Appendix B

A Process Review of the Best Practices Using Systems Engineering to Develop ITS Architectures

Technical Paper

Architecture and Systems Engineering

Prepared for:

PBS&J

Prepared by:

ConSysTec Corp.
POB 517, 17 Miller Ave.
Shenorock, NY 10587-0517
914-248-8466

ConSysTec Corp

September 15, 2002

Document Control Panel	
File Name:	W:\ITS Program\ITS GC\TWO11-SEMP\021010 Final SE Process Rvw (ConSysTec).doc
Created By:	ConSysTec Corporation
Date Created:	September 15, 2002
Version Number:	2
Reviewed By:	Traci Matthews
Modified By:	Pamela Hoke
Date Modified:	October 10, 2002

Table of Contents

List of Tables

List of Figures

List of Acronyms

EIA/IS .... Electronic Industries Association Interim Standard
FDOT .... Florida Department of Transportation
FHP .... Florida Highway Patrol
FHWA .... Federal Highway Administration
FTA .... Federal Transit Administration
IEEE .... Institute of Electrical and Electronics Engineers
INCOSE .... International Council on Systems Engineering
ITS .... Intelligent Transportation Systems
NHI .... 0National Highway Institute
NITSA .... *National ITS Architecture*
SECM .... Systems Engineering Capability Model
SITSA .... *Statewide ITS Architecture*
TMC .... Traffic Management Center
TV .... Television

1. Scope of Document

This paper examines the relationship between the regional and statewide intelligent transportation system (ITS) architectures developed in the State of Florida and the systems engineering process. The paper answers the following questions:

- How have other state or federal ITS transportation efforts addressed the relationship between regional or statewide ITS architectures and systems engineering?
- How was the systems engineering process applied in the creation of the regional and statewide ITS architectures?
- How can regional and statewide ITS architectures be used to support the systems engineering analysis that will be required for the development of ITS projects?

Before addressing these three (3) questions, the paper provides a discussion of the version of the systems engineering process that will be used as the point of reference for subsequent discussions.

2. Systems Engineering Process

Systems engineering is defined by the International Council on Systems Engineering (INCOSE) as "an interdisciplinary approach and a means to enable the realization of successful systems". It is applicable across a wide range of disciplines, including ITS.

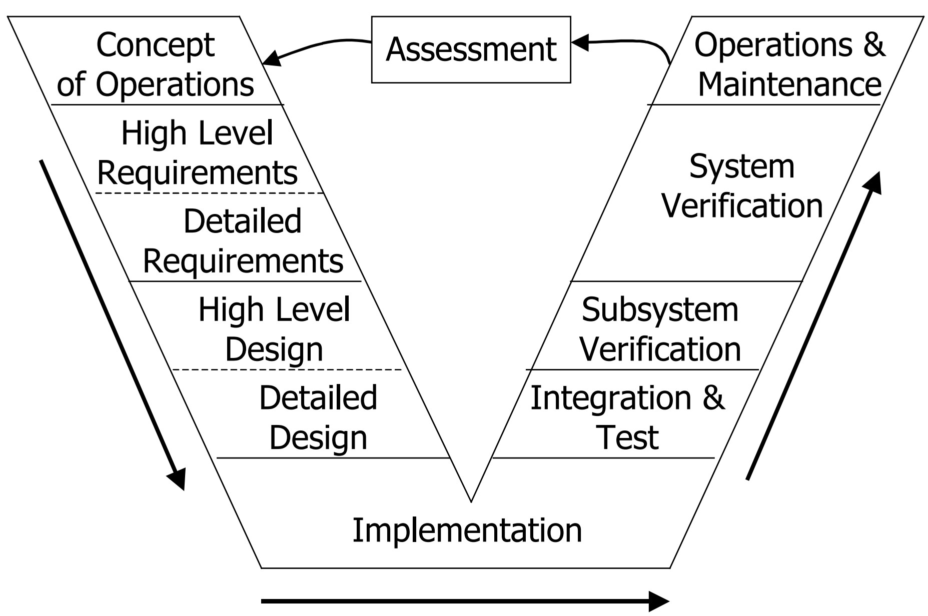
Closer to home, as a part of the Federal Highway Administration's (FHWA) Rule 940, *Intelligent Transportation Systems Architecture and Standards*, systems engineering is defined as: "…a structured process for arriving at a final design of a system. The final design is selected from a number of alternatives that would accomplish the same objectives and considers the total life-cycle of the project including not only the technical merits of potential solutions but also the costs and relative value of alternatives." This rule requires that ITS projects undergo a systems engineering analysis defined by the following steps:

- 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 Architectur*e (*NITSA*);
- Identification of participating agencies' roles and responsibilities;

- Requirements definitions;
- Analysis of alternative system configurations and technology options to meet requirements;
- Procurement options;
- Identification of applicable ITS standards and testing procedures; and
- Procedures and resources necessary for operations and management of the system.

