



## Approaches for Integrating Systems Engineering into Your Agency's Business Practices

Presented by: Amy Tang McElwain

August 2, 2007

Talking Technology and Transportation (T3) Webinar

# System Operations in VDOT

Program established in 2004

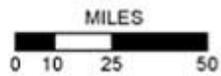
Mission ...

***“Actively manage the transportation system to maximize safety, security, mobility ...”***

# VDOT Operations Regions

Northern Region Operations (NRO)

5 Regional Operations Centers



# VDOT NRO Org Chart

**Northern Region  
Operations Director**

**ATMS Replacement  
Project Manager**

**Executive Assistant**

Ops Administration

Ops Planning &  
Programming

System Engr.

Traffic Engr.

Traffic Ops –  
Smart Traffic Center  
& ITS – Info. Tech.

Maintenance

Ops Inspection &  
Construction

**Admin.**

- Business Plan
- Performance Mgmt
- Contract Admin.
- 604 Budgeting
- Back Office Oversight

**OPP**

- Strategic Planning
- Architecture/Rule 940
- Ops Project Planning
- Regional Coord
- Annual Invest. Plan Dev, Initiation, and Management
- Project programming
- Earmark Project Coord
- Year-End Report
- Outreach

**SE**

- Ops Engineering Analysis
- Ops Project Development
- Review all Roadway Project ITS and Telecomm Design

**TE**

- Project Programming
- Customer Service
- Study Assessment
- Safety/Operational Review & Proj Support
- Plan Dev, Coord, Review
- Signal Engr Coord
- Constructability Review
- Data Collection
- Strategic Improvement / Corridor Study
- Operations Enhancement

**TO – STC & ITS-IT**

- Emergency Coord
- Incident Mgmt
- Traffic Mgmt
- Traveler Info
- Work Zone Mgmt
- Freeway & Arterial Operations
- Signal Operations
- Roadway Flow Assessment
- IT / Network Support to Operations System

**Maintenance**

- Sign Maintenance
- Pavement Marking Maintenance
- Lighting Maintenance
- Signal Maintenance
- ITS Asset Maintenance
- Telecomm Maintenance

**OIC**

- Install and Construct ITS Devices, Signals, Telecomm, and Highway Lighting
- Constructability & Maintainability Review

## ***VDOT NRO: Strategically Driven, Operationally Led***

### **VDOT NRO has become a “strategic” organization through:**

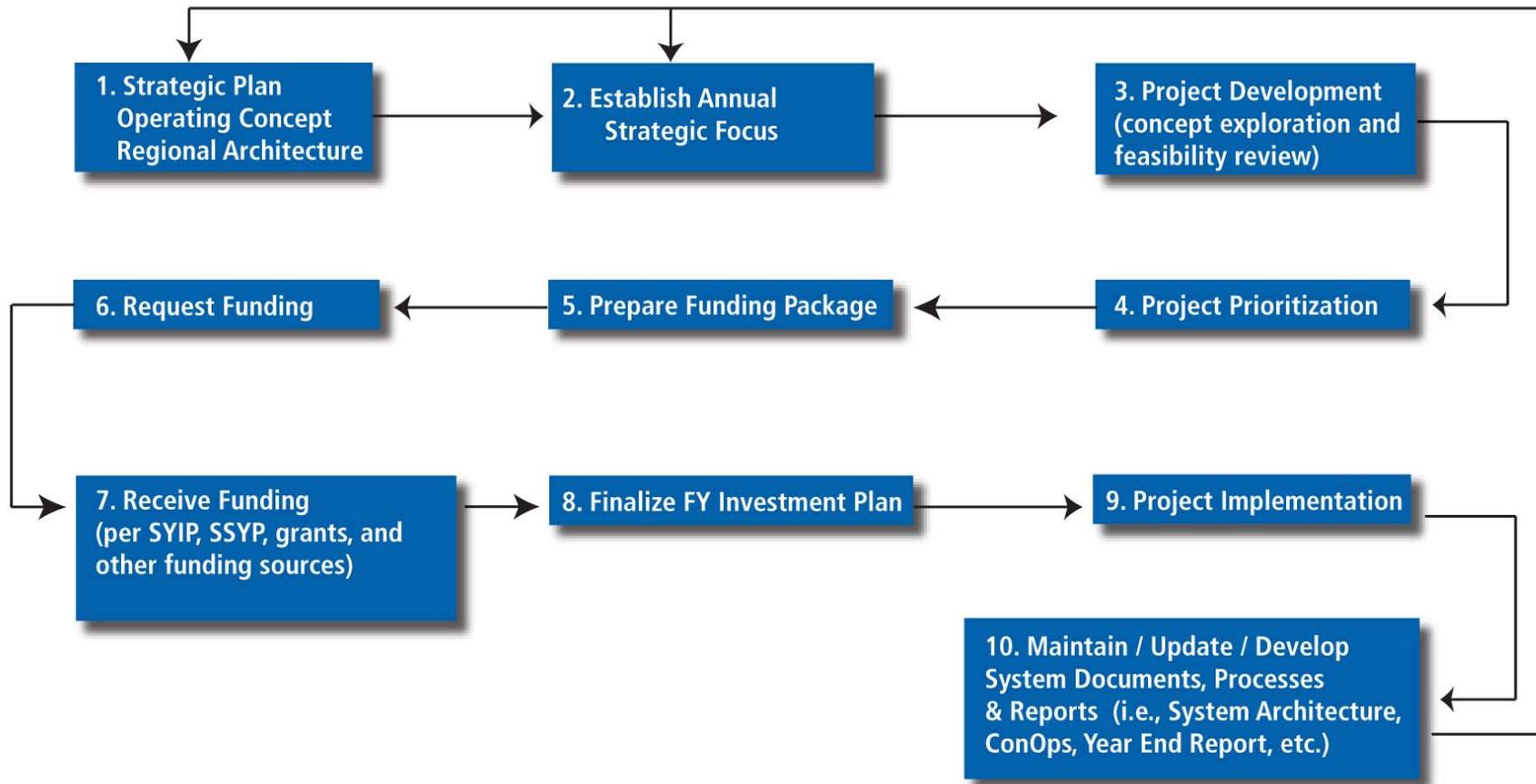
- Integrating the Planning and Programming processes.
- Mapping organizational structure to the Systems Engineering Process.
- Providing tools for Project Managers to navigate the integrated process.
- Incorporating Operations Planning into traditional roadway project development from the outset.

