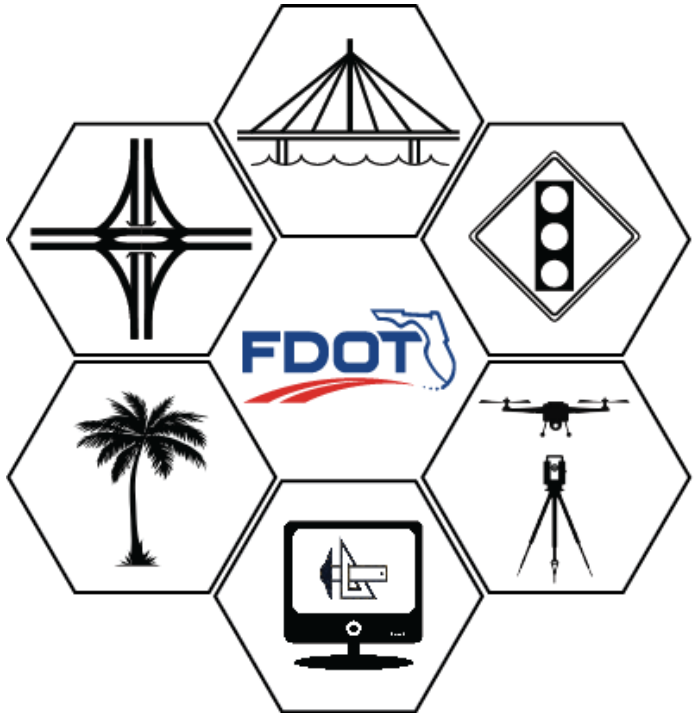


FDOT TRANSPORTATION SYMPOSIUM 2019

Transportation Systems Management and Operations (TSM&O)

Clinton Smith, PE

Agenda

- What is TSM&O?
- TSM&O Focus Areas
- FDOT's Systems Engineering Procedure
- How FDOT is integrating TSM&O into traditional project development processes, such as planning and project development and environmental (PD&E) studies
- The difference between developing TSM&O strategies and ITS projects
- The tools FDOT is developing to support Systems Engineering and Design of TSM&O projects

What is TSM&O?

- **Transportation Systems**
  - Interstates and other Strategic Intermodal System (SIS)
  - Priority corridors and other non-limited access routes
  - Transit
  - Freight
  - Rail
  - Airport, seaports, spaceports
  - Intermodal facilities

- **Management and Operations**
  - Techniques and strategies to optimize safety and efficiency of transportation systems
  - FDOT M&O safety and mobility performance measures
    - Travel reliability increase
    - Throughput increase
    - Delay reduction
    - Crash reduction
    - Incident clearance time reduction

Where are priority TSM&O techniques and strategies identified?

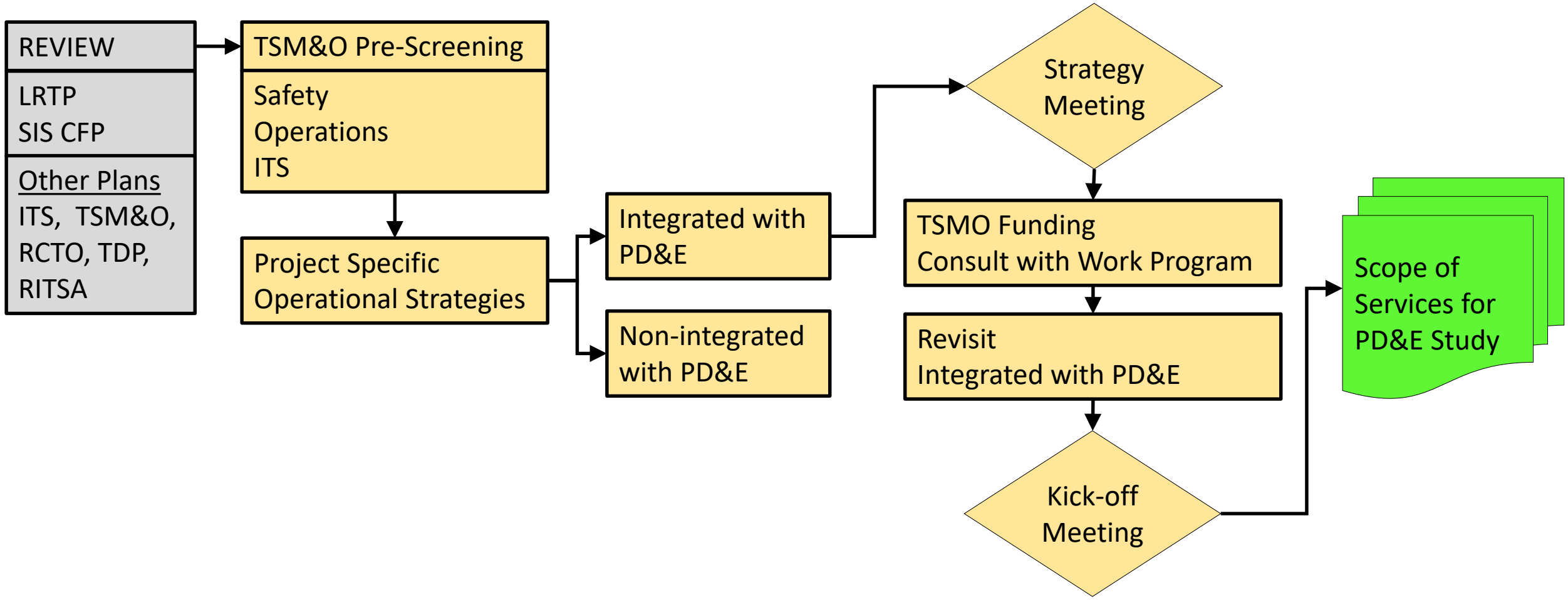
- Florida Transportation Plan (FTP)
- FDOT 2017 TSM&O Strategic Plan
- FDOT 2019 Freight Mobility and Trade Plan (FMTP)
- Transit Development Plans (TDP)
- District TSM&O Implementation Plans
- Long Range Transportation Plans (LRTP)
- Transportation Improvement Plans (TIP)
- Regional Concepts for Transportation Operations (RCTO)

What are TSM&O Priorities for the Office of Traffic Engineering and Operations?

Focus Area #1: TSM&O Mainstreaming?

- TEO is working with the Office of Environmental Management to update the Project Development and Environment (PD&E) Manual to promote TSM&O:
  - No longer will TSM&O or ITS only be considered as an alternative to capacity improvement; TSM&O will be an integral part of all capacity improvements.
  - TSM&O strategies will be introduced during planning and continue into PD&E, design, and implementation.
  - The flow charts on the next two slides begin with planning and depict TSM&O strategies being incorporated into PD&E and Design.

