

Management of ITS Project through Systems Engineering

PMI TLH Chapter

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- ▶ ITS overview
- ▶ Federal regulations for ITS projects
- ▶ Overview of systems engineering (SE)
- ▶ Application of SE process to projects
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- ▶ Roles and responsibilities of stakeholders
- ▶ Future steps

Intelligent Transportation Systems

- Technologies to ensure the safety and mobility of transportation operations.
- CCTV, DMS, Detectors, CVO, Transit, Signal, TMC, CV, AV, 511, Big Data, RWIS...
- Why SE for ITS?



Federal Regulations (FHWA)

23 CFR 940.11 “Project Implementation” requires:

- a) All ITS projects funded with highway trust funds shall be based on a systems engineering analysis.
- b) The analysis should be on a scale commensurate with the project scope.

Federal Regulations (FHWA) *(Cont.)*

23 CFR 940.11 “Project Implementation” requires:

- c) Any major ITS project funded with highway trust funds that advances to final design shall have a project level ITS architecture that is coordinated with the development of the regional ITS architecture.
- d) The project level ITS architecture shall be based on the results of the systems engineering analysis.

Federal Regulations (FHWA) *(Cont.)*

23 CFR 940.13 “Project Administration” requires:

- e) Prior to authorization of highway trust funds for construction or implementation of ITS projects, compliance with §940.11 shall be demonstrated.
- f) Compliance will be monitored under federal-aid oversight procedures.
 - Each FHWA Division Office works with state and local partners to establish these procedures.

23 CFR 940.11(c) Defines Seven Minimum “systems engineering analysis” Items

1. Regional ITS architecture
2. Stakeholders’ roles and responsibilities
3. Requirements
4. Alternative system configurations and technology
5. Procurement
6. ITS standards and testing
7. Operations and management of the system

ITS Architecture

- ▶ The functions (e.g., gather traffic information or request a route) that are required for ITS
- ▶ The physical entities or subsystems where these functions reside (e.g., the field or the vehicle).
- ▶ The information flows and data flows that connect these functions and physical subsystems together into an integrated system.



Using the Regional ITS Architecture

▶ Key activities:


- Identify relevant regional ITS architecture(s)
- Identify portions of regional ITS architecture that the project will implement*
- Identify stakeholders' roles and responsibilities*
- Identify functional requirements*
- Identify interfaces requirements and information exchanges*
- Identify ITS standards*
- Verify project is consistent with regional ITS architecture
- Identify any necessary changes to regional ITS architecture



*Denotes
FHWA
requirement

Where are the Regional ITS Architectures?

<http://www.consystem.com/florida/default.htm>

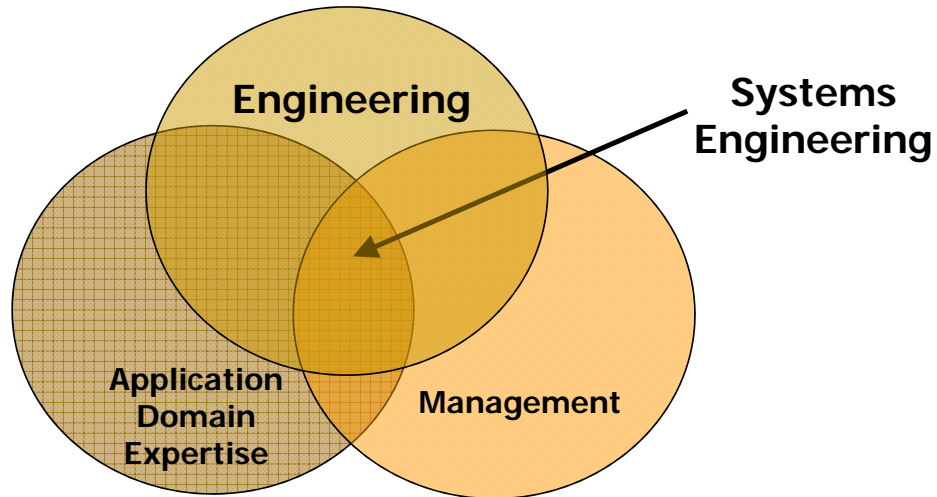
	Florida Statewide and Regional ITS Architectures (Update)
Regions	About this Project
Statewide	<p>Florida ITS Architecture The objective of the Florida Statewide and Regional ITS Architectures Update is to update the regional and statewide ITS architecture services to comply with the FHWA 23 CFR Rule 940 requirements, and to support Version 5.1 of the National ITS Architecture. A brochure summarizing the Update project and objectives can be found here.</p> <p>About this Web Site</p> <p>The purpose of this Florida Statewide and Regional ITS Architectures (Update) web site is to present the ITS architectures that reflect the intelligent transportation system vision for each of the districts.</p> <p>NOTE: The following files has been updated on the project website(s) since August 19, 2008:</p> <ul style="list-style-type: none">• Florida Turbo Architecture Database• Version Log File
District 1 - Southwest Florida	
District 2 - Northeast Florida	
District 3 - Northwest Florida	
Districts 4 & 6 - Southeast Florida	
District 5 - Central Florida	
District 7 - Tampa Bay Region	
Turnpike Enterprise	Statewide and Regional ITS Architectures Development Process
Integrated All Regions	
Send Your Comments	