**This approach can work for your organization, too!**

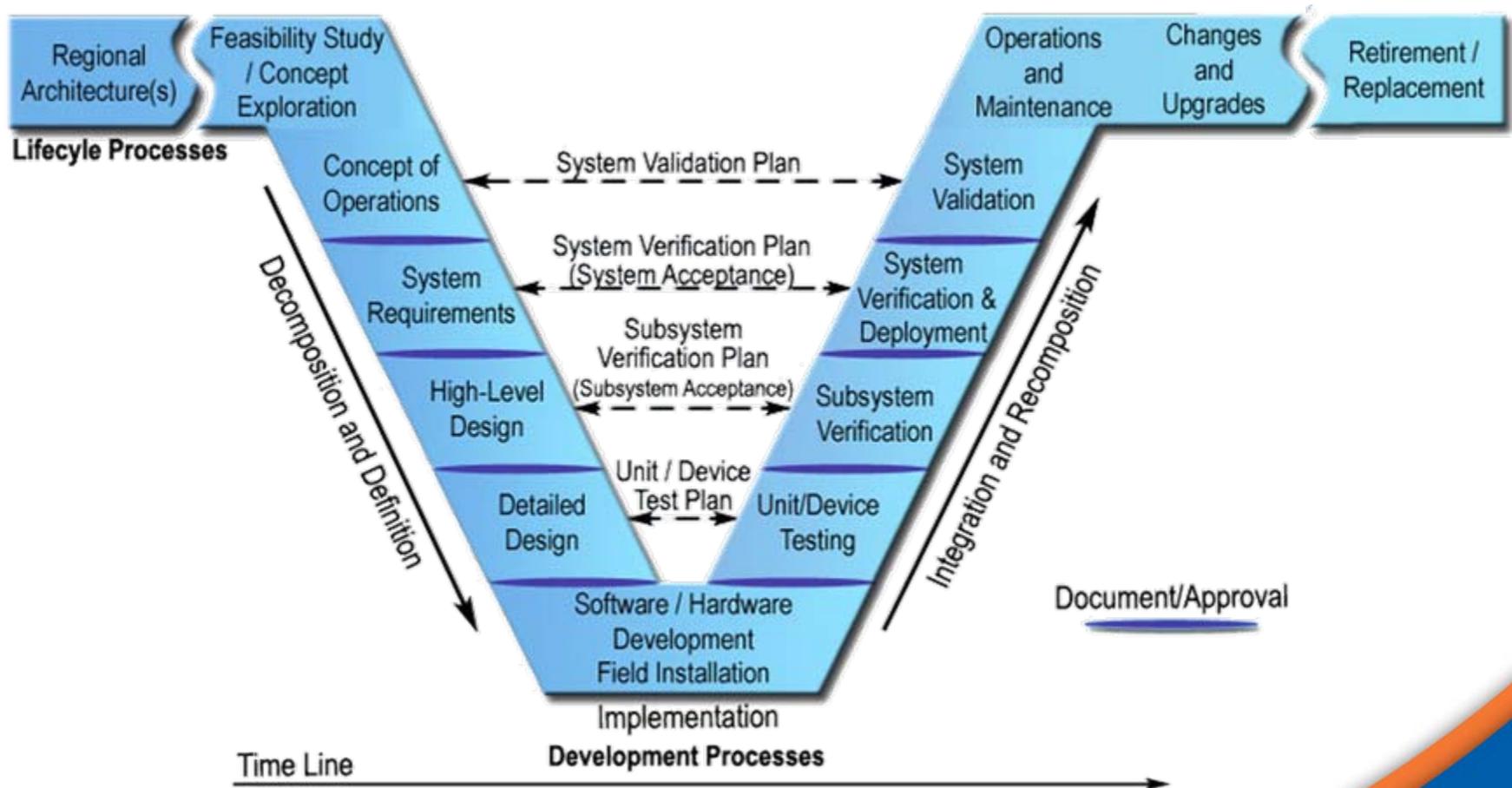
## *Origin of VDOT NRO ITS Projects*

- 1. Developed by VDOT NRO**
2. Roadway Construction Projects
3. Local ITS Projects
4. Partnership Projects
5. Metropolitan Washington D.C. Regional Projects
6. Statewide Projects
7. CMP-Induced Projects
8. NVTAGenerated Projects