Mainstreaming TSM&O into Planning and PD&E Scoping



Planning Process | **District Project Scoping Process**

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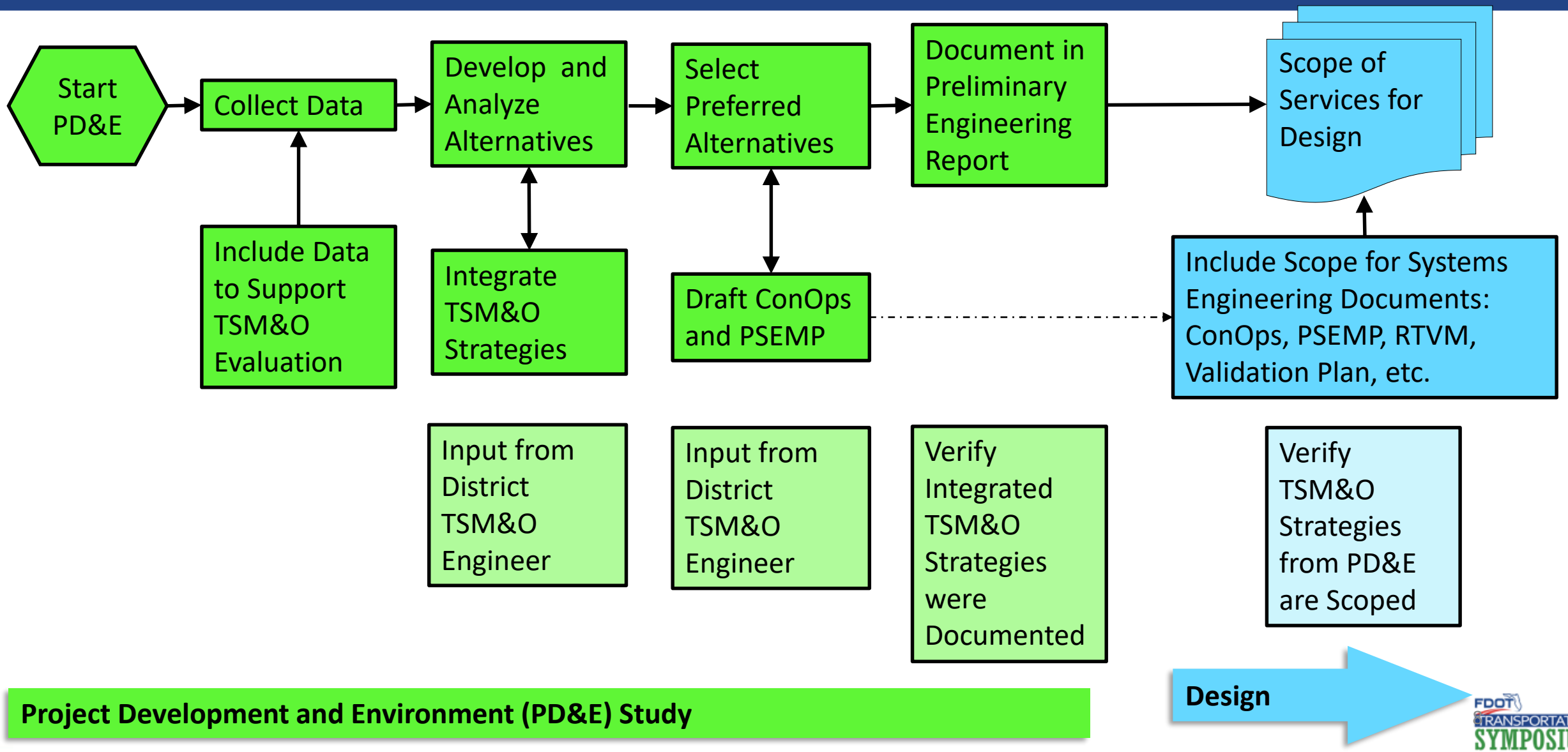
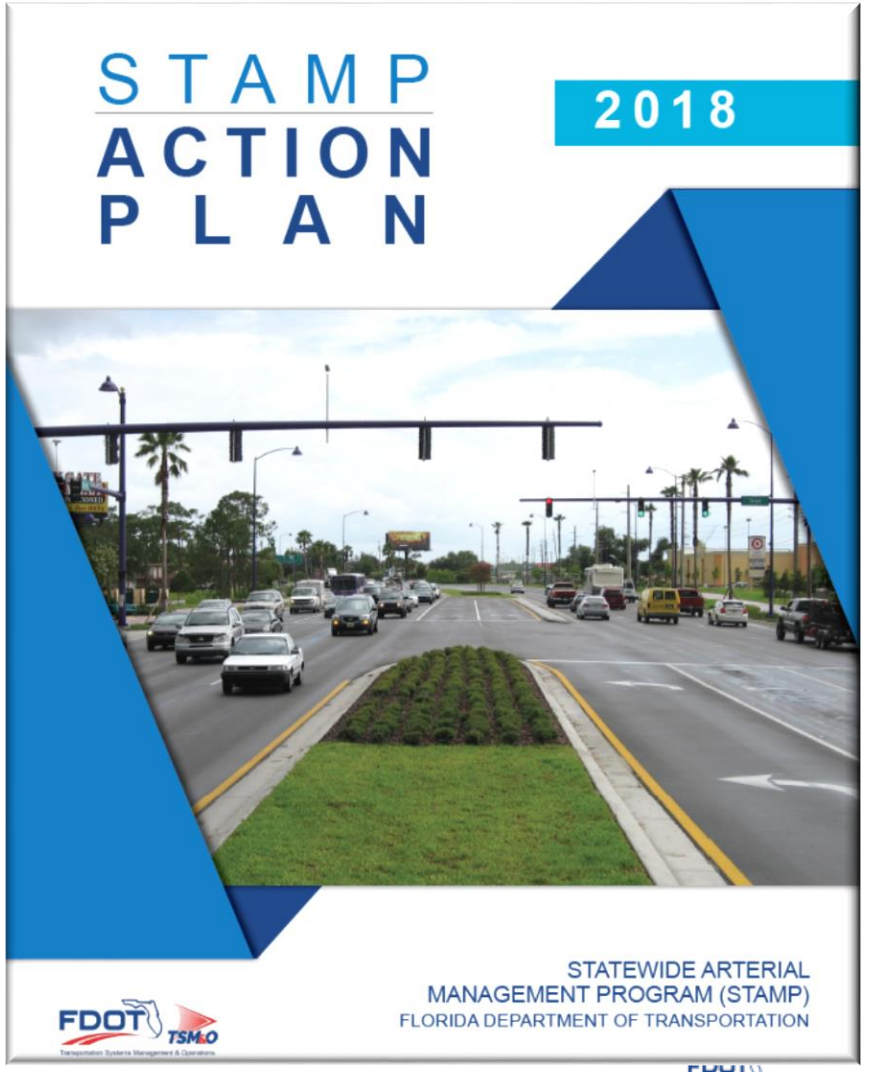
Mainstreaming TSM&O Into PD&E Study and Design



Focus Area #2: Arterial Management:

- Regular retiming and coordination
- Automated traffic signal performance measures (ATSPM)
- Adaptive signal control technologies (ASCT)
- Active arterial management (AAM)
- Integrated corridor management (ICM)

For more information, contact Raj Ponnaluri

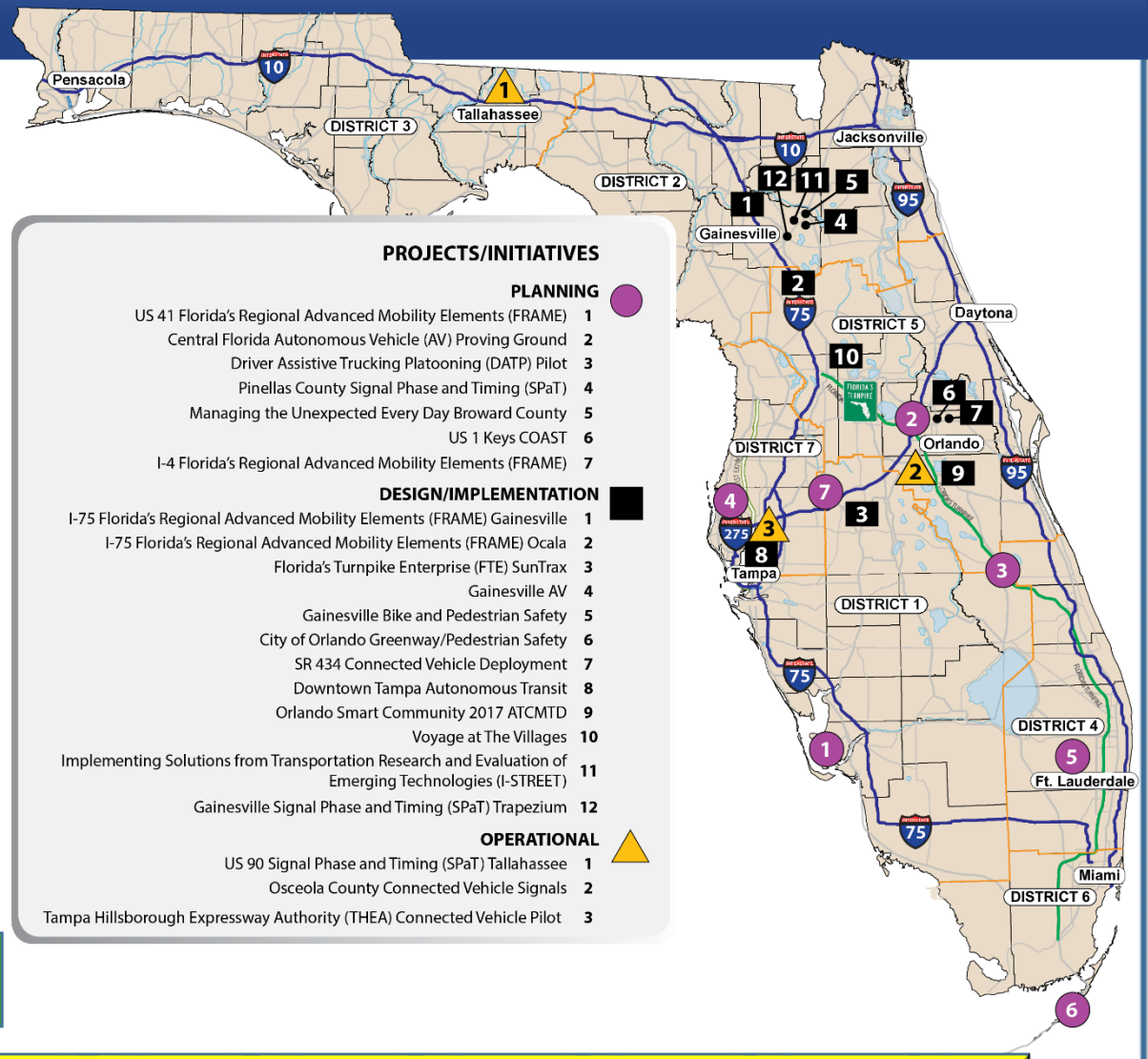


Focus Area #3: Connected Vehicles

- FDOT 2019 Connected and Automated Vehicle (CAV) Business Plan
- Updating Standard Specifications
  - Section 671 Traffic Signal Controllers
  - Roadside Unit Developmental Specification
- Updating FDOT Design Manual
- Check out Raj Ponnaluri's session on the CAV Business Plan