23 CFR 940.11(e) Defines Five “project level ITS architecture” Items

1. Project scope
2. Operational concept
3. Functional requirements
4. Interface requirements and information exchanges
5. ITS standards

What is Systems Engineering (SE)?

An *inter-disciplinary approach* and means to enable the realization of successful systems... A *structured process* for arriving at a final design of a system.



System means a combination of interacting elements organized to achieve one or more stated purposes.

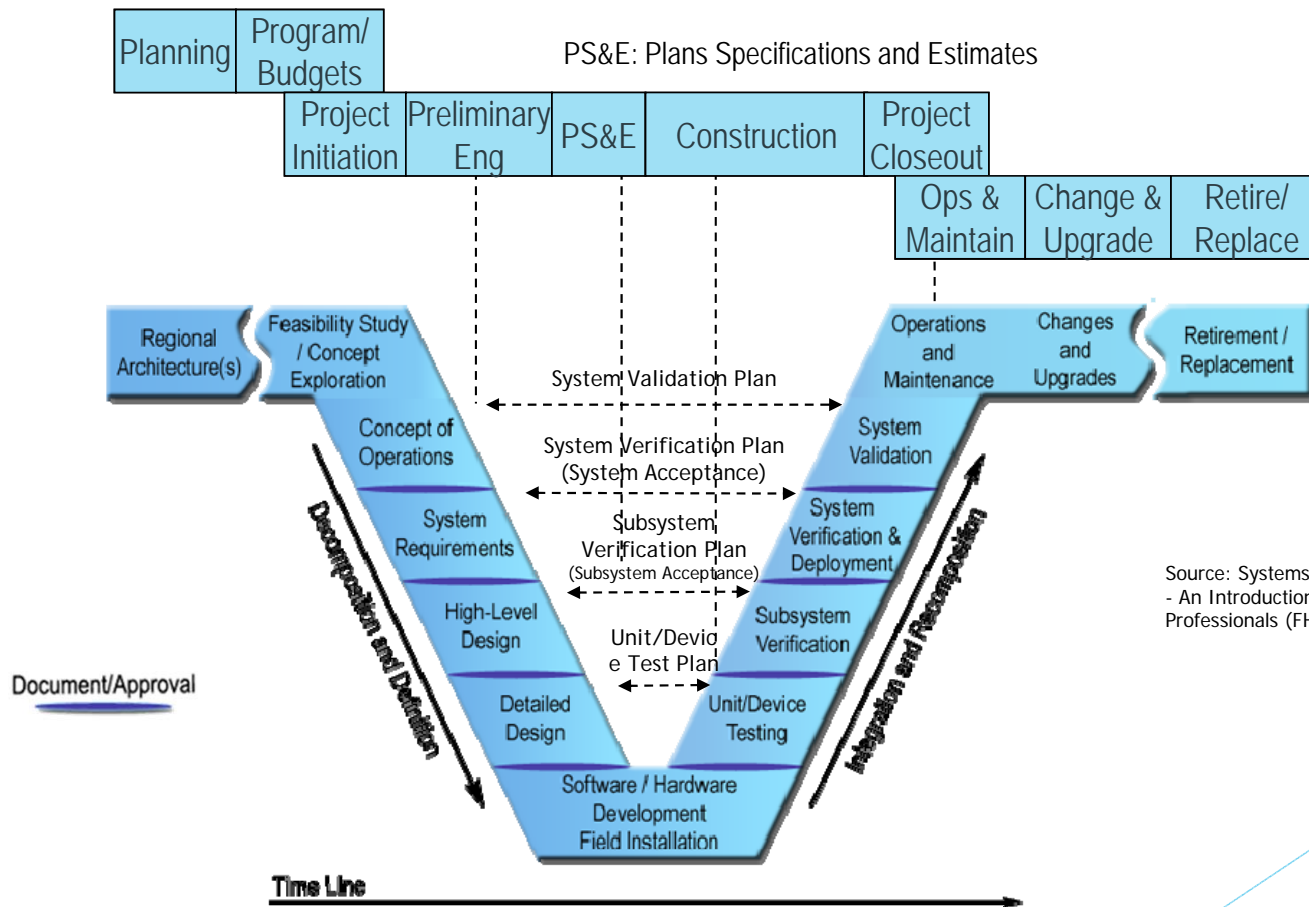
What are the SE Principles?

