Introduction to Systems Engineering 100 course

Part 2 of 2 – Module 1

Welcome

Welcome to the second of two parts of the Florida Department of Transportation's Introduction to Systems Engineering 100 course for Intelligent Transportation Systems, or ITS. This is Module 1.

Overview

In Part 1, we looked at basic ideas about systems and systems engineering and moved on to elements of systems engineering for ITS and project deliverables. We answered the questions: "What is a system?" and "Why do Systems Engineering for ITS?". Part 1 also covered the FDOT and federal requirements and deliverables for systems engineering of ITS projects.

The second part of the course goes into greater depth on documentation described in Part 1 and explores what systems engineering is needed to begin a basic, example ITS project. We examine development of documents needed to take a project to the Request for Proposal, or RFP, stage for project procurement, including the Project Systems Engineering Management Plan, or PSEMP, the Regional ITS Architecture, or RITSA, Concept of Operations, or ConOps, document, and Systems Requirements.

SE Effort and Risk and Complexity

As mentioned earlier, the need to reduce risk is one of the major reasons ITS projects are subject to a systems engineering approach. In approaching a project, one of the first things to establish is if the project is low or high risk. According to the FDOT Systems Engineering and ITS Architecture Procedure Number 750-040-003, the systems engineering effort is to be commensurate with the degree of risk and complexity.

This chart, from the FDOT ITS Procedure, illustrates the kinds of combinations of risk and complexity that can occur. In the lower left (in green), with low risk and low complexity, only the basic systems engineering effort is made. In the upper right (in red), with high risk and high complexity, the systems engineering effort needs to address both the risk and complexity of the project.

In the other two corners (in amber), the focus needs to address the system according to the risk and complexity issues that influence its development. The extent of tailoring should be described in the Project Systems Engineering Management Plan. We will examine developing an ITS project in the amber category on the lower right.

Example ITS Project

The following is a hypothetical FDOT ITS project that will be used to explore the systems engineering process. There are routine traffic jams. The intention is to divert traffic to a bypass route during jam periods. FDOT and the county will co-own the project. Determine the risk level and outline the first steps in the systems engineering process to undertake procurement with production of a Request for Proposal.

In our hypothetical project, existing Regional ITS Architecture elements include:

- Traffic Management Center,
- Traffic controllers,
- Communications,
- Closed-circuit television, or CCTV, and
- Dynamic message signs, or DMS.

The project will include only existing Regional ITS Architecture elements and software. The project will supply additional new:

- CCTV cameras;
- Blank-out signs and electronic message boards, which may be considered a kind of DMS in the Regional ITS Architecture.

To be clear about use of systems engineering, let us assume it uses federal funds.

Example Risk Assessment for ITS Project

The first step is to fill out a Project Risk Assessment and Regulatory Compliance Checklist (FDOT Form 750-040-05) Part 1.6:

a. Only your agency, not multiagency? NO

b. Uses only existing software or none? YES

c. Uses only proven hardware and communications? YES

d. Uses only existing interfaces? YES

e. Uses only existing system requirements? YES

f. Uses only existing operating procedures? YES

g. Uses only technologies with service life longer than 2-4 years? YES

Since all of these are not Yes, then it is a high-risk project.

Risk Assessment

The rest of the Project Risk Assessment and Regulatory Compliance Checklist (FDOT Form 750-040-05) (Part 2) needs the following completed, which gives an initial coverage of the 7 points in the Federal Final Rule for ITS:

1. Parts of the Regional ITS Architecture to be used

2. Participating agencies, roles, responsibilities – to describe, in particular, the role of FDOT and the County

3. Resources needed for Operations and Maintenance

4. Requirements definitions

5. Applicable ITS standards and testing procedures

6. Alternative systems configurations

7. Procurement options

Project Risk Determination

The District Transportation Systems Management & Operations, or TSM&O, Program Engineer reviews the Project Risk Assessment and Regulatory Compliance Checklist (FDOT Form 750-040-05) and determines, with Central Office and FHWA approval, that it is a high-risk project and the amount of tailoring of systems engineering needed. This project will be continued according to the standard FDOT systems engineering process with documents being combined where possible. Projects underway that are changed need to be reassessed for risk and tailoring.

Project Checklist Form

Since the project is federally funded and high risk, the FDOT ITS Procedure calls for use of a Project Checklist Form to be federally compliant. The form must be submitted to the Central Office TSM&O Program Office with supporting system engineering documents within 30 days of project acceptance. Complete instructions are available in the FDOT ITS Procedure and on the form.

