4 Justification - Expected Improvements to be Gained by Fixing this Problem

2.5 Map to NoVA's Smart Travel's Program Plan

Table 1. Mapping to NoVA's Smart Travel's Goals and Objectives

	NoVA's Smart Travel's Goals & Objectives										
Action	1.A	1.B	1.C	2.A	2.B	2.C	3.A	3.B	4.A	4.B	4.C
	●	●	●	●	●	●	●	●	●	●	●
	●	●	●	●	●	●	●	●	●	●	●
	●	●	●	●	●	●	●	●	●	●	●
	●	●	●	●	●	●	●	●	●	●	●

2.6 Map to NoVA's Operations' Strategic Plan

Table 2. Mapping to NoVA's Operations' Strategic Goals and Objectives

	NoVA's Ops' Goals					NoVA's Ops' Objectives								
Action	1.	2.	3.	4.	5.	A.	B.	C.	D.	E.	F.	G.	H.	I.
	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	●	●	●	●	●	●	●	●	●	●	●	●	●	●

2.7 Portions of Regional ITS Architecture Implemented by Project

2.7.1 Stakeholders

2.7.2 Systems or Inventory

2.7.3 Interfaces or Interconnections

3. Implementation Strategy

3.1 Tasks Identification

3.2 Time Line

3.3 Cost (by Fiscal Year)

4. Roles and Responsibilities

5. Interdependencies

6. Evaluation Plan

VDOT-NoVAs Smart Travels Goals and Objectives

Goal	Objectives
Goal 1 **Enhance Safety**	1A. Minimize Incidents 1B. Respond efficiently to incidents 1C. Improve transportation security
Goal 2 **Enhance Mobility**	2A. Operate the transportation system efficiently and effectively 2B. Enhance district operations and maximize effectiveness of personnel, equipment and resources 2C. Expand ITS infrastructure to enable corridor management
Goal 3 **Make the Transportation System User Friendly**	3A. Enhance and simplify all VDOT interactions with customers 3B. Support traveler information services
Goal 4 **Enable Cross-Cutting Activities to Support Goals 1-3**	4A. Enhance mobility using technology 4B. Create a 21st century foundation for operations 4C. Conduct a strategic research and development program

VDOT-NoVAs Operations Strategic Goals and Objectives

NoVA District Operations Goals

1. Ensure safe operation of the VDOT-NoVA's road network
2. Move traffic efficiently on the VDOT-NoVA's road network
3. Detect, verify, respond and manage vehicular incidents timely and effectively
4. Communicate / coordinate road net information with regional and local jurisdictions
5. Provide meaningful and useful information to the traveling public

NoVA District Operations Objectives

A. Establish and implement an integrated traffic management program
B. Coordinate and integrate program & system activities through a structured communication and feedback process
C. Provide customer service and manage expectations
D. Assess continuous improvement opportunities
E. Reduce vehicular accidents
F. Improve traffic flow and travel time
G. Reduce incident clearance cycle time
H. Provide relevant travel information systems
I. Measure what is managed

Appendix B: Rule 940 Checklist Example

ITS Projects – Systems Engineering and Architecture Compliance (Rule 940) Checklist

This Checklist to be filled out by VDOT-NoVA's ITS / Operations' Planning Staff and the Project Manager.

Project Name:		
Date	Name of Person Filling/ Modifying the Form	Notes
1/18/06	Archie Tecture	Documents still to be developed - Detailed Work Plan - Requirements - Detailed Design - Integration Plan - Test Plan and System Verification Plan - RFP for contract with Private ISP - Evaluation Plan

ITS Projects – Systems Engineering and Architecture Compliance (Rule 940) Checklist

SECTION 1 – Project Information

1.1 PROJECT TITLE
HOV Condition Monitoring and Improvement

1.2 PROJECT NUMBER
☒ New Project
☐ Modification to existing Project

1.3 BRIEF DESCRIPTION/PURPOSE
VDOT has procured a private ISP partner to install sensors at strategic locations on I-395 HOV lanes. This project is to deploy additional sensors that would provide traffic volume and complete traffic condition monitoring on I-395/I-95 HOV and I-66 HOV lanes. This project will also assure data connection with the Virginia ADMS and modify the ADMS tool to provide automatic data analysis for HOV condition monitoring in NOVA. The HOV improvement might also include restriping, signing, and implementing demand management strategies.