Connected Vehicle Initiative

- Over 22 projects in various levels of development
- CV applications include:
  - Signal phase and timing (SPaT)
  - Transit signal priority (TSP)
  - Freight signal priority (FSP)
  - Pedestrian and bicycle safety
  - Traveler information messages (TIM)
  - Basic safety messages (BSM)

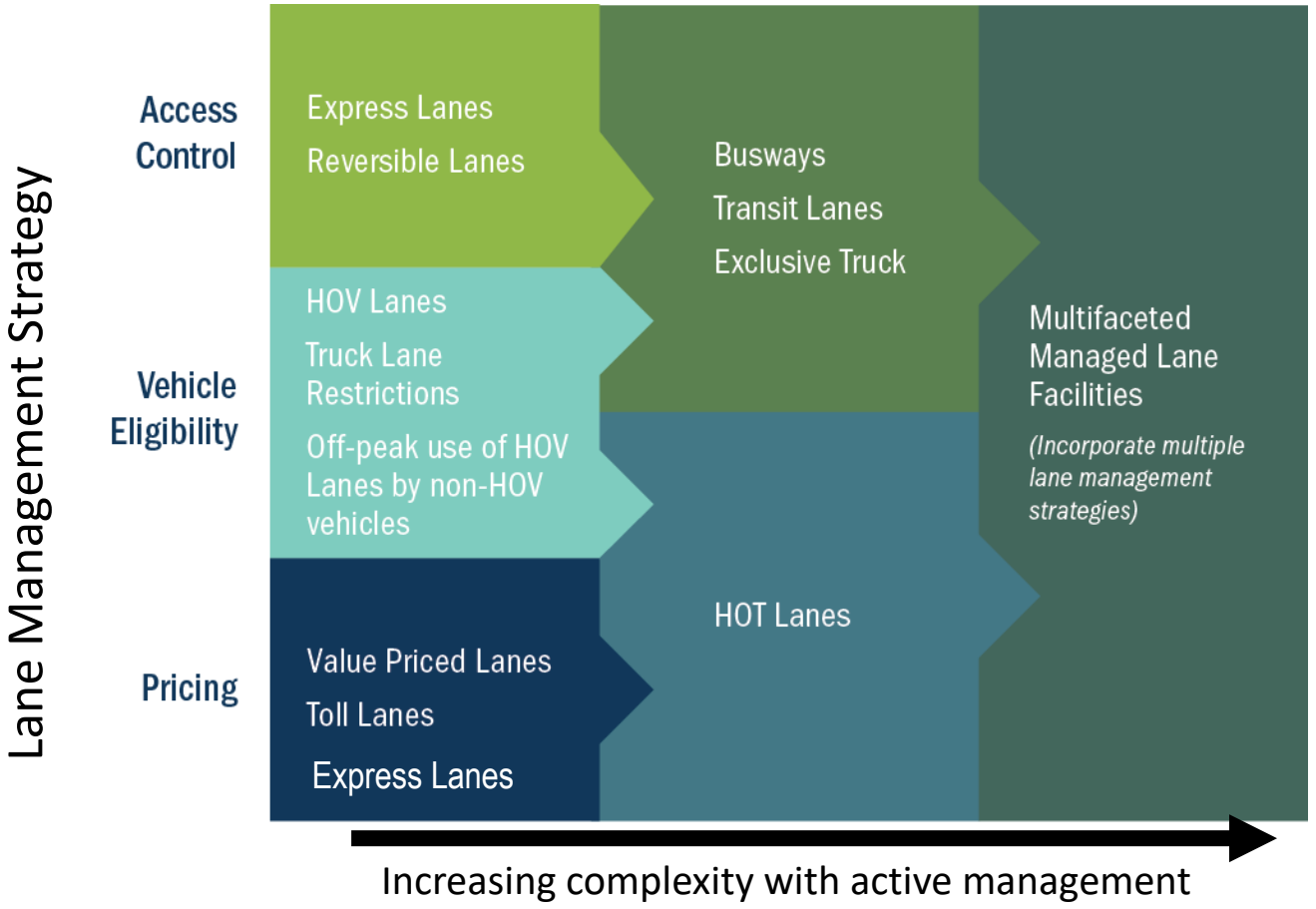


For more information, contact Raj Ponnaluri

https://www.fdot.gov/traffic/ITS/Projects-Deploy/CV/Connected-Vehicles.shtm

Focus Area #4: Managed Lanes

- When evaluating capacity projects for limited access facilities on the State Highway System (SHS), evaluate an alternative that includes **Managed Lanes strategies**.
- Managed Lanes are a TSM&O solution
  - Management Strategies
    - Vehicle Eligibility
    - Separation and Access
    - Tolling