Architecture Form

The FDOT ITS Procedure calls for use of an Architecture Modification Form for high-risk projects when there are changes to the RITSA. The ITS Architecture Request Form (750-040-04) is used to change the Regional ITS Architecture. Present the description and rationale for any RITSA changes. It is not needed for low-risk projects, since, for a project to be low-risk, it can't involve a change to the RITSA. We will see that this example project has no RITSA changes during the RITSA discussion to follow shortly.

Contracting Systems Engineering Services

Agencies initiating an ITS project do not generally do the entire project and, instead, let out portions to be done by others under contract. In our example project, let us assume everything shown in green in the V-model, done after System Requirements and before Operations and Maintenance, will be done by a Design-Build contractor. Other means of contracting services are possible, such as Design-Bid-Build, among others.

Operations and Maintenance, in the upper right, will likely be done by a different contractor, who is already operating and maintaining the TMC and equipment. And the initial systems engineering and Request for Proposal could be done by a systems engineering consultant as well. Whether by the agency or their consultant, enough systems engineering must be done up front to create an RFP to go to bid for the design, implementation, testing, verification and system validation.

Decomposition Phase

Let's examine the inputs, processes, and documents we will need to use or produce. This slide is from the FDOT ITS Procedure and features the initial Decomposition Phase in the V-model. On the left of the flowchart, as Inputs of our example project, a feasibility study was done recommending the ITS solution we are developing. The existing District RITSA, which will be unchanged, is a given per the District's RITSA website.

On the right of the flowchart, the Concept of Operations, Needs Validation Plan, Project Systems Engineering Management Plan, Systems and Technical Requirements, and Requirements Traceability Verification Matrix, or RTVM, need to be done by FDOT consultant and reviewed by the agencies, FDOT and the county. The diagram shows how the process contributes all the necessary work to proceed to the procurement of contractor services with a Request for Proposal. The Design-

Build firm, as described in the RFP, will carry out tasks as prescribed by and tailored by the Project Systems Engineering Management Plan, Concept of Operations, System Requirements, and the other documents shown to the right.

In our project, we will combine documents, so the ConOps will include the Needs Validation Plan, and the PSEMP will include the System and Technical Requirements. The RTVM will stand alone but be based on the higher-level requirements in the PSEMP. We will leave verification plans to the contractor and make that part of the work to be done in the RFP.

Decomposition Documents & Their Use

To bring us to the point of procurement of Design-Build services, we will go over essential first steps to produce the:

- PSEMP,
- Project Architecture,
- Alternatives Analysis or Feasibility Study/Concept Exploration,
- ConOps,
- System Requirements, and
- RTVM

After that, we will discuss their use in developing the RFP for procurement of most of the remaining services on the V, pertaining to design, implementation, and testing.

Project Systems Engineering Management Plan

First, let's look at the Project Systems Engineering Management Plan, or PSEMP. Recall that project management is a cross-cutting activity used throughout the systems engineering process at every stage. Project management is built into FDOT procedures for ITS in the production of a PSEMP. The cover page of the FDOT template to be used when creating a PSEMP is shown.

To begin the PSEMP, use the PSEMP Template at the FDOT Systems Engineering website. A PSEMP describes the various steps to be undertaken, how they will be performed, and who will perform them. The PSEMP addresses the roles of the project systems engineer and the overall project manager and the contracting process. The PSEMP describes the tailoring that will be done to conform to the FDOT checklist.

Illustrated here is the intersection of project management and systems engineering. These are both major sections in the PSEMP. The PSEMP depth and breadth can vary depending on the scope of the project. The systems engineering should be scaled according to the risk and complexity of the project scope.

Both systems engineering and project management become larger as projects encounter more risk and complexity. In our example project, we will need to supply information to manage the project that systems engineering does not focus on. Systems engineering pulls together all the engineering work that needs to be done. Accordingly, the project manager and systems engineer may be the same person in smaller projects and different persons as more expertise and time is required in larger, more complex projects.

The PSEMP first defines systems engineering processes and methodologies to be used:

- project architecture,
- requirements,
- need for tradeoff studies and technical reviews,
- risk analysis,
- creating the RTVM,
- performance measures, and
- system testing.

The PSEMP secondly defines project management to be used:

- the organizational structure,
- schedule,
- procurement management,
- project communications,
- quality management,
- how to manage risks,

- subcontractor management, and
- revisions to the project and its costs and schedule.