1.4 CONTACT PERSON/GROUP	1.5 PROJECT LOCATION	1.6 PERIOD OF PERFORMANCE	1.7 BUDGET & FUNDING SOURCE
Hari Sripathi **703-383-2403**	**I-395/I-95/I-66 HOV Lanes, NOVA District**	**07-2005 to 06-2009**	**$600,000 ($480,000 CMAQ, and $120,000 State Match)**

1.8 NATURE OF WORK
☐ Scoping ☒ Design ☒ Software/Integration ☒ Implementation ☒ Operations ☒ Evaluations ☐ Others (Please specify)
If Other, Please Specify

1.9 RELATIONSHIP TO OTHER PROJECTS AND PHASES
Demonstration of Speed Info Sensors to VDOT
Evaluation of traffic detection sensors by VDOT-NoVA's Systems Engineering Section

1.10 EQUIPMENT TO BE PURCHASED WITH PROJECT FUNDING
Traffic Sensors

1.11 STATUS
☒ CCB Approval
☒ STOB Approval
☒ Environmental Clearance, If applicable
☐ TIP/STIP Amendment
☐ FHWA Authorization

1.12 IS THERE A WORK PLAN FOR THIS PROJECT WITH TASK BREAKDOWN?
☐ No
☐ Yes, Provide Document Reference
☒ To Be Developed

SECTION 2 – Needs Assessment

2.1 WHAT IS/ARE THE PROBLEM(S) WITH THE CURRENT SITUATION?
VDOT needs to know the HOV facility usage conditions for its facilities in NOVA

2.2 WHAT NEEDS DOES THIS PROJECT ADDRESS?
The need is for VDOT to monitor and report to FHWA the HOV facility usage conditions. This is especially important after SAFETEA-LU was passed that required DOTs to monitor HOV operations to determine if single-occupancy hybrid vehicles be allowed to use HOV lanes.

2.3 HOW WERE THESE NEEDS IDENTIFIED?
☐ Internal VDOT Assessment ☐ Stakeholder Involvement ☐ From Technical Reviews or other studies ☐ Other

Please provide details on how needs were identified – If other documentation was used as reference, please identify it here.
USDOT has also identified HOV condition monitoring as an important element of traffic operations

SECTION 3 – Regional Architecture Assessment and Concept Exploration

3.1 STAKEHOLDERS IN VDOT REGIONAL ARCHITECTURE INCLUDED BY PROJECT

VDOT-NoVA District
Private ISP Providers
University of Virginia

Turbo Architecture© – "Stakeholder Report" ☐ Attached ☒ Unavailable

3.2 INVENTORY ELEMENTS IN VDOT REGIONAL ARCHITECTURE INCLUDED BY PROJECT

VDOT-NoVA's Smart Traffic Center (STC)
VDOT-NoVA's STC Field Equipment
VDOT-NoVA's Sections
Private Sector ISP Centers
Smart Travel Lab

Turbo Architecture© – "Inventory Report" ☐ Attached ☒ Unavailable

3.3 INTERFACE IMPACTS (I.E DATA EXCHANGES) DUE TO PROJECT. PORTIONS OF ARCHITECTURE BEING IMPLEMENTED

1. VDOT plans to obtain speed estimates from traffic monitoring devices along the roadway on the HOV network. The data will be collected by the field equipment and transferred to the STC. This is referenced by the following link in the architecture
http://www.vdot-itsarch.com/nova/html/flow/vdot_nova_stc_field_equipment_to_vdot_nova_stc.htm

2. Another source of traffic information is from private ISP providers who have installed equipment on VDOT roadway system. A private provider will provide data to STC using sensors installed at strategic locations. This is referenced by the following in the architecture.
http://www.vdot-itsarch.com/nova/html/flow/vdot_nova_stc_to_virginia_statewide_information_clearinghouse_and_private_isp_centers.htm

3. VDOT also plans to archive and analyze travel time data for Operations' Planning. These will be done through the Smart Travel Lab (University of Virginia). This is referenced by the following link
http://www.vdot-itsarch.com/nova/html/flow/smart_travel_lab_to_vdot_nova_stc_and_vdot_nova_stss.htm

4. VDOT-NoVA's Sections will analyze and report the conditions of the HOV lanes. NOVA'S sections will receive the data directly or from the Smart Travel Lab. These exchanges are described by the following link.
http://www.vdot-itsarch.com/nova/html/flow/nova_sections_to_smart_travel_lab_and_vdot_mobility_data_store_and_vdot_nova_gis.htm

Turbo Architecture© – "Project Architecture Report" ☐ Attached ☒ Unavailable
Turbo Architecture© – "Interconnect and Flow Diagrams" ☐ Attached ☒ Unavailable