- ▶ Start with your eye on the finish line
- ▶ Involve stakeholders
- ▶ Define the problem before implementing the solution
- ▶ Delay technology choices
- ▶ Divide and conquer
- ▶ Connect the dots - traceability

What are the Benefits of Using SE?

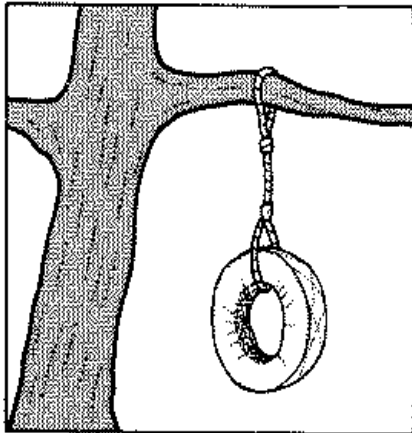
- ▶ Reduced risk of schedule and cost overruns
- ▶ Users' needs met
- ▶ Improved stakeholder participation
- ▶ More adaptable and resilient systems
- ▶ Verified functionality and fewer defects
- ▶ Higher level of reuse from one project to the next
- ▶ Better documentation

Traditional Road Project Process and the SE "V"

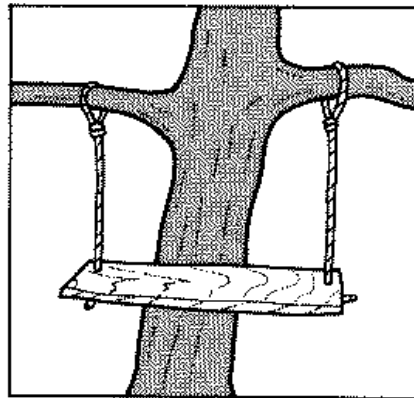


Source: Systems Engineering for ITS
- An Introduction for Transportation Professionals (FHWA)