The PSEMP also treats systems acceptance criteria, operations and maintenance, upgrading, and eventual system retirement.

By identifying project management tasks, risks, and establishing stakeholder interests and responsibilities early in the project development cycle, implementation costs can be greatly reduced. In our example project, which is high risk but not complex, the project manager and systems engineering tasks may be done by the same project manager.

Knowledge Check #1

Which of the following statements are true regarding the Project System Engineering Management Plan? Choose all that apply.

a. **It describes how systems engineering and project management will be performed for an ITS project**

b. **It is a FDOT requirement for all high-risk projects**

c. It is included in the V-diagram

d. **It describes the tailoring used in the project**

A, B, and **D** are correct. C is incorrect. The PSEMP is not included in the V-diagram.

Using the Regional ITS Architecture

We now turn to the first step on the V-diagram, in the FDOT ITS Procedure, which may run concurrently with ConOps and PSEMP development. All ITS project architectures, at any level, are derived from the Service Packages that are defined in the National ITS Architecture, or NITSA. This includes the state, regional and project levels. Service packages in the National Architecture are bundles of devices and information flows that provide a service like Traffic Signal Control or Traffic Information Dissemination, which apply to our project.

The first step in the Systems Engineering process is to show how your ITS project fits within your District's Regional ITS Architecture. Identify the portions of the regional architecture applicable to your project. Then add any new functional elements such as subsystems or information flows. This will provide information for changes to the regional architecture definition that may be required. The regional architecture grows as details of new ITS elements enter the network.

Architecture Revisions – Low & High Risk

If the project has no RITSA changes, it meets one of the seven criteria for a low-risk project. And need not fill out the RITSA Change Request form. High-Risk projects may be high-risk for reasons other than Architecture changes, as this project is.

Examine the RITSA to see if it already has the system elements and information flows that will be in the project. If there are RITSA changes, High-Risk projects must use the form for RITSA changes:

ITS Architecture Change Request Form (FDOT Form 750-040-04).

The ITS architecture Change Request defines a Project ITS Architecture, or PITSA.

ITS Architecture: NITSA to PITSA

Now that we have brought the PITSA into the picture, let's take a look at the complete ITS architecture hierarchy. The National ITS Architecture - Architecture Reference for Cooperative and Intelligent Transportation, or ARC-IT, is the generic source for the Florida State ITS Architecture, which includes all the elements used in Florida’s seven regional architectures. Each Regional ITS Architecture is updated to contain all the project components of each new ITS project, if it already doesn't include them. Lower-level architectures fit inside higher ones.

A project architecture is part of its regional architecture, which is part of the statewide architecture, which is part of the national architecture. The consistent use of this multi-level ITS architecture, as part of the systems engineering holistic approach, makes it possible to develop, use, and maintain the many complex ITS projects and systems across Florida and the United States. Travelers also can rely on consistent user interfaces and services.

Florida’s Regional ITS Architectures

The National Architecture, ARC-IT, was instituted nationally in mid-2017. In Florida, the RITSAs are being updated to ARC-IT in early 2020. The eight ITS architectures cover the entire State of Florida and are all accessible on the Resources page.

The ITS architectures have been developed through a cooperative effort by FDOT, including its Central Office, each of its Districts, Florida's Turnpike Enterprise, and agency stakeholders within each region. All Statewide and Regional ITS Architecture updates are coordinated through FDOT's Central Office TSM&O Program.

RITSA Coverage

The Statewide and Regional ITS Architectures include all past projects, some planned projects, and projects in active development. The RITSA is oriented around Stakeholders and the architecture flows between them in the Service Packages. The ITS Service Packages cover a broad spectrum of ITS services, including:

- Traffic Management,
- Transit Management,
- Traveler Information,
- Connected Vehicles,
- Maintenance and Construction,
- Emergency Management, and
- Archived Data Management.

Traffic Signal Control and Traffic Information Dissemination, which Service Packages used in our project, both fall under Traffic Management.

RITSA District Webpage

Each District RITSA website follows the same pattern. The District 1 RITSA home screen shown here shows a directory in the blue banner at the top of the page. The current RITSA will show all the Service Packages, Interfaces, Stakeholders, and Planned Projects in your District ITS and their relationships to one another. If you look under Services by Stakeholder, you can seek out the elements of your project. If they are already in the RITSA, you can document them as part of your low-risk assessment and compliance form.