3.4 OTHER REGIONAL ARCHITECTURES IMPACTED BY PROJECT

☐ DC Region (MWCOG) ☐ Maryland ☐ Other VDOT Districts ☐ VDOT Statewide ☒ None

Changes communicated to appropriate architecture maintenance agencies ☐ No ☐ Yes

3.5 CHANGES RECOMMENDED TO VDOT-NoVA and/or REGIONAL ARCHITECTURES

☒ No ☐ Yes

If "Yes", Please Specify and provide detail

Turbo Architecture© – "Region to Project Comparison Report" ☐ Attached ☒ Unavailable

SECTION 4 – Alternative Analysis

4.1 WERE ANY ALTERNATE CONCEPTS/IDEAS CONSIDERED? ANY OTHER SOLUTIONS TO THE PROBLEM?

☒ No ☐ Yes

Please Specify how the best concept was selected

This project uses a combination of private ISP data as well as VDOT sensors. However, VDOT evaluated several traffic sensor technologies to be used for this project

4.2 REFERENCE DOCUMENTS (IF ANY)

SECTION 5 – Concept of Operations

5.1 IS THERE A CONCEPT OF OPERATIONS (COO) FOR THIS PROJECT?

☐ No ☐ Yes ☒ To Be Developed

If "No" was selected, please specify reason

5.2 IF "Yes" WAS SELECTED, PLEASE FILL OUT THE FOLLOWING

COO Contains:

- Scope (Geographic, Timeframe, Region etc)	☐ Yes	☐ No
- Description of what the project/system is expected to do	☐ Yes	☐ No
- Roles and Responsibilities for all stakeholders	☐ Yes	☐ No
- Operational Scenarios	☐ Yes	☐ No
- Project/System Impacts	☐ Yes	☐ No

If "No" was checked in any of the boxes, please specify reason

5.3 PLEASE PROVIDE COO DOCUMENT REFERENCE IF AVAILABLE

A COO will be developed with the work plan

Turbo Architecture© – "Roles and Responsibilities Report" ☐ Attached ☒ Unavailable

SECTION 6 – Requirement Definitions (High-Level and Detailed)

6.1 ARE HIGH-LEVEL FUNCTIONAL REQUIREMENTS WRITTEN AND DOCUMENTED

☐ No ☐ Yes ☒ To Be Developed

6.2 IF "Yes" WAS SELECTED, PROVIDE REQUIREMENTS DOCUMENT REFERENCE IF AVAILABLE

Turbo Architecture© – "Functional Requirements Report" ☐ Attached ☒ Unavailable

SECTION 7 – Detailed Design

7.1 IS THERE A DESIGN DOCUMENT AVAILABLE

☐ No ☐ Yes ☒ To Be Developed

Please provide reference to design document

7.2 IF "YES" WAS SELECTED, PLEASE FILL OUT THE FOLLOWING

Are the design details well documented	☐ Yes	☐ No
Do the details of the design trace to requirements definitions	☐ Yes	☐ No
Are boundaries and interfaces of the system clearly identified	☐ Yes	☐ No
Is there a process for Configuration Control	☐ Yes	☐ No

If No was checked in above boxes , please provide an explanation

7.3 DOES THE DESIGN INCORPORTATE NATIONAL ITS STANDARDS

☐ No ☐ Yes

IF YES, Please mention what ITS Standards are being used

Turbo Architecture© – "Standards Report" ☐ Attached ☒ Unavailable

7.4 DOES THE DESIGN INCORPORTATE ANY VDOT ENTERPRISE STANDARDS

☐ No ☐ Yes,

IF Yes, Please mention what VDOT Enterprise Standards are being used

SECTION 8 – Implementation

8.1 PROCURMENT DETAILS

VDOT will use internal staff for technology analysis
On-Call contract to develop concept of operations, requirements, design
RFP to procure data from field
Contract to Smart Travel Lab for HOV data analysis

8.2 REFERENCE DOCUMENTS (IF ANY)

SECTION 9 – Integration and Test

9.1 IS THERE AN INTEGRATION PLAN

☐ No ☐ Yes ☒ To Be Developed

If "Yes" Please provide reference

9.2 IS THERE A TEST PLAN

☐ No ☐ Yes ☒ To Be Developed

If "Yes" Please provide reference

SECTION 10 – System Verification and Acceptance

10.1 IS THERE A SYSTEM VERIFICATION AND ACCEPTANCE PLAN (verification of the entire system and acceptance criteria)

☐ No ☐ Yes ☒ To Be Developed

If "Yes" Please provide reference

10.2 IF YES, PLEASE FILL OUT THE FOLLOWING

- Is there a clear criteria for completion ☐ Yes ☐ No
- Are there clear performance metrics for system acceptance ☐ Yes ☐ No
- Will there be adequate system documentation for all users and maintainers ☐ Yes ☐ No

If No was checked in above boxes , please provide an explanation

SECTION 11 – Operations and Maintenance

11.1 WHO WILL MAINTAIN THE SYSTEM

VDOT ITS Maintenance and Construction (IMC) will maintain the field equipment
VDOT Central Office will maintain the ADMS
Private ISP will maintain their equipment.