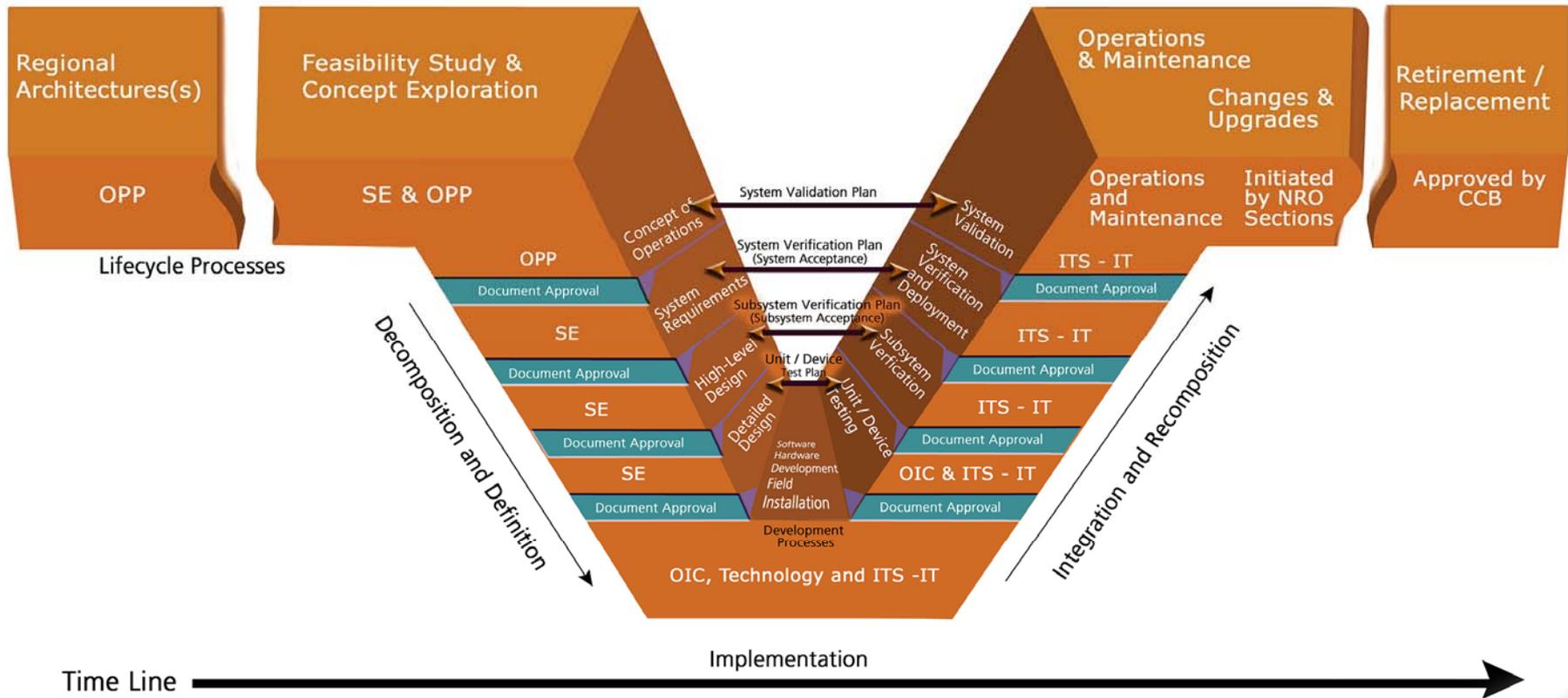
# NRO's Planning/Programming Process Ensures Consistency and Traceability



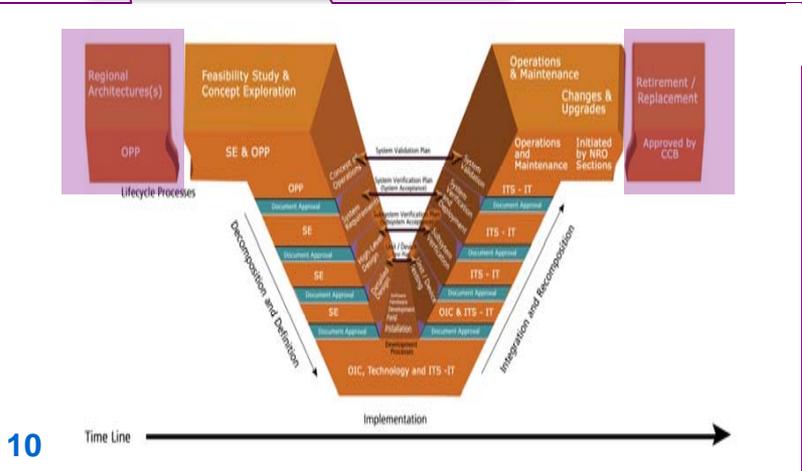
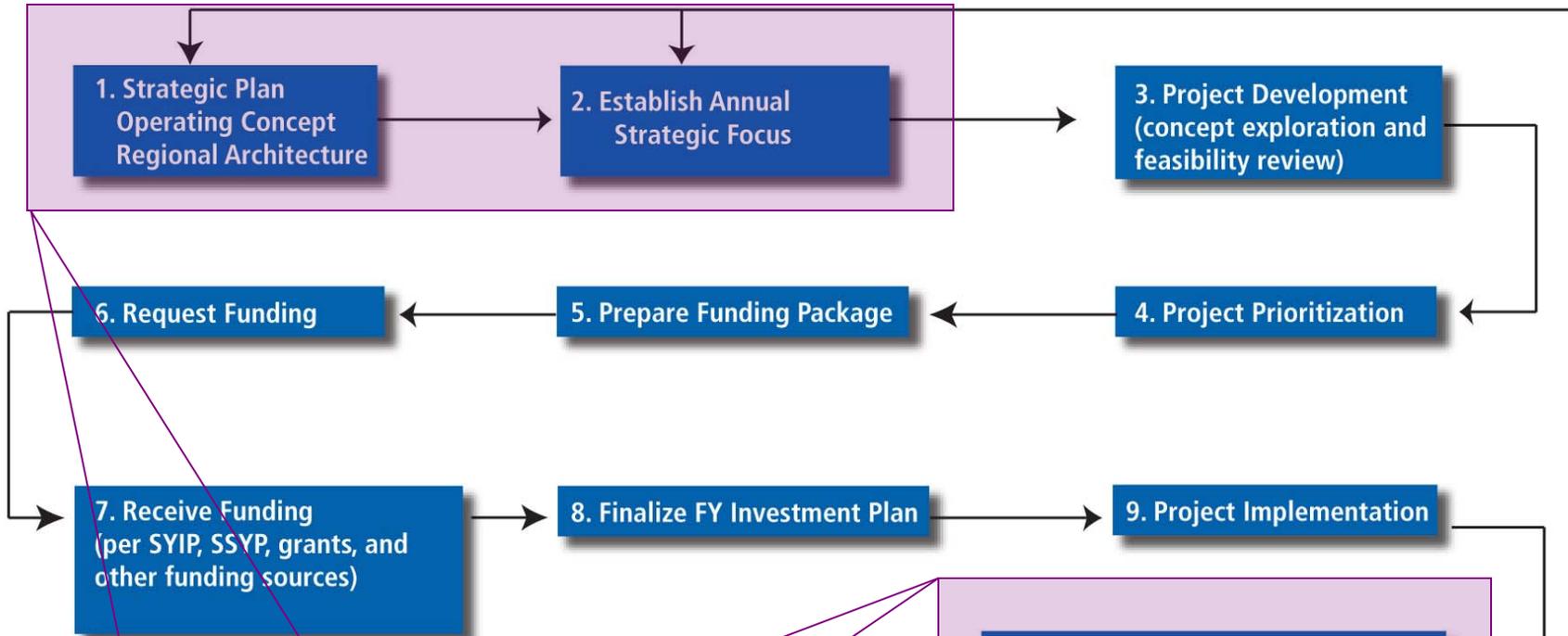
# Systems Engineering V Diagram as Applied to Operations Projects