Managed Lanes Network

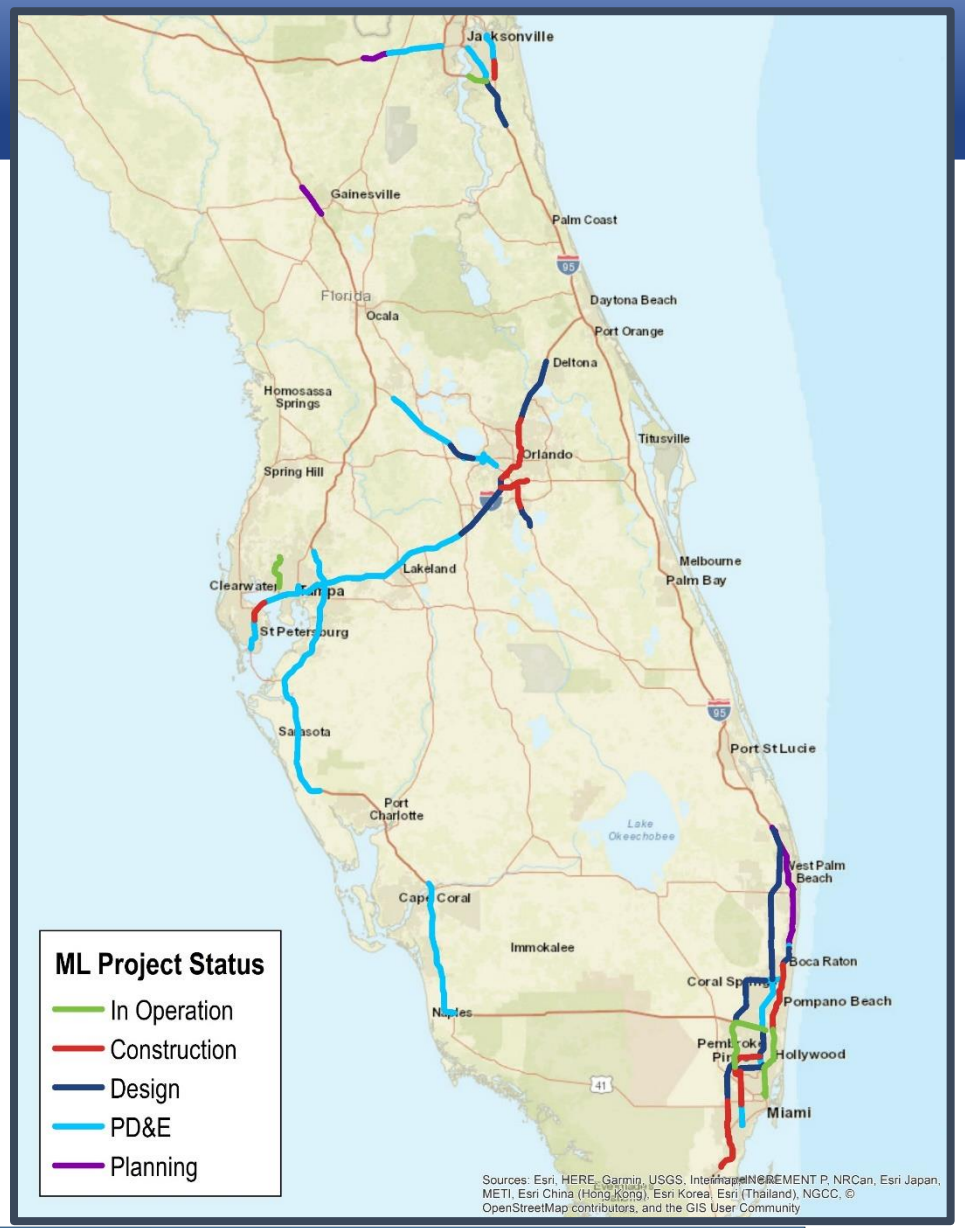
In Operation – 60 miles

Construction – 120 miles

Design – 170 miles

PD&E – 340 miles

Planning – 60 miles



For more information, contact Jennifer Fortunas

http://floridaexpresslanes.com/

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Focus Area #5: Freeway Management

- A lot has been done!
  - Full build-out of freeway management systems is expected to be complete in 2019
    - Fiber optic communication networks, cameras, detection, dynamic message signs, road ranger service patrols, rapid incident scene clearance, regional transportation management centers
- But more is underway or coming soon, for example
    - Truck parking availability system (TPAS)
    - Wrong-way vehicle detection and warning systems
    - Statewide standard operating guidelines
    - Florida regional advanced mobility elements (FRAME) projects on I-75, I-4 and other corridors

Focus Area #6: Information Systems

- Advanced transportation management system software, called SunGuide®
- Florida advanced traveler information system, called FL511
- Data integration and video aggregation system (DIVAS)
- ITS Facility Management (ITSFM)
- Regional integrated traffic information system (RITIS)

SUNGUIDE® Florida's Intelligent Transportation System

FLORIDA 511™ Connect. Know. Go.

DIVAS Data Integration and Video Aggregation System

FDOT ITSFM

RITIS

FDOT TRANSPORTATION SYMPOSIUM

SunGuide® Software

- Version 7.1.2 distributed in April, 2019
- Version 7.2 planned distribution, Fall 2019

District Four Regional Transportation Management Center
SunGuide Video Display Wall

For more information on SunGuide, contact Christine Shafik

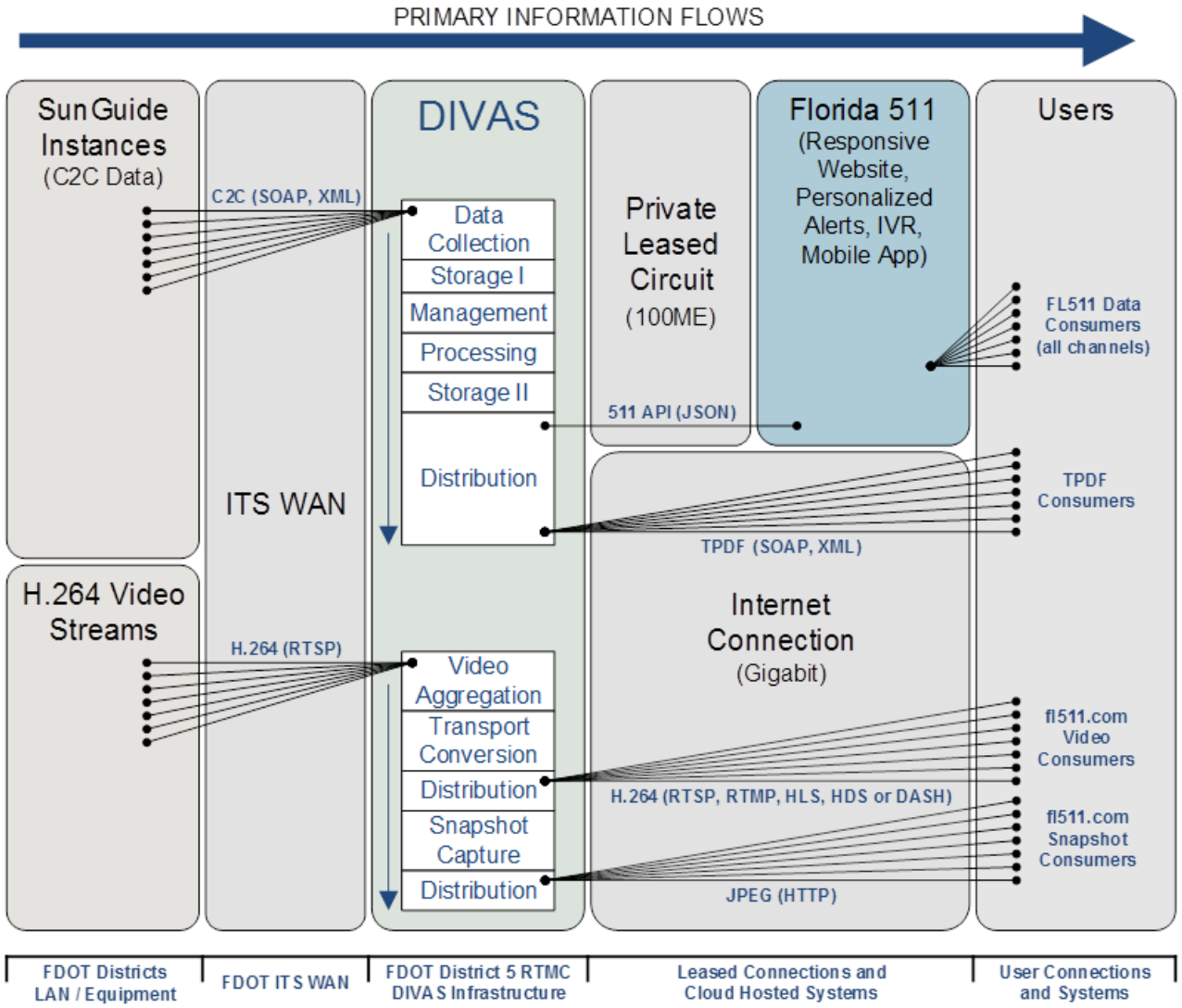
Florida 511 Advanced Traveler Information System

- A service of the Florida Department of Transportation
- Florida's official source for traffic and travel information
- One-stop shop for commuters, visitors and commercial vehicle operators
- Real-time traffic and travel information via:

FL511.COM | MOBILE APP | TEXT ALERTS | #FL511 | @FL511 | @FLORIDA_511

Data Integration and Video Aggregation System (DIVAS)