11.2 IS THERE A SCHEDULE FOR UPGRADES/ENHANCEMENTS TO THE SYSTEM

None

11.3 WILL THERE BE AN EVALUATION OF THE SYSTEM

Yes. An Evaluation Plan will be developed

VDOT Virginia Department of Transportation

Northern Virginia

ITS Projects – Systems Engineering and Architecture Compliance (Rule 940) Checklist

This Checklist to be filled out by VDOT-NoVA's ITS / Operations' Planning Staff and the Project Manager.

Project Name:		
Date	Name of Person Filling/ Modifying the Form	Notes

ITS Projects – Systems Engineering and Architecture Compliance (Rule 940) Checklist

SECTION 1 – Project Information

1.1 PROJECT TITLE

1.2 PROJECT NUMBER
☐ New Project
☐ Modification to existing Project

1.3 BRIEF DESCRIPTION/PURPOSE

1.4 CONTACT PERSON/GROUP	1.5 PROJECT LOCATION	1.6 PERIOD OF PERFORMANCE	1.7 BUDGET & FUNDING SOURCE

1.8 NATURE OF WORK
☐ Scoping ☐ Design ☒ Software/Integration ☒ Implementation ☒ Operations ☐ Evaluations ☐ Others (Please specify)
If Other, Please Specify

1.9 RELATIONSHIP TO OTHER PROJECTS AND PHASES

1.10 EQUIPMENT TO BE PURCHASED WITH PROJECT FUNDING

1.11 STATUS

☐ CCB Approval	☐ TIP/STIP Amendment
☐ STOB Approval	☐ FHWA Authorization
☐ Environmental Clearance, If applicable	

1.12 IS THERE A WORK PLAN FOR THIS PROJECT WITH TASK BREAKDOWN?
☐ No
☐ Yes, Provide Document Reference
☐ To Be Developed

SECTION 2 – Needs Assessment

2.1 WHAT IS/ARE THE PROBLEM(S) WITH THE CURRENT SITUATION?

2.2 WHAT NEEDS DOES THIS PROJECT ADDRESS?

2.3 HOW WERE THESE NEEDS IDENTIFIED?
☐ Internal VDOT Assessment ☐ Stakeholder Involvement ☐ From Technical Reviews or other studies ☐ Other

Please provide details on how needs were identified – If other documentation was used as reference, please identify it here.

SECTION 3 – Regional Architecture Assessment and Concept Exploration

3.1 STAKEHOLDERS IN VDOT REGIONAL ARCHITECTURE INCLUDED BY PROJECT

Turbo Architecture© – "Stakeholder Report" ☐ Attached ☐ Unavailable

3.2 INVENTORY ELEMENTS IN VDOT REGIONAL ARCHITECTURE INCLUDED BY PROJECT

Turbo Architecture© – "Inventory Report" ☐ Attached ☐ Unavailable

3.2 INVENTORY ELEMENTS IN VDOT REGIONAL ARCHITECTURE INCLUDED BY PROJECT

Turbo Architecture© – "Inventory Report" ☐ Attached ☐ Unavailable

3.3 INTERFACE IMPACTS (I.E DATA EXCHANGES) DUE TO PROJECT. PORTIONS OF ARCHITECTURE BEING IMPLEMENTED

Turbo Architecture© – "Project Architecture Report" ☐ Attached ☐ Unavailable
Turbo Architecture© – "Interconnect and Flow Diagrams" ☐ Attached ☐ Unavailable

3.4 OTHER REGIONAL ARCHITECTURES IMPACTED BY PROJECT
☐ DC Region (MWCOG) ☐ Maryland ☐ Other VDOT Districts ☐ VDOT Statewide ☐ None

Changes communicated to appropriate architecture maintenance agencies ☐ No ☐ Yes

3.5 CHANGES RECOMMENDED TO VDOT-NoVA and/or REGIONAL ARCHITECTURES
☐ No ☐ Yes

If "Yes", Please Specify and provide detail

Turbo Architecture© – "Region to Project Comparison Report" ☐ Attached ☐ Unavailable