RITSA Service Packages

Under the Services drop-down menu, you can select the full list of Service Packages in the District 1 RITSA. These are all from Advanced Traffic Management Systems, or ATMS, Packages. There are more subjects on additional ITS services, such as Emergency Management and Archived Data Management, among others. Service numbers shown in each RITSA are being updated to conform to the latest version of the National ITS Architecture, or ARC-IT.

Since the Service Package names remain the same, mainly the names are used in this module for clarity. To get a sense of scale, in District 1 there are about 54 Service Packages listed. Each package may have a few versions, based on the localities that use them. The total number of Service Packages for the District is about 288. For example, there are 14 versions of ATMS03, Traffic Signal Control and 10 for ATMS06, Traffic Information Dissemination.

Check the list to see what Service Packages may apply. There may be several even in a simple, low-risk project. In our case, we need to examine the list to see if our needed elements are included somewhere. At first glance, ATMS03, Traffic Signal Control, and ATMS06, Traffic Information Dissemination, look promising for the county project. The Service Packages listed all link to diagrams.

ATMS03 - Traffic Signal Control

This figure shows the ATMS Service Package, ATMS03-01_D1 –Traffic Signal Control for the Manatee-Sarasota Regional ATMS where our project is hypothetically located. The Roadway Equipment packages, in purple, include the field elements that monitor and control signalized intersections.

The information flows include the needed traffic flow data, signal control plans, and video surveillance control cameras. This covers the signalization and CCTV portion of our project. The DMSs remain to be identified in the RITSA.

ATMS06 - Traffic Information Dissemination

This diagram shows the District 1 RITSA Service Package, ATMS06-02_1 – Traffic Information Dissemination for the same area. The Roadway Equipment packages, in purple, include the field elements that send messages to DMSs, which include the project's blank-out signs. In the Transit Management box on the left, in blue, Manatee County Area Transit, or MCAT and Sarasota County Area Transit, or SCAT, receive traffic information from the TMC. Also, in another blue box, Information Service Providers, or ISPs, such as Florida 511, the Manatee County website for Traveler Information, and Private Sector ISPs, such as radio and TV stations, etc.

As you can see, the county already has the necessary elements in the RITSA to do the project and will not need to revise or update the RITSA. These two diagrams could be copied into the PSEMP and/or ConOps with a discussion of the current system. We will cover more RITSA elements in a follow-up Systems Engineering for ITS Course, which will examine what to do for a high-risk project in which the RITSA is changed.

Project Service Packages

To review, check in the RITSA to see what Service Packages apply. There may be several even in a simple, low-risk project. ATMS03 and ATMS06 turn out to be sufficient for the county's project.

In our project we add:

- CCTV cameras which are in ATMS03 – Traffic Signal Control

- Blank-out signs (DMS) which are in ATMS06 – Traffic Information Dissemination.

There is also an element of:

- Traffic detection & control – ATMS03 - Traffic Signal Control.

All the needed functionality is already present in the RITSA. Cite the coverage by ATMS03 and ATMS06 in the PSEMP and/or ConOps and include the diagrams and a discussion.

ARC-IT

Let's take a brief look at the National Architecture Reference for Cooperative and Intelligent Transportation, or ARC-IT, that is the National ITS Architecture. ARC-IT was first introduced in July 2017.

This is the home page of the ARC-IT website. (at https://local.iteris.com/arc-it/index.html).

In the banner near the top left, when you hover over the Architecture button, a drop-down menu appears that includes a link to Service Packages. Generically, a Reference Architecture:

- Provides templates for similar structures of elements and interfaces, and

- Encourages reuse of effective solutions.

ARC-IT Service Package Example

ARC-IT provides the generic Service Package templates on which the customized RITSA Service Packages are based. Similar to the ATMS03 RITSA diagram, this diagram is from the TM03 Physical View, in the ARC-IT format, and can be copied and pasted into your ConOps and PSEMP for reference, as needed, to explain your project's operations.

In the Physical View of an ARC-IT Service Package, elements are color coded in the ARC-IT format. The light green boxes on the left are for Traffic Management Center operations. Tan, in the center, is for ITS Roadway Equipment. Blue and yellow, on the right, represent the vehicles and pedestrians/cyclists, respectively. The colored arrows are user interfaces, shown as information flows between ITS system elements.

Besides color, the placement depends on function, as the Traffic Management Center is on the left, equipment in the center, and travelers on the right. By showing the information flows to and from the drivers and pedestrians/cyclists, ARC-IT allows for representation of connected vehicle services. Your PITSA will not necessarily use exactly the elements shown on the generic ARC-IT Physical Diagrams or RITSA.