DIVAS Architecture



Data Integration and Video Aggregation System

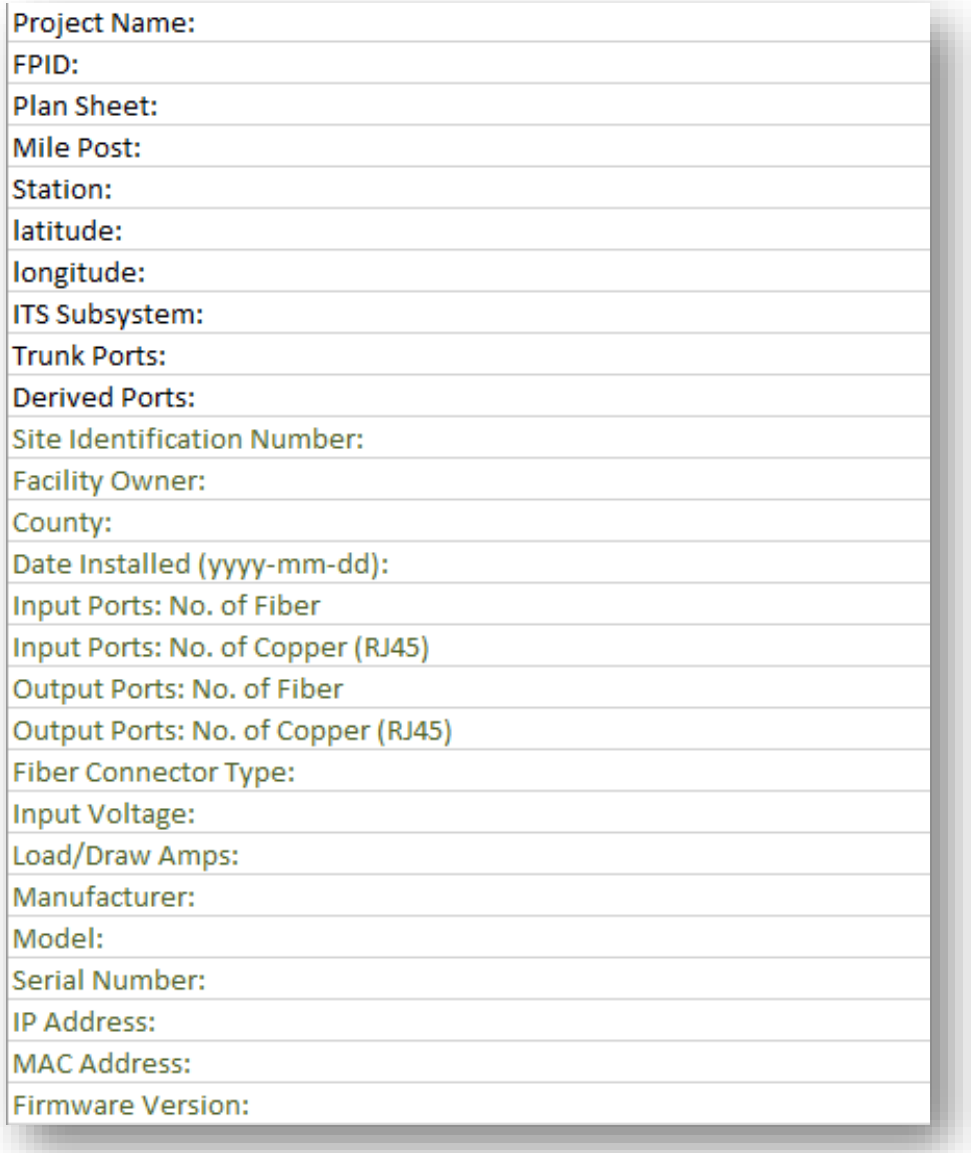
FDOT TRANSPORTATION SYMPOSIUM

ITS Facility Management (ITSFM)

- Asset, configuration, and document management software tool:
  - Documents installed condition.
  - Information is immediately available via web browser – no reporting delays or waiting for daily or weekly uploads….
  - Ability to export geo-spacial data to assist designer.
  - Preserves institutional knowledge

ITS Construction Engineering and Inspection (CEI) Checklists

- Checklists for Devices:
  - Managed Field Ethernet Switch
  - Microwave Vehicle Detection System
  - Closed-Circuit Television Camera
  - Roadway Weather Information System
  - Dynamic Message Signs
- Checklists contain project and device specific information for inventory and maintenance
- Help the CEI know what to check for on projects
- Currently under final review



Project Name:
FPID:
Plan Sheet:
Mile Post:
Station:
latitude:
longitude:
ITS Subsystem:
Trunk Ports:
Derived Ports:
Site Identification Number:
Facility Owner:
County:
Date Installed (yyyy-mm-dd):
Input Ports: No. of Fiber
Input Ports: No. of Copper (RJ45)
Output Ports: No. of Fiber
Output Ports: No. of Copper (RJ45)
Fiber Connector Type:
Input Voltage:
Load/Draw Amps:
Manufacturer:
Model:
Serial Number:
IP Address:
MAC Address:
Firmware Version:

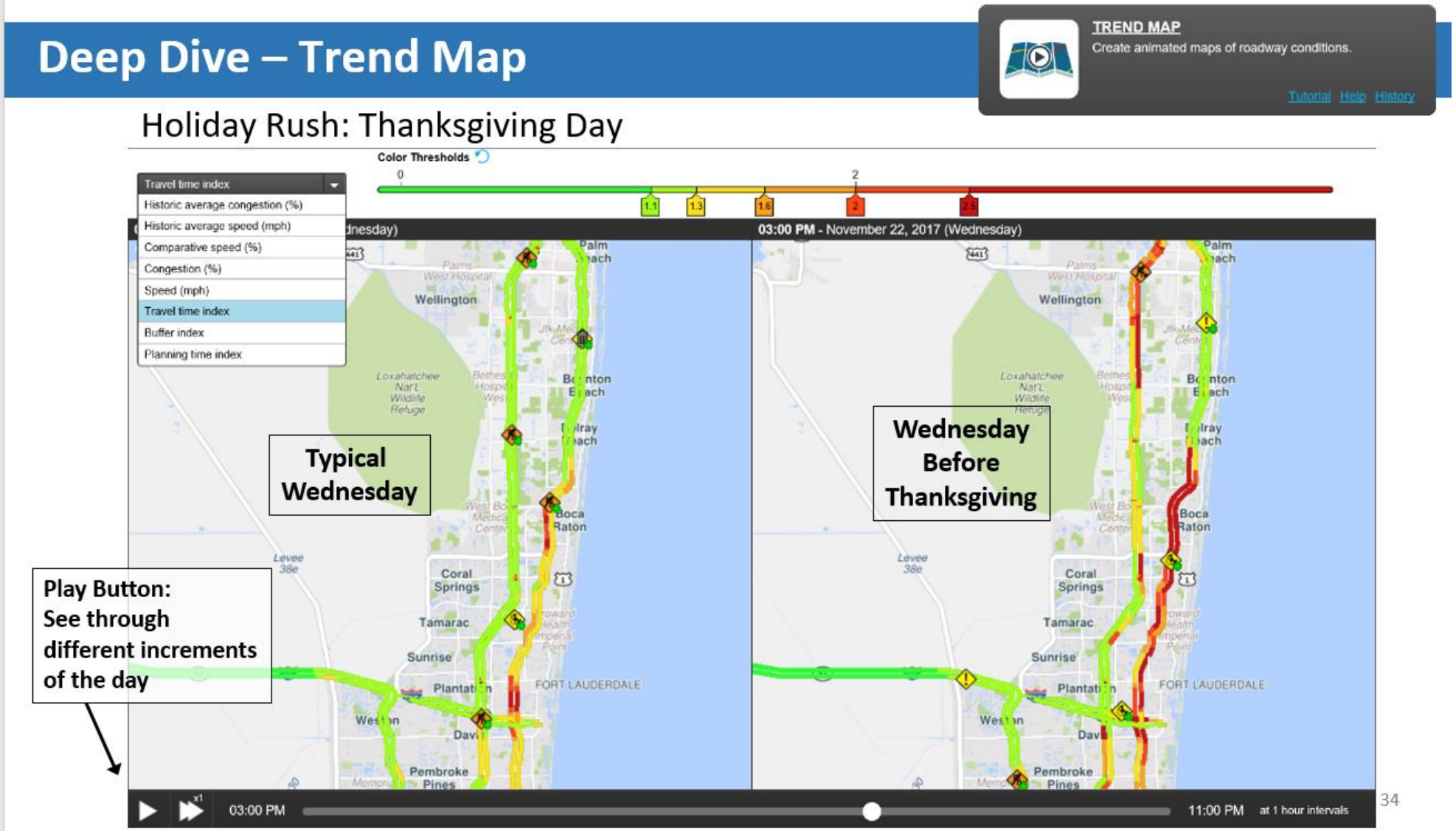
Regional Integrated Transportation Information System (RITIS)

- Storing data at the Regional Integrated Transportation Information System (RITIS)
- Provide performance data from:
  - FDOT detector data
  - FDOT and FHWA purchased probe vehicle data
  - Incident data from FL511
- Data goes back several years, for historical comparisons
- FHWA now provides access for any valid user, requires FDOT approval, as well

For more information on RITIS, contact Christine Shafik

Example Analysis from RITIS

Deep Dive – Trend Map



FDOT TRANSPORTATION SYMPOSIUM

FDOT Procedure for Systems Engineering 750-040-003

- Meets Code of Federal Regulations Section 23, Part 940 (23 CFR 940) Intelligent Transportation System Architecture and Standards
- Describes for framework for tailoring systems engineering analysis and processes systems based on project risk

Florida Department of Transportation
Systems Engineering and Intelligent Transportation Systems (ITS) Architecture Procedure

750-040-003-c

FDOT TSM&O
Transportation Systems Management & Operations

Florida Department of Transportation
Traffic Engineering and Operations Office
Transportation Systems Management and Operations Section
605 Suwannee Street, M.S. 90
Tallahassee, Florida 32399-0450
(850) 410-5600

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For more information, contact Christine Shafik

FDOT TRANSPORTATION SYMPOSIUM

Systems Engineering Context: TSM&O and ITS

- FDOT used ITS to describe M&O tactics and strategies in the past, but here's the scoop, now:
  - ITS are the infrastructure, technologies, data, and software than enable the M&O strategies to function … the STUFF
  - M&O are the strategies that define what PEOPLE and ORGANIZATIONS do with the STUFF in order to achieve safety and mobility impact objectives
- Or, putting it another way:
  - TSM&O starts with a Concept of Operations (ConOps) to identify PEOPLE and ORGANIZATIONAL safety and operational "Needs"
  - Needs lead to technical requirements for the STUFF
  - STUFF is developed through a Systems Engineering Process

Systems Engineering: Developing STUFF for PEOPLE and ORGANIZATIONS

Systems engineering is defined by the International Council on Systems Engineering (INCOSE) as an interdisciplinary approach and means to enable the realization of successful systems.