# VDOT NRO Organization is Mapped to V Diagram



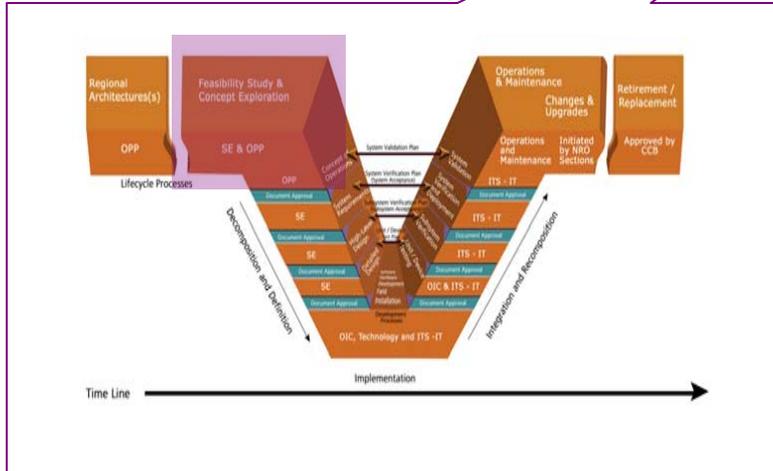
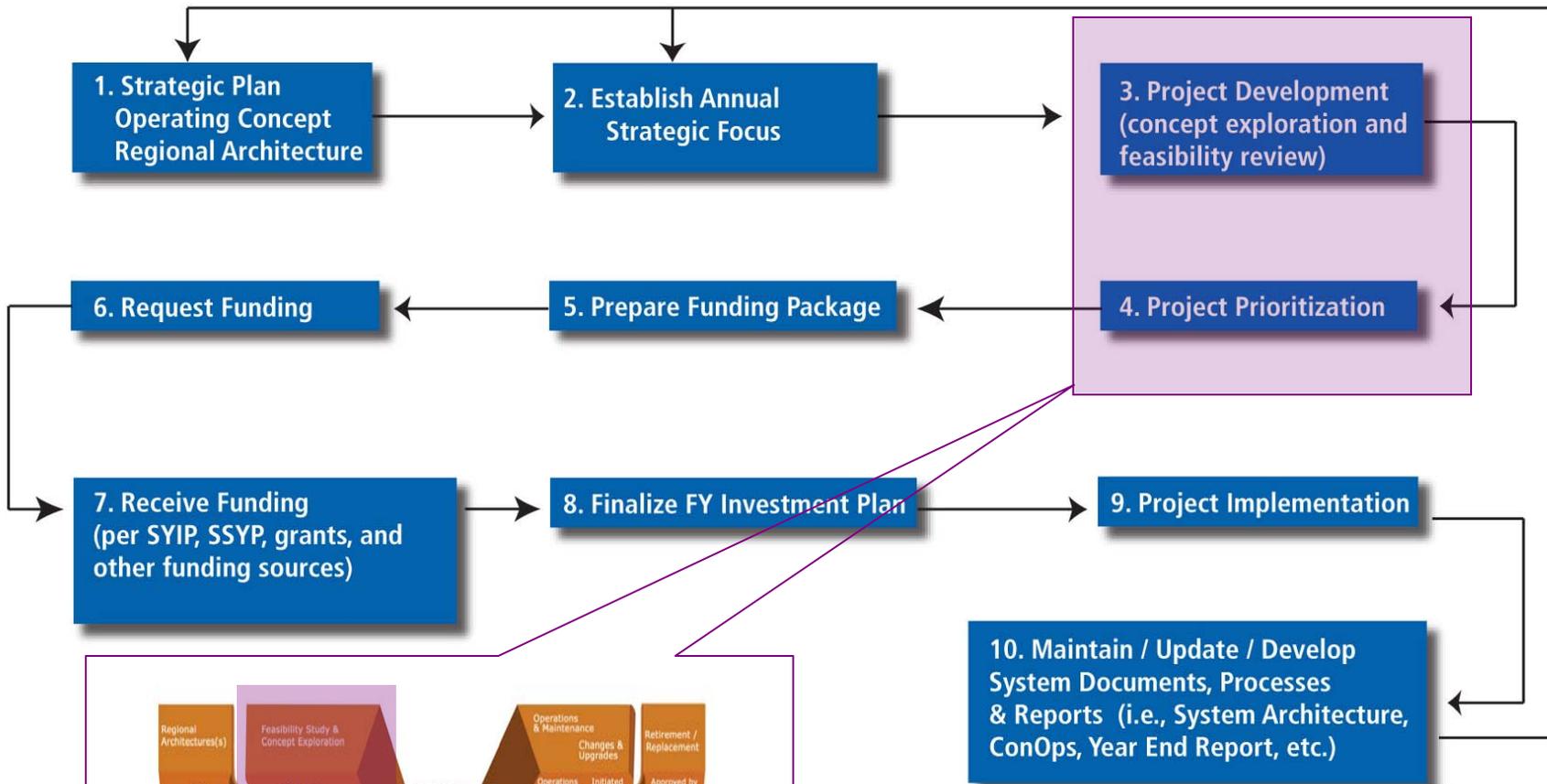
# VDOT NRO Business Process is Mapped to V Diagram