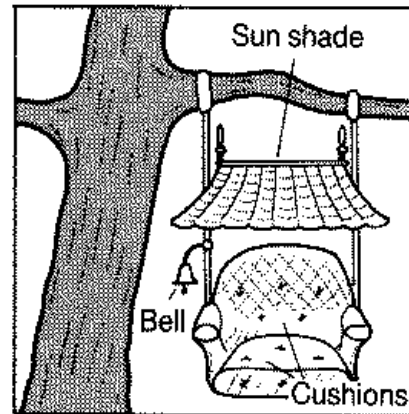
Configuration Management



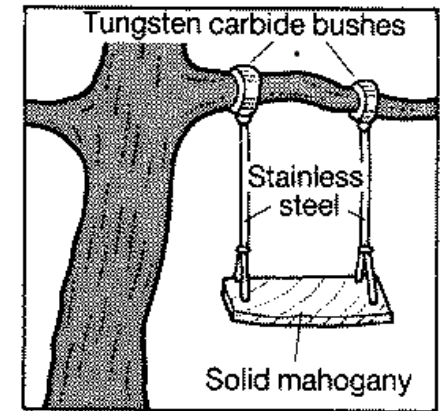
What the customer actually wanted



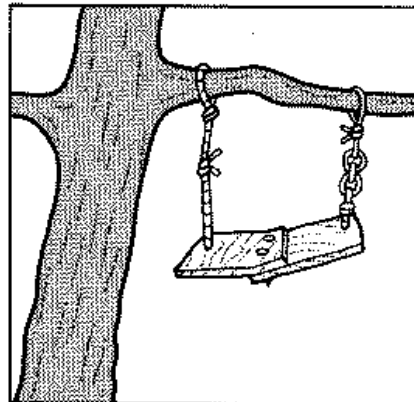
Design group's initial design



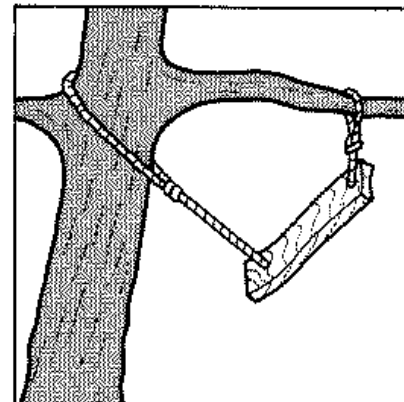
What the salesman promised



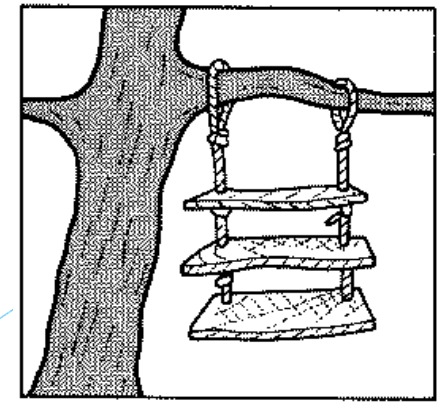
What Product Marketing specified



General release version



Pre-release version



Corp. Product Architecture's modified design

Concept of Operations



▶ The ConOps defines:

- Who: Stakeholder roles and responsibilities
- What: Stakeholder needs, system elements, and high-level capabilities
- Where: Geographic and physical extent
- When: Sequence of activities performed
- How: Development, operations, and maintenance of the system

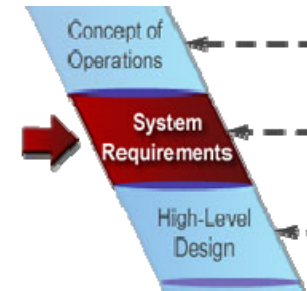
Concept of Operations (Cont.)

▶ Key activities:

- Identify stakeholders
- Define core group responsible for creating ConOps
- Develop initial ConOps, review with broader stakeholder group, and iterate
- Define stakeholder needs
- Create a System Validation Plan