It focuses on defining customer needs and required functionality early in the development cycle, documenting requirements, and then proceeding with design synthesis and system validation while considering the complete problem. Systems engineering integrates all the disciplines and specialty groups into a team effort forming a structured development process that proceeds from concept to production to operation. Systems engineering considers both the business and the technical needs of all customers with the goal of providing a quality product that meets the user needs.

Procedure 750-040-003, Section 1

- **SYSTEMS ENGINEERING AND INTELLIGENT TRANSPORTATION SYSTEMS ARCHITECTURE INTRODUCTION**
- **1.1 SYSTEMS ENGINEERING PROCESS**
- **1.2 SYSTEMS ENGINEERING ANALYSIS**
- **1.3 REGIONAL INTELLIGENT TRANSPORTATION SYSTEMS ARCHITECTURE**
- **1.4 TAILORING THE SYSTEMS ENGINEERING PROCESS**
- **1.5 TAILORING GUIDE**
- **1.6 SYSTEMS ENGINEERING CHECKLISTS AND SUPPORTING DOCUMENTS**

Procedure 750-040-003, Section 2

- **MAINTAINING THE INTELLIGENT TRANSPORTATION SYSTEMS ARCHITECTURE**
- **2.1 MAINTENANCE PLAN**
- **2.2 INTELLIGENT TRANSPORTATION SYSTEMS ARCHITECTURE CHECKLIST AND CHANGE REQUESTS**

Note: FDOT is planning to work with local transportation and planning agencies to update all Regional ITS Architectures to conform to the national Architecture Reference for Connected and Intelligent Transportation (ARC-IT), beginning summer of 2019.

New FDOT RITSA website
https://teo.fdot.gov/architecture/

New National ITS Architecture website
https://local.iteris.com/arc-it/

Procedure 750-040-003, Section 3

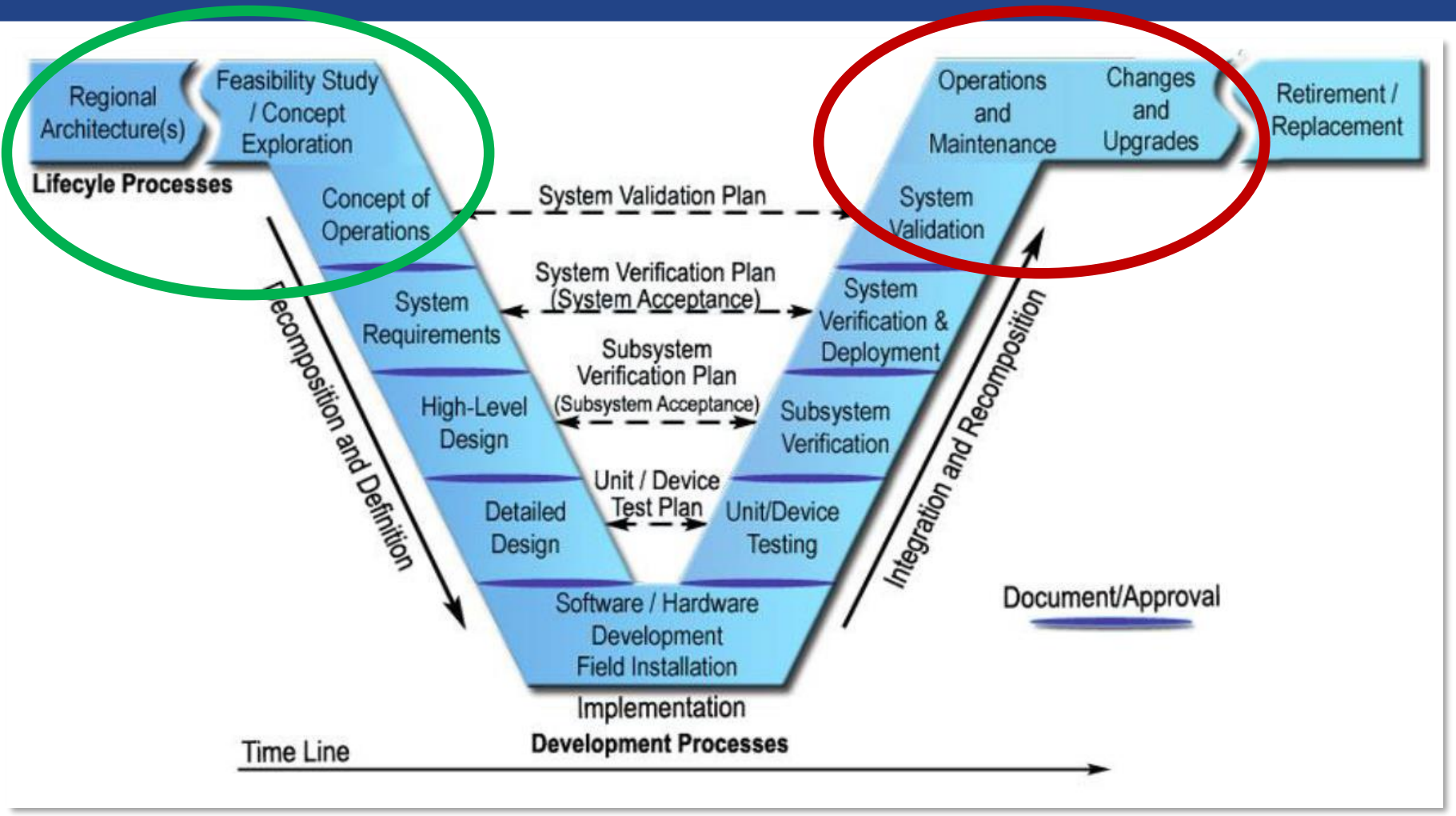
- **AGENCY ROLES FOR SYSTEMS ENGINEERING AND INTELLIGENT TRANSPORTATION SYSTEMS ARCHITECTURE**
- **3.1 PROJECT-SPECIFIC ROLES**
- **3.2 NON-PROJECT SPECIFIC ROLES**
  - CO TSM&O Program
  - District TSM&O Program Engineers
  - FHWA Florida Division
  - Local Agencies
  - Metropolitan/Transportation Planning Organizations

Systems Engineering Analysis

- Basic requirements of 23 CFR 940
  1. Identification of portions of the RITSA being implemented.
  2. Identification of participating agencies roles and responsibilities which draws from the RITSA Operational Concept (OpsCon) and Agreements.
  3. Identification of requirements definitions (draws from RITSA system functional requirements, interface requirements, and architecture flows).
  4. Analysis of alternative system configurations and technology options to meet requirements.
  5. Identification of procurement options.
  6. Identification of applicable ITS standards and testing procedures (draws from RITSA identification of standards).
  7. Identification of procedures and resources necessary for operations and management of the system (draws from RITSA OpsCon and Agreements).