The systems engineer may add or remove project-specific elements and flows as necessary. Several Service Packages may be needed to describe your project. ARC-IT images may be edited in PowerPoint or Visio, among other programs, and then copied into your ConOps document or Project Systems Engineering Management Plan.

Similar to the ATMS06 RITSA, this image is from the TM06 Physical View, based on the ARC-IT format, and can be copied and pasted into your ConOps and PSEMP for reference, as needed. It can also be modified to show only the elements in your project.

Knowledge Check #2

True or False. The Project and Regional Architectures have nothing to do with the National ITS Architecture.

False! The Project and Regional Architectures are made up of standard system elements and Service Packages from the National ITS Architecture.

Knowledge Check #3

How is the Regional ITS Architecture (RITSA) used in an ITS project? Choose all that apply.

a. **Identify elements from RITSA that are applicable to the ITS project**

b. **Identify elements in the ITS project that are new to RITSA**

c. **Identify and report all necessary changes to RITSA using ITS Architecture Change Request Form (750-040-04)**

d. **Used as a reference in low-risk projects**

All are correct. The RITSA should be used for all projects. Even though there are no changes to the RITSA in low-risk projects and some high-risk projects, how existing RITSA elements sufficiently support the project, as in A, will be reported in the ConOps and PSEMP. When there are new elements or changes, the RITSA is used to identify them and then reported in the ITS Architecture Change Request Form.

Feasibility Study/Concept Exploration

In the next step on the V are Feasibility Study and Concept Exploration. It is not always necessary to carry out a feasibility study, especially when the ITS solution is a low-risk project. In our example project, an earlier feasibility study resulted in a decision to extend existing ITS elements, such as CCTV coverage and dynamic message signs for rerouting. It was further found to not need RITSA changes.

In the early project definition stage, the alternatives considered may be fundamental, such as maintaining the existing facility ("do nothing"), building a new road, or adding ITS technology to the existing facility. These high-level concepts need to be evaluated against performance criteria defined at the outset of this step. Evaluation and analysis results should be documented for reference later in the process. Enter the results in the ConOps, which will be discussed shortly.

Concept of Operations

Once an ITS solution is identified from the feasibility analysis, a Concept of Operations, or ConOps, is pursued. A ConOps is a systems engineering foundation document that frames the overall system and sets the technical course for the project. Its purpose is to clearly convey a high-level view of the system to be developed that each stakeholder agrees to. A good ConOps document answers who, what, where, when, and how questions about the project from the viewpoint of each stakeholder. For major projects, the ConOps should begin during planning and feasibility exploration.

Stakeholders/Users

As mentioned earlier, one of the reasons we do systems engineering is to include stakeholders, who are also the system users. The ConOps is to clearly state who the stakeholders are and their user needs. Stakeholders may include the transportation agency acting as the sponsor, local transportation agencies, support agencies, such as Florida Highway Patrol and Road Rangers, among others. Also, user interests of auto, truck and transit drivers, pedestrians, and any other travelers involved will be considered, especially in more complex projects.

By establishing stakeholder interests and responsibilities early in the project development cycle, implementation costs can be greatly reduced. The ConOps is instrumental in reducing costs by early identification of user needs and the operational strategies to meet those needs. In our example project the FDOT and County are the primary stakeholders.

Concept of Operations

The ConOps is written for the users of the system in their vernacular, that is, with the minimal technical jargon needed. It should be understandable to all stakeholders. The ConOps and systems engineering, generally, are all about meeting the system users and their needs. The ConOps will define the user needs, which must be met by the project in order for the project to be successful. The user needs must come from the users or stakeholders and must be understandable and agreed upon by everyone involved in the project.

What is most important to understand about a ConOps? Capturing and addressing the correct user needs and how the system operationally addresses those needs. In our example project, which will use CCTV cameras and DMS, the User Needs would include, among others:

"Provide CCTV oversight of roadway and intersections"
and "Blank out signs will inform motorists of rerouting path."

The User Needs are used later when deriving the detailed requirements in the Verification Plan and RTVM. The ConOps lays the groundwork for a System Validation Plan, and, in our example project, the ConOps will contain most, if not all of the plan to measure that user needs were met. At the end of the project, a validation analysis will be done to determine if the project met users' needs.