10. Maintain / Update / Develop System Documents, Processes & Reports (i.e., System Architecture, ConOps, Year End Report, etc.)



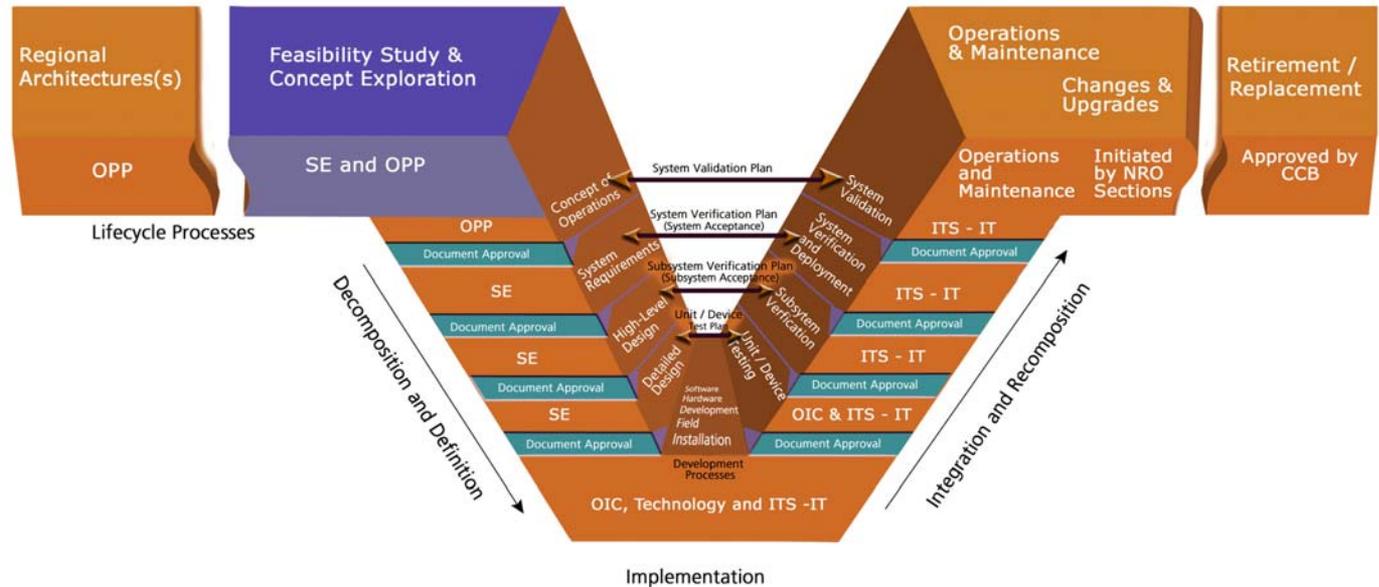
# VDOT NRO Business Process is Mapped to V Diagram



# Consistent Document and Tools Facilitate the Process for NRO Section Managers

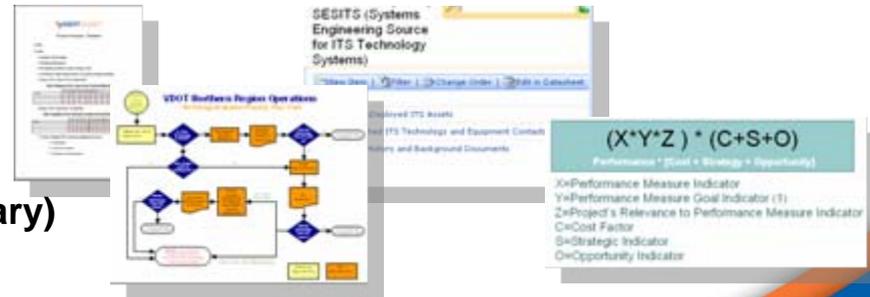
## Relationship to the Business Process:

- 3. Project Development (concept exploration and Feasibility review)
- 4. Project Prioritization