Systems Engineering Process

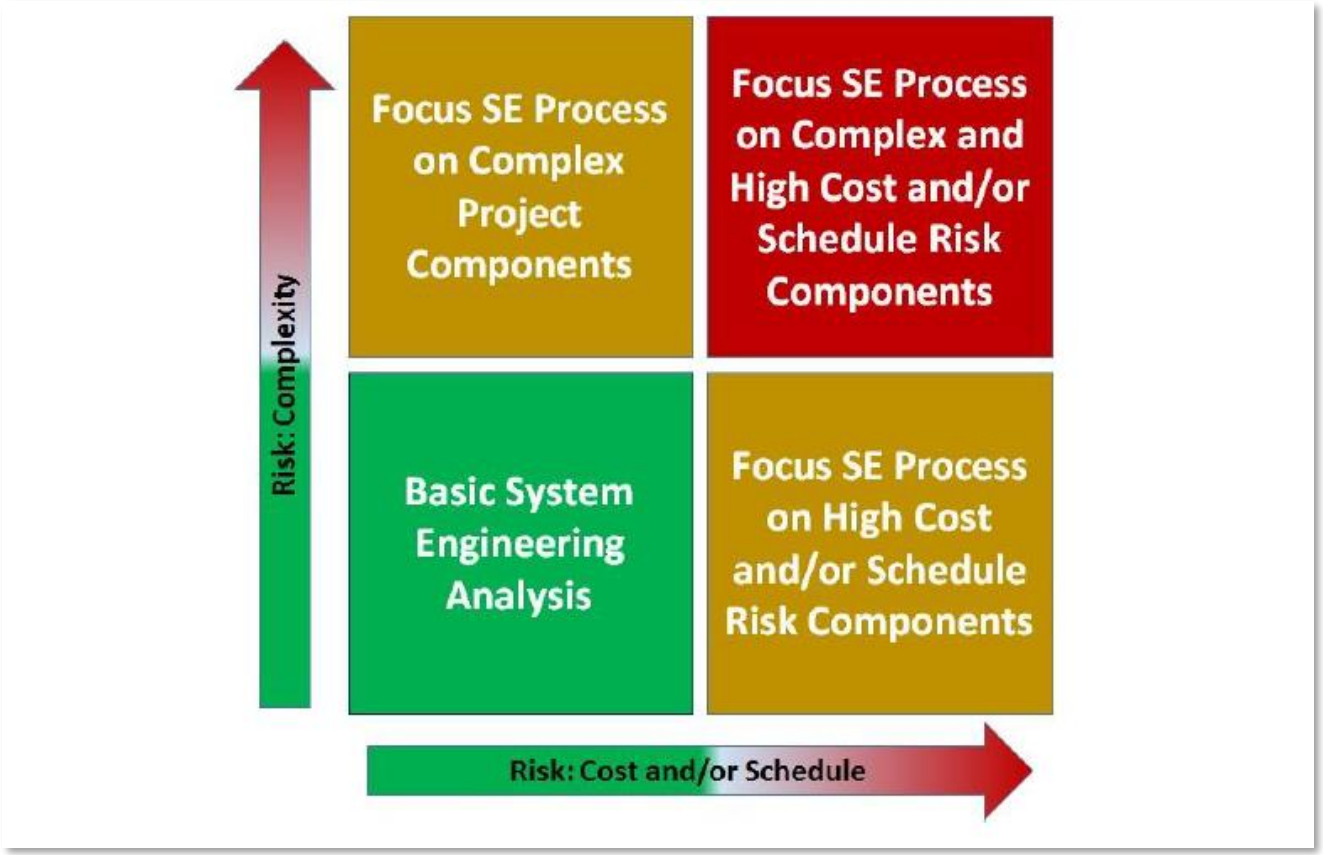
- This “V” diagram is from FDOT Procedure 750-040-3
- The process begins with the Regional ITS Architecture (RITSA)
- The process ends with validation and operations and maintenance.
- For major projects, the RITSA and concept exploration feed the PD&E. ConOps and preliminary risk assessment start during PD&E
- Incorporates FDOT and industry best practices



Typical Systems Engineering Process Depicted as a “V” Diagram

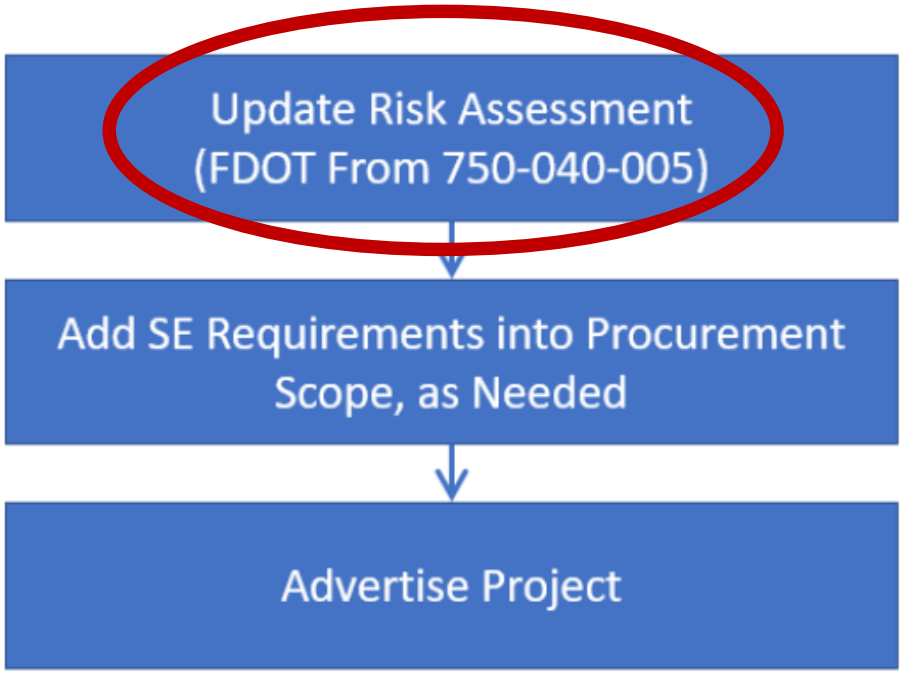
Guidance for Tailoring and Budgeting for Systems Engineering Based on Risk Assessment

- Example risk elements
  - One to multiple jurisdictions or stakeholders
  - Existing to new custom software
  - Proven to emerging cutting edge technologies
  - Existing to new interfaces and connectivity
  - Existing to new operation and maintenance procedures