SECTION 4 – Alternative Analysis

4.1 WERE ANY ALTERNATE CONCEPTS/IDEAS CONSIDERED? ANY OTHER SOLUTIONS TO THE PROBLEM?
☐ **No** ☐ **Yes**

Please Specify how the best concept was selected

4.2 REFERENCE DOCUMENTS (IF ANY)

SECTION 5 – Concept of Operations

5.1 IS THERE A CONCEPT OF OPERATIONS (COO) FOR THIS PROJECT?
☐ **No** ☐ **Yes** ☐ **To Be Developed**

If "No" was selected, please specify reason

5.2 IF "Yes" WAS SELECTED, PLEASE FILL OUT THE FOLLOWING
COO Contains:

- Scope (Geographic, Timeframe, Region etc)	☐ Yes	☐ No
- Description of what the project/system is expected to do	☐ Yes	☐ No
- Roles and Responsibilities for all stakeholders	☐ Yes	☐ No
- Operational Scenarios	☐ Yes	☐ No
- Project/System Impacts	☐ Yes	☐ No

If "No" was checked in any of the boxes, please specify reason

5.3 PLEASE PROVIDE COO DOCUMENT REFERENCE IF AVAILABLE

Turbo Architecture© – "Roles and Responsibilities Report" ☐ Attached ☐ Unavailable

SECTION 6 – Requirement Definitions (High-Level and Detailed)

6.1 ARE HIGH-LEVEL FUNCTIONAL REQUIREMENTS WRITTEN AND DOCUMENTED

☐ No ☐ Yes ☐ To Be Developed

6.2 IF "Yes" WAS SELECTED, PROVIDE REQUIREMENTS DOCUMENT REFERENCE IF AVAILABLE

Turbo Architecture ©– "Functional Requirements Report" ☐ Attached ☐ Unavailable

SECTION 7 – Detailed Design

7.1 IS THERE A DESIGN DOCUMENT AVAILABLE

☐ No ☐ Yes ☐ To Be Developed

Please provide reference to design document

7.2 IF "YES" WAS SELECTED, PLEASE FILL OUT THE FOLLOWING

Are the design details well documented	☐ Yes	☐ No
Do the details of the design trace to requirements definitions	☐ Yes	☐ No
Are boundaries and interfaces of the system clearly identified	☐ Yes	☐ No
Is there a process for Configuration Control	☐ Yes	☐ No

If No was checked in above boxes , please provide an explanation

7.3 DOES THE DESIGN INCORPORTATE NATIONAL ITS STANDARDS

☐ No ☐ Yes

IF YES, Please mention what ITS Standards are being used

Turbo Architecture© – "Standards Report" ☐ Attached ☐ Unavailable

7.4 DOES THE DESIGN INCORPORTATE ANY VDOT ENTERPRISE STANDARDS

☐ No ☐ Yes,

IF Yes, Please mention what VDOT Enterprise Standards are being used

SECTION 8 – Implementation

8.1 PROCURMENT DETAILS

8.2 REFERENCE DOCUMENTS (IF ANY)

SECTION 9 – Integration and Test

9.1 IS THERE AN INTEGRATION PLAN

☐ No ☐ Yes ☐ To Be Developed

If "Yes" Please provide reference

9.2 IS THERE A TEST PLAN

☐ No ☐ Yes ☐ To Be Developed

If "Yes" Please provide reference

SECTION 10 – System Verification and Acceptance

10.1 IS THERE A SYSTEM VERIFICATION AND ACCEPTANCE PLAN (verification of the entire system and acceptance criteria)

☐ No ☐ Yes ☐ To Be Developed

If "Yes" Please provide reference

10.2 IF YES, PLEASE FILL OUT THE FOLLOWING

- Is there a clear criteria for completion ☐ Yes ☐ No
- Are there clear performance metrics for system acceptance ☐ Yes ☐ No
- Will there be adequate system documentation for all users and maintainers ☐ Yes ☐ No

If No was checked in above boxes , please provide an explanation

SECTION 11 – Operations and Maintenance

11.1 WHO WILL MAINTAIN THE SYSTEM

11.2 IS THERE A SCHEDULE FOR UPGRADES/ENHANCEMENTS TO THE SYSTEM

11.3 WILL THERE BE AN EVALUATION OF THE SYSTEM

For questions or comments about this guide, please vist the Architecture website at www.vdot-itsarch.com

FHWA's support in the development of this User's Guide is recognized and appreciated.

This document's technical specifications have been provided by Battelle, under contract with Wilbur Smith Associates.