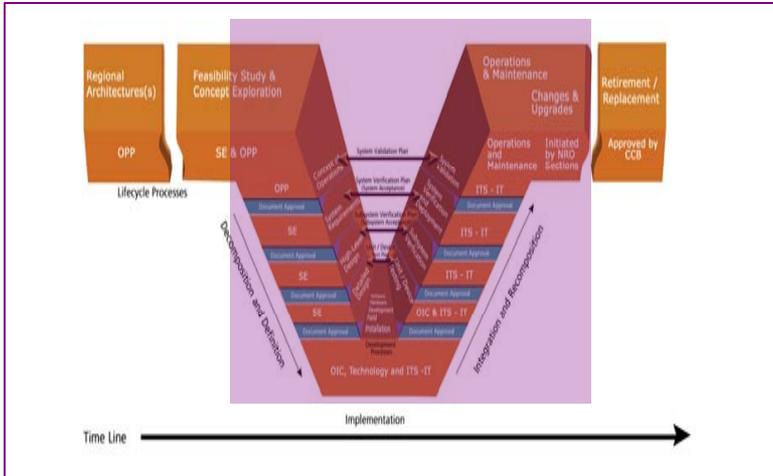
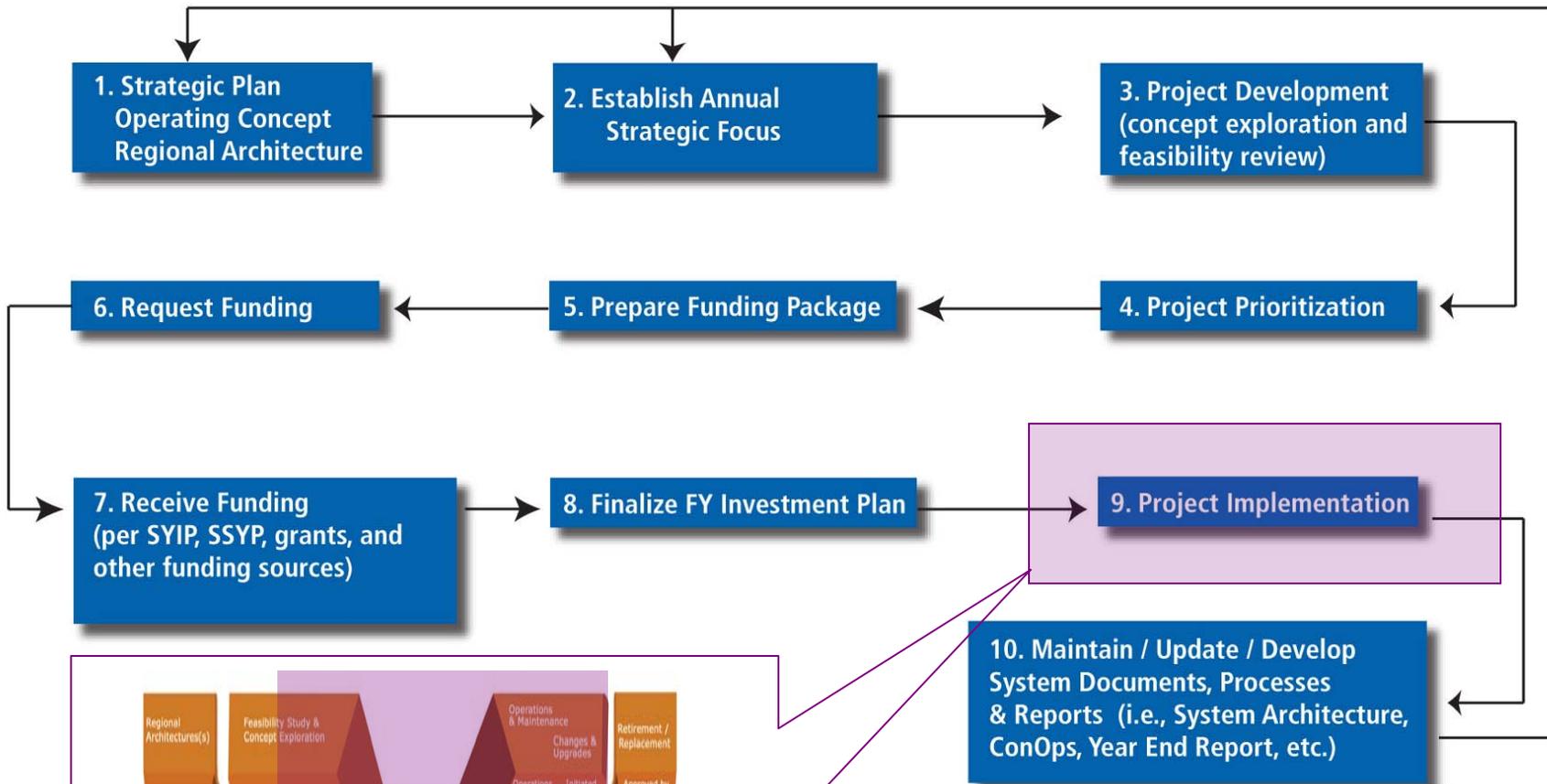


## Tools Available:

- Project Proposal Template
- Technology Evaluation Process
- SE Source for ITS Tech. System (SESITS library)
- Prioritization Model