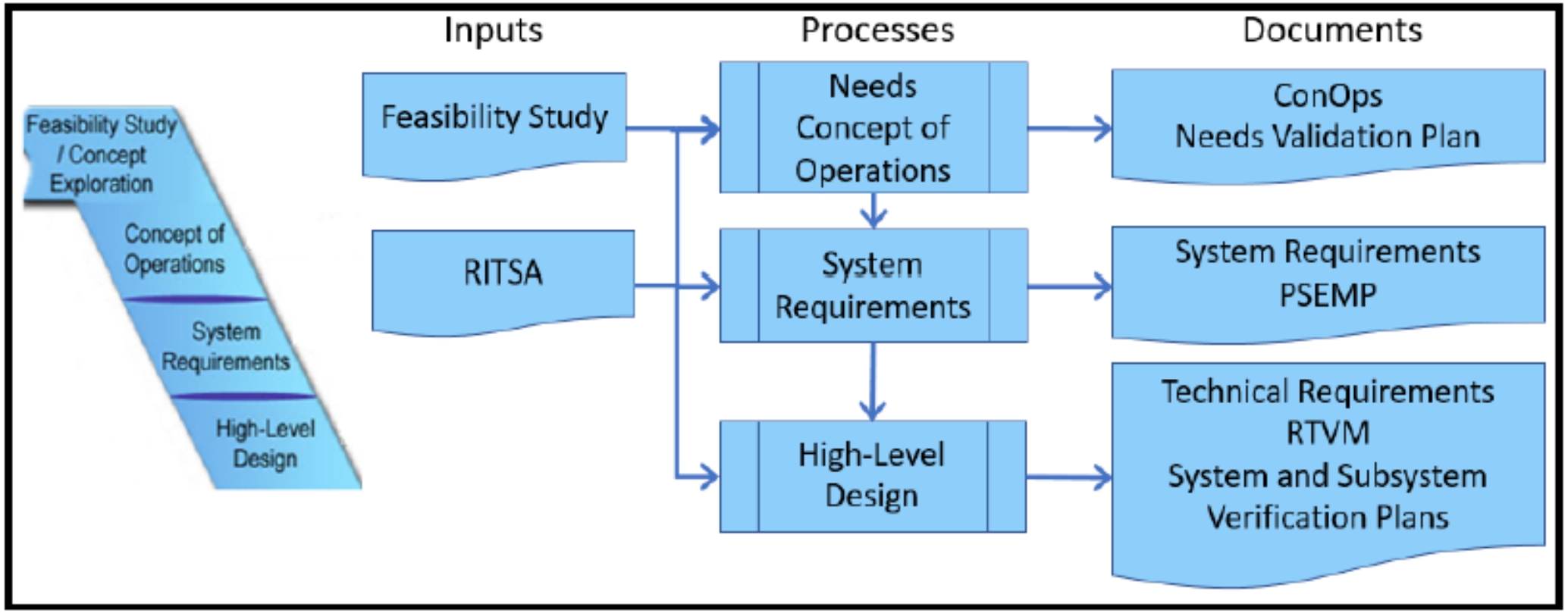
When to Conduct Risk Assessments

Steps Involved in ITS Project Planning



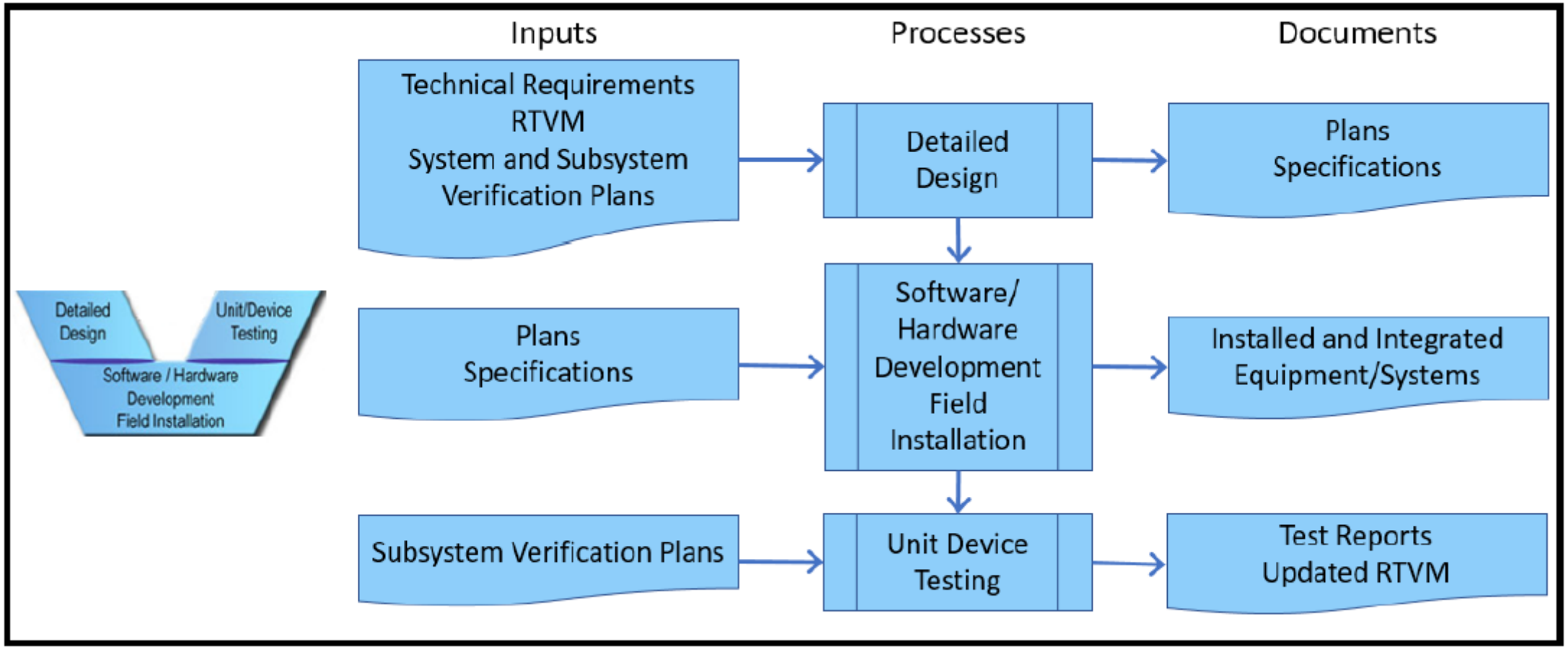
Steps Involved in ITS Project Advertisement

Systems Engineering Decomposition: Inputs and Outputs



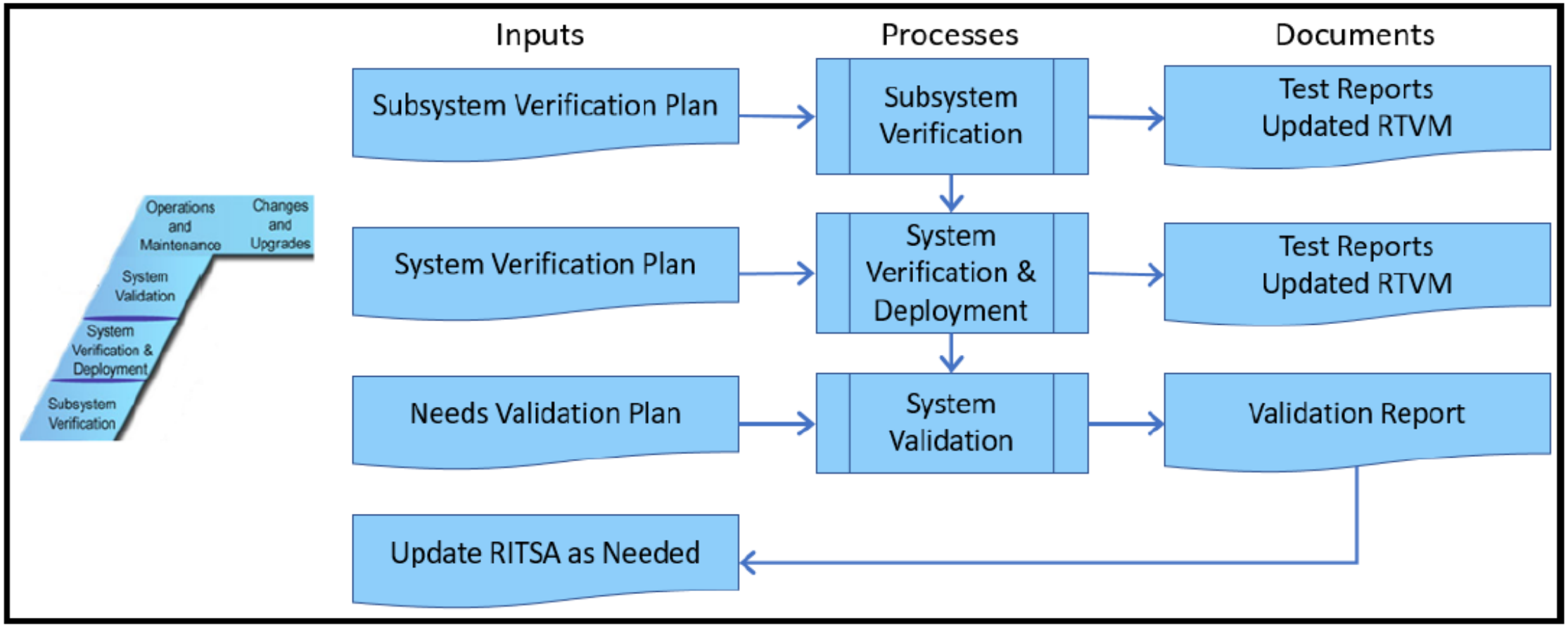
Decomposition Phase

Systems Engineering Implementation: Inputs and Outputs



Implementation Phase

Systems Engineering Recomposition: Inputs and Outputs



Recomposition Phase

Minimum Systems Engineering Documents for All TSM&O/ITS Projects

- Project Risk Assessment and Regulatory Compliance Checklist (FDOT Form 750-040-05)
- Systems Engineering Project Checklist (FDOT Form 750-040-06) (and required supporting documents)

Minimum Systems Engineering Documents Needed for High Risk TSM&O Projects

Note: PSEMP template includes additional risk assessment guidance and tools.

1. Project Systems Engineering Management Plan (PSEMP).
2. Concept of Operations (ConOps).
3. Analysis of Alternative System Configurations and Technology Options – can be included in the PSEMP.
4. High-Level System Requirements.
5. Requirements Traceability Verification Matrix (RTVM) – current focus of FHWA review for TSM&O/ITS project oversight.
6. List of ITS Standards – can be included in the PSEMP, or reference the standard specifications.
7. System Verification Plan.
8. System Validation Plan.
9. Operations and Management Plan.

For current SE templates, see: https://www.fdot.gov/traffic/ITS/Projects-Deploy/SEMP.shtm

Use of Previously Created SE Documents

- SE documents created for previous ITS projects may be reused if applicable to the current ITS project. When using previously created SE documents, verify they are up to date and validated by current project stakeholders, and that the project described in the SE documents remains in conformance with the current RITSA.

For more information, contact Christine Shafik

Training Modules

Learning Curve

- ITSFM Viewer
- ITSFM Maintainer
- Traffic Signal Training
- Fiber Design for ITS and Signalization Projects
- ITS CEI: Closed Circuit Television Cameras Module

TEO Website

- Traffic Signal Training
- Fiber Design for ITS and Signalization Projects
- ITS CEI: Closed Circuit Television Cameras Module