System Requirements



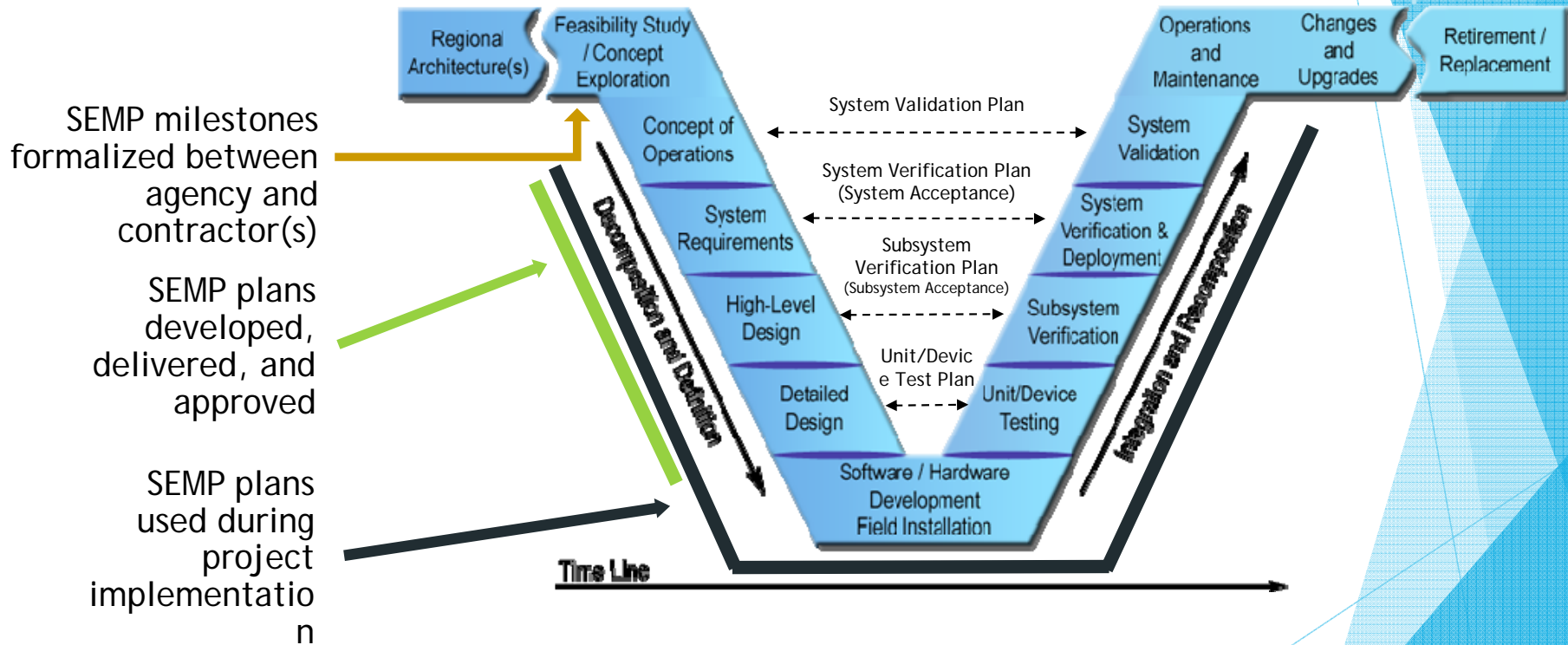
▶ Key activities:

- ▶ Elicit, analyze, document, validate, and manage Requirements
- ▶ Create a System Verification Plan that assures testing, demonstration, inspection, and analysis in relation to each requirement
- ▶ Create a System Acceptance Plan that describes the functionality the system must display prior to customer acceptance

How is SE Applied to a Project?

- ▶ Project Systems Engineering Management Plan (PSEMP):
 - Documents how the technical development will be managed and what needs to be documented
 - Details how the SE process will be tailored and development will be conducted
 - Explains how the process activities will be brought together

How is SE Applied to a Project? (Cont.)