# VDOT NRO Business Process is Mapped to V Diagram

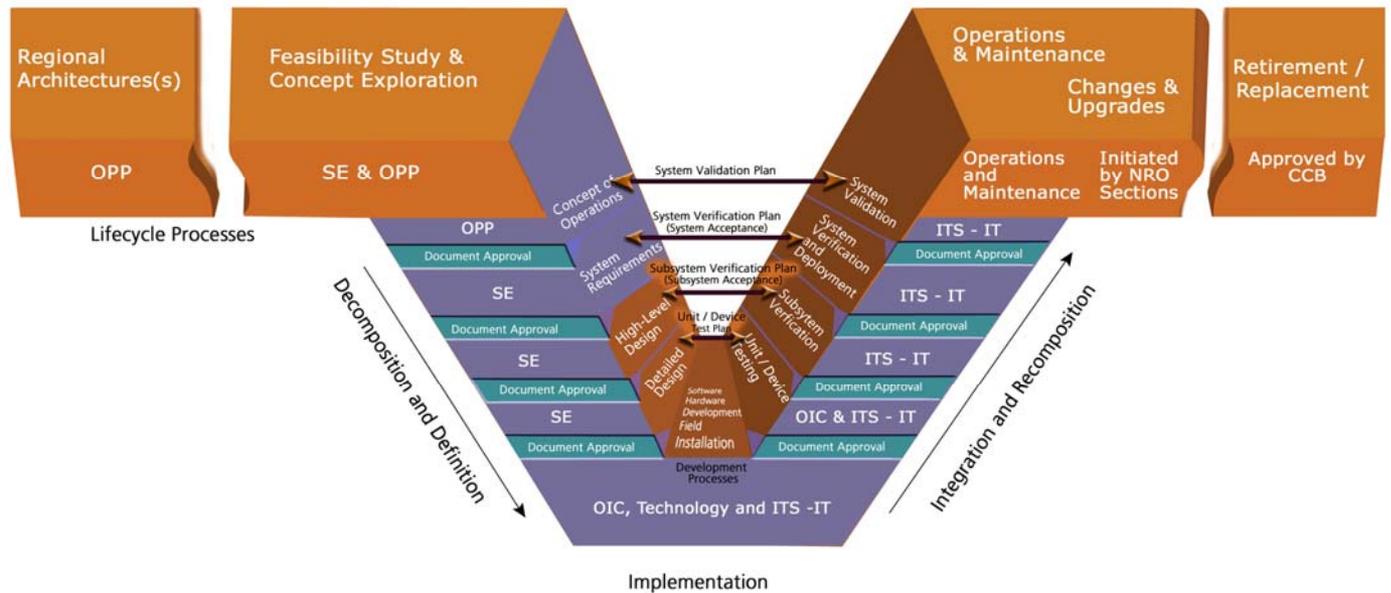


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# Consistent Document and Tools Facilitate the Process for NRO Section Managers

Relationship to the P&P Process:

9. Project Implementation



## Tools Available:

- Project & Rule 940 User Guide
- Rule 940 Checklist
- Concept of Operations Outline
- Standard Operating Procedure
- Project Mgmt Forum & Planning Advancement Board



# Other Tools for Managing NRO Budget and Projects

## Current practice: Spreadsheets

- **Funding Plan** – NRO activities and their funding & source
- **Work Plan** – NRO activities with basic project info, funding and spending, agency approval requirement status, etc.
- **Unfunded List** – Partially and unfunded NRO activities as candidate for receiving funds during fiscal year or being considered at the next fiscal year investment dev. process
- **Funding Reallocation** – proposed and approved funding re-allocation during fiscal year
- **And many other agency process tracking spreadsheets**



## Upcoming New Practice: Database and web tool

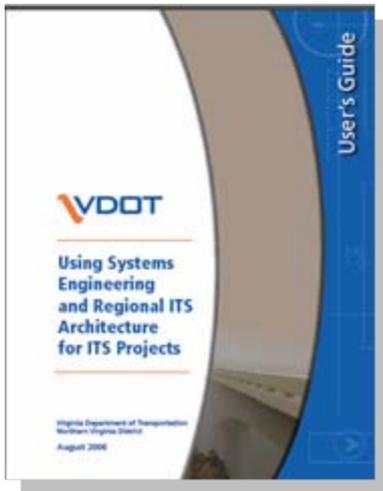
- Project database and intranet web-based interface
- No more separate spreadsheets



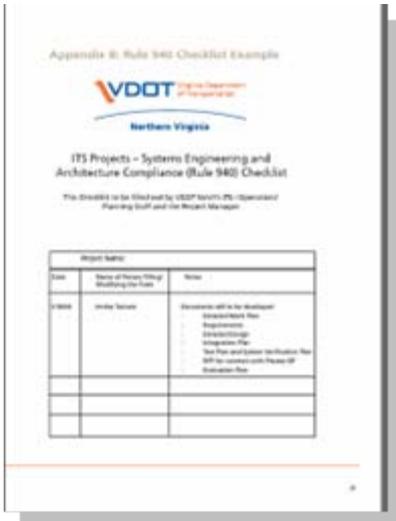
## VDOT official construction project management web-based tool

- NRO projects funded by the construction fund can benefit from using VDOT's enterprise tool

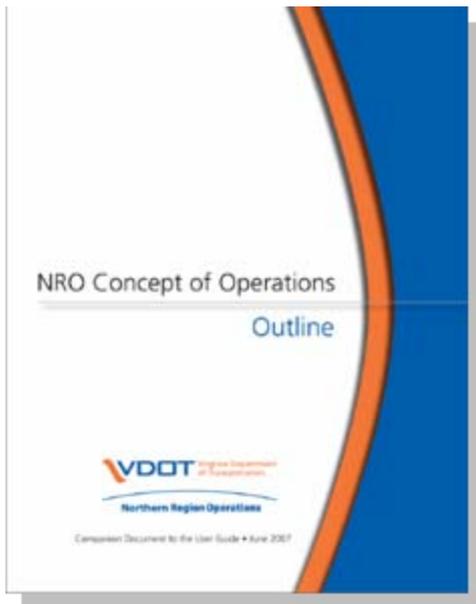
# VDOT Rule 940 Checklist Ensures and Documents That the Process Has Been Followed