The ConOps follows the Institute of Electrical and Electronics Engineers, or IEEE, and International Council on Systems Engineering, or INCOSE, standards for ConOps coverage. The chapters in the FDOT ConOps template include:

- Current System Situation/Scope
- Justification and Nature of Changes
- Concepts for the Proposed System
- Operational Scenarios
    - Users' operational perspectives
- Impacts to Operations
    - Development or installation impacts that could arise, training periods needed, and so forth
- Analysis of System
    - Benefits, limitations, tradeoffs, etc.

One purpose of the ConOps is to help users to anticipate problems that could arise. For example, in Operational Scenarios the system is described from the perspective of the various users. The Installers/Maintenance people may need to make new arrangements for maintenance of traffic, or

MOT, which may be problematic when examined in detail. Seen early on, an issue like this is cheaper and easier to solve than if it were encountered later during implementation or after the system is built.

Another example is FHP operations during a traffic incident. If the protocols are firmly established and agreed upon in the ConOps, the system is far more likely to operate efficiently in the field. Details like these are meant to be explored in the ConOps, which is concerned with operation of the system.

The ConOps is used to develop agreement among stakeholders on:

- Project Architecture;
- Stakeholder participation;
- User needs, goals, objectives, and expectations;
- Project scope;
- Project Risk Assessment and Mitigation;
- Stakeholder responsibilities, including any formal agreement or Memorandum of Understanding, or MOU;
- How the system will operate (e.g. high-level functionality and operational scenarios);
- Operational and support environment; and
- System validation performance measures.

One of the first steps in developing a ConOps is to make sure that all the stakeholders involved in or impacted by the project – owners, operators, maintainers, users, and so forth – are identified and involved. The ConOps is the stage to determine the need for and begin the process of obtaining any agreements or any Memorandum of Understanding between the stakeholders. In a transportation department, there may be several department sections involved in a project, such as TSM&O, planning, highway design and so forth. So even in a low-risk project with one agency, there may be several stakeholder groups with user needs. Also, larger projects will often have several agencies involved.

Although broad involvement is critical, you can't have 20 people on your writing team. Select or participate as one of a few individuals who are responsible for capturing and documenting the vision of the broader group. Incrementally create the ConOps, review relevant portions with stakeholders, and adjust the ConOps, as necessary, to get buy-in.

All stakeholders do not have to agree on every aspect of the project, but all must feel that they are achieving their major goals for the project. Capture a clear definition of the stakeholders' needs and constraints that will support system requirements development in the next systems engineering step. Stakeholder group meetings, interviews, workshops, and surveys are some of the techniques that are used to perform this activity. The ConOps is a great tool for defining user needs since it directs the stakeholders to think about the way the system will behave when users interact with it.

The initial user needs and performance measures that are identified in the ConOps provide a foundation for the System Validation Plan. This was shown in the dotted line of the V-diagram from ConOps to System Validation. While expectations for the system will change over time, the performance measures outlined in the ConOps force early consideration and agreement of how system performance and project success will be measured. Examples of performance measures include travel time, incident duration, and level of service. In addition to the ConOps template, all the systems engineering documents that need to be prepared have FDOT systems engineering templates online.

The ConOps will need to capture the user needs and how the system addresses those needs. The architecture treatment will include a description of the service packages appropriate to the project. In this project, we can make assurances that there are no new Service Packages, elements, or interfaces to add and that the RITSA does not need to be amended.

We can show that ATMS03 and ATMS06 service packages suffice without additions. Use the ConOps Template online at the FDOT Templates website. Complete the template subsections. If the project builds off an existing system, the original ConOps should be referenced and used.

Knowledge Check #4

When may a new Concept of Operations not be required for a new ITS project?

a. **New ITS project is a low-risk project and the District TSM&O Program Engineer accepts the Risk Assessment form as sufficient**

b. New ITS project is a High-Risk federally funded project

c. Development of new Concept of Operations will incur additional costs to the new ITS project

d. A ConOps is always required

A is the correct answer.

Knowledge Check #5

Which of the following statements is true about the Concept of Operations (ConOps)? Choose all that apply.

a. **Documents user needs**

b. **Includes validation measures to determine if the user needs are met**

c. Documents detailed technology choices that will be used in the ITS project

d. **Is scaled appropriately with project scope**

e. **Includes high-level functionality**

A, B, D and **E** are correct. C is incorrect. Details of technology choices are not called out in a ConOps.

Conclusion

You have completed module 1 of part 2 of the Florida Department of Transportation's Introduction to Systems Engineering 100 course for Intelligent Transportation Systems, or ITS. Please continue to module 2 of part 2.

Thank you for your time and attention.