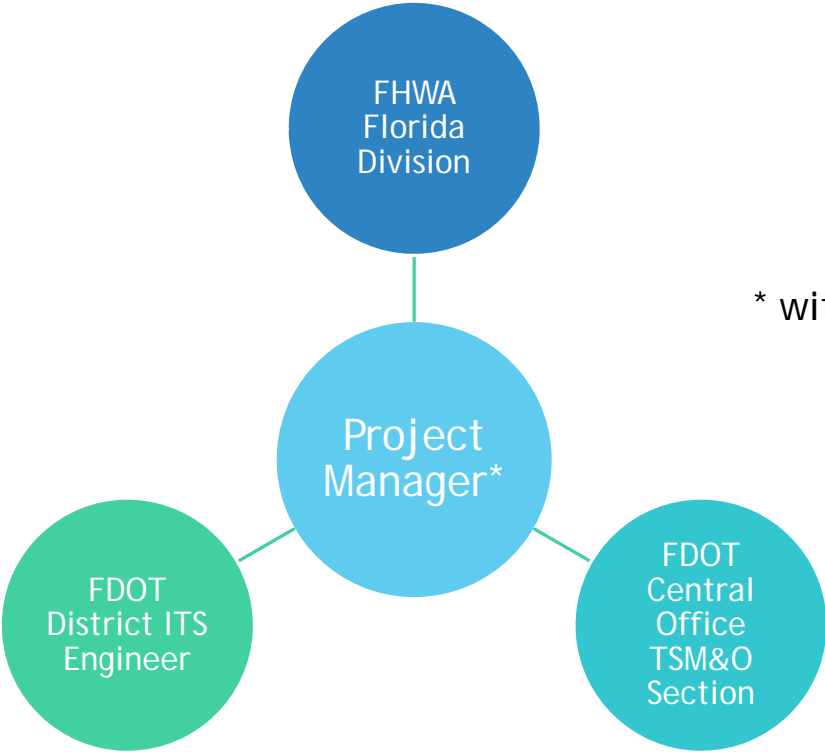


Eleven Items of the Systems Engineering Project Checklist

1. Project information
2. Systems engineering management plan
3. Architecture assessment
4. Alternative analysis
5. Concept of operations
6. Requirements definitions

7. High level and detailed design
8. Implementation
9. Integration and verification
10. System validation and acceptance
11. Operations and maintenance

Stakeholders Identified in FDOT Policy/Procedure for SE



* with FDOT District or Local Agency



Roles and Responsibilities for ITS Projects Funded with Highway Trust Funds and FHWA Oversight

Role	Action
Project Manager (PM)	<ul style="list-style-type: none"><input type="checkbox"/> Complete Project Risk Assessment and Regulatory Compliance Checklist<input type="checkbox"/> Complete Systems Engineering Project Checklist¹<input type="checkbox"/> Include tailored Systems Engineering Documents¹<input type="checkbox"/> Coordinate extent of oversight with District ITS Engineer and FHWA Florida Division<input type="checkbox"/> Submit all documentation to FHWA Florida Division and Central Office TSM&O Section

¹ for projects classified as high-risk

Roles and Responsibilities for ITS Projects Funded with Highway Trust Funds and FHWA Oversight *(Cont.)*

Role	Action
District ITS Engineer	<input type="checkbox"/> Provide assistance to PM for ensuring compliance with FDOT policy/procedure
FHWA Florida Division	<input type="checkbox"/> Review and approve documentation (for FHWA oversight projects ONLY)
Central Office ITS Section	<input type="checkbox"/> Provide clarification on FDOT policy/procedure for use on projects

Future Steps

- ▶ Outreach and coordination of document updates through multiple FDOT offices

Document Title	Document Owner
Project Management Handbook	Production Support Office
Local Agency Program Manual	Production Support Office
Plans Preparation Manual	Roadway Design Office
Construction Project Administration Manual	Construction Office

Resources

Statewide and Regional ITS Architectures:

http://www.dot.state.fl.us/trafficoperations/ITS/Projects_Arch/SITSA.shtm

Systems Engineering and ITS Architecture Procedure (750-040-003-c)*:

<http://www.dot.state.fl.us/proceduraldocuments/procedures.shtm>

* Not yet posted

Project Risk Assessment and Regulatory Compliance Checklist, and Systems Engineering Project Checklist*:

<http://www.dot.state.fl.us/proceduraldocuments/forms.shtm>

Systems Engineering for ITS - An Introduction for Transportation Professionals (FHWA): <http://ops.fhwa.dot.gov/publications/seitsguide/seguide.pdf>

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QUESTIONS AND ANSWERS