- **Section 1:** Project Introduction
- **Section 2:** Needs Assessment
- **Section 3:** Regional Architecture Assessment and Concept Exploration
- **Section 4:** Alternative Analysis
- **Section 5:** Concept of Operations
- **Section 6:** Requirements Definition
- **Section 7:** Detailed Design
- **Section 8:** Implementation
- **Section 9:** Integration and Test
- **Section 10:** System Verification and Acceptance
- **Section 11:** Operations and Maintenance



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# VDOT Rule 940 Checklist Ensures and Documents That the Process Has Been Followed



VDOT Northern Region Operations (NRO)  
Concept of Operations

## VDOT NRO Concept of Operations Outline

### EXECUTIVE SUMMARY (Optional)

1. **SCOPE.** This section provides an overview of the entire Concept of Operations. *(Rule 940 VDOT NRO Checklist: Section 5 – Concept of Operations)*
2. **REFERENCED DOCUMENTS.** This section identifies resources used when developing the Concept of Operations. Types of references typically include:
3. **USER-ORIENTED OPERATIONAL DESCRIPTION.** This section focuses on how the goals and objectives are accomplished currently. Specifically, it describes strategies, tactics, policies, and constraints. This is where the stakeholders are described. It includes who users are and what the users do. Specifically, it covers when, and in what order, operations take place, personnel capabilities, organizational structures, personnel & inter-agency interactions, and types of activities. This may also include operational process models in terms of sequence and interrelationships. *(Rule 940 VDOT NRO Checklist: Section 5 – Concept of Operations)*
4. **OPERATIONAL NEEDS.** This section details agency- and region- specific needs that will drive the requirements for the system. This section is attempting to answer the question of what is necessary for the agency or region that would complement and improve the existing system. Operational Needs are developed independent of technologies / systems. For major construction projects, operational needs should be considered during and after construction. *(Rule 940 VDOT NRO Checklist: Section 2 – Needs Assessment)*
5. **SYSTEM OVERVIEW.** This section provides a high-level description of the interrelationships of key subsystems, focusing on their interrelationships. *(Rule 940 VDOT NOR Checklist: Section 4 – Alternate Analysis and Rule 940 VDOT NOR Checklist: Section 6 – Requirement Definitions)*
6. **OPERATIONAL AND SUPPORT ENVIRONMENT.** This section describes the environment or "world" in which the system will operate including information about the system's environment. This section will answer the questions on personnel, facilities, hardware and software, operating procedures, and maintenance.
7. **OPERATIONAL SCENARIOS.** In this section, the authors place themselves in the users' position and detail how the new system would impact their activities under differing conditions. *(Rule 940 VDOT NRO Checklist: Section 5 – Concept of Operations)*
8. **NEXT STEPS.** This section identifies the next steps in the System Engineering Process and assigns VDOT NRO Section responsibility for each step.
  - 8.1. Detailed Requirements. *(Rule 940 VDOT NRO Checklist: Section 6 – Requirements Definition)*
  - 8.2. System Design. *(Rule 940 VDOT NRO Checklist: Section 7 – Detailed Design)*
  - 8.3. Software / Hardware Development Field Installation. *(Rule 940 VDOT NRO Checklist: Section 8 – Implementation)*
  - 8.4. Unit / Device Testing. *(Rule 940 VDOT NRO Checklist: Section 9 – Integration and Test)*
  - 8.5. Subsystem & System Verification and Acceptance. *(Rule 940 VDOT NRO Checklist: Section 10 – System Verification and Acceptance)*
  - 8.6. System Validation.
  - 8.7. Operations & Maintenance. *(Rule 940 VDOT NRO Checklist: Section 11 – Operations and Maintenance)*

NRO Concept of Operations

Outline



Companion Document to the User Guide • June 2007

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# Operations SE Process “Shoehorned” into Traditional Roadway Project Development

- Assess need for and feasibility of Operations elements (ITS Market Packages) in initial project planning (PE Phase).
- Assess funding need based upon Step 1 and include Statewide Transportation Plan (SYIP in Virginia).
- For projects included in Statewide Plan, conduct more detailed analysis and feasibility study to determine specific Operations applications. (In Virginia, pre-Scoping with Location & Design during PE Phase.)
- For projects in Scoping phase, include requirement for consultant to develop Concept of Operations based upon Steps 1-3 as part of bid package.
- Upon project design award, design of Operations elements enters V Diagram process described previously.

***It is important to consider both temporary Operations elements during construction phase and permanent elements for Management & Operations phase.***



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***NRO starts participating from the concept exploration and/or Concept of Operation development phases.***

## ***IN CONCLUSION***

- **Integrated strategic planning, budgeting, progressing, and tracking of Operations projects adds efficiency and effectiveness to an agency's Operations practice.**
- **Integrating the Planning and Programming processes, and mapping organizational structure to the Systems Engineering process, have been keys for VDOT NRO in becoming a "strategic" organization.**
- **Clear, simple tools can help Project Managers to navigate the integrated process.**
- **Planning for Operations needs to extend beyond the Operations business units and be incorporated into traditional roadway project development from the outset.**

## **Contact Information**

**Amy Tang McElwain**

**VDOT Northern Region Operations  
Planning and Programming Manager**

**[amytang.mcelwain@vdot.virginia.gov](mailto:amytang.mcelwain@vdot.virginia.gov)**

**<http://www.vdot-itsarch.com/Default.htm>**