There are a variety of industry standards that address systems engineering from a general viewpoint [i.e., the Electronic Industries Alliance Interim Standard (EIA/IS) 632, Processes for Engineering a System, EIA/IS 731.1, Systems Engineering Capability Model (SECM), and 731.2, SECM Appraisal Method, and the Institute of Electrical and Electronics Engineers (IEEE) Standard 1290]. The only source found that considered the systems engineering process as it relates to ITS was the discussion provided by the National Highway Institute's (NHI) Course 137024, *Introduction to Systems Engineering*. This course, developed and taught by the FHWA, contains a simple process model that can be readily understood and used in the context of ITS. This process model of the basic steps of the systems engineering process as applied to the life cycle of system development is shown in Figure 1 and is called the Vee Representation.

Figure 1 – Representation of the Systems Engineering Life Cycle



A short description of the steps in the process is given below:

- The concept of operations defines the manner in which the system will be used.

- Requirements define what the system will do. Requirements are typically developed using at least two (2) levels of detail. At the higher level, they focus on what functions the system will perform to meet the concept of operations. At the more detailed level, requirements address performance, implementation, interface, availability, and a range of other specific requirements that are needed to design the system.

- Design defines how the system will do it. Here again, two (2) levels of detail are defined. System design is the appropriate selection of system components and their interconnection so as to meet the system requirements and the preparation of specifications that describe the design.

- Implementation involves building the system.

- The Integration and Test step describes how, as each module is completed, it is tested and integrated into the overall system. As the overall subsystems are assembled, they are tested to ensure they satisfy the specifications.

- When the entire system has been developed, a verification step ensures that the overall system is consistent with the design and that it meets the requirements. Some would call this acceptance testing.

- Operations and maintenance is the ongoing process of using the system.

- Assessment is an evaluation of the system's ability to meet new conditions and the identification of a potential need for a new system. If a new system is required, the steps of the Vee are begun again.

The five (5) steps down the left side of the Vee, from the concept of operations step to the detailed design step, represent the definition and decomposition phase of the systems engineering process. This is the side of the Vee during which the system's planning and design is performed (i.e., the system is defined). The term decomposition refers to the fact that at the left side of the Vee, each step considers the system at a finer level of detail.

3. Review of Previous Efforts

The first subject addressed by this paper is how other state or federal ITS transportation efforts addressed the relationship between regional or statewide ITS architectures and systems engineering? The simplest answer to this question is that no other states have addressed the relationships between architectures and the systems engineering process. The review of over a dozen regional and statewide ITS architectures (including architectures from Arizona, California, Idaho, Michigan, North Carolina, New York, Washington, and Wisconsin) identified not one example of a systems engineering management plan, or of any documentation that connected architectures with systems engineering, either in the process of developing the architecture or in the planned usage of the architecture.

Additional documentation review has identified only two (2) sources that draw any connection between architectures and systems engineering. The first of these is the NHI Course, *Introduction to Systems Engineering*, described above. The second is the guidance document developed by the FHWA, *Regional ITS Architecture Guidance – Developing, Using, and Maintaining an ITS Architecture for your Region* (dated October 12, 2001). The latter document identifies the systems engineering analysis requirements of Rule 940 and suggests ways that a regional ITS architecture could be used to meet the systems engineering requirements. The information in these two sources serves as the basis for the suggested approaches described in the following sections.

4. Systems Engineering and Architecture Development

This section addresses the question of how the systems engineering process was applied in the creation of the regional and statewide ITS architectures? Or more simply, what is the relationship of the development of architecture to the systems engineering process?

Regional ITS architectures have been developed for many Florida regions (i.e., statewide, district, and corridor architectures have been developed). A regional ITS architecture is defined as a "regional framework for ensuring institutional agreement and technical integration for the implementation of ITS projects in a particular region." The regional ITS architectures will be used as a tool to support regional transportation planning and ITS project development. As part of this project development effort, a project-level ITS architecture may be created. This is defined as a "framework that identifies the institutional agreement and technical integration necessary to interface a major ITS project with other ITS projects and systems."

Normally, the systems engineering process is applied to the development of ITS services composed of hardware, software, and communications links. However, the systems engineering process can be applied to the development of virtually any system, including cases where the system is a regional or project ITS architecture. The following discussion uses this approach to indicate how the process that was used to create regional ITS architectures has many similarities to the systems engineering process.

In the development of regional or project ITS architectures, the concept of operations can be viewed as the description of how the architecture will be utilized. In the case of a regional ITS architecture, it will be used as a resource for transportation planning and as a source of input for the application of a systems engineering analysis for the development of projects. In the case of a project ITS architecture, it will be used to provide definition to a project and as a source of information for the performance of the systems engineering analysis required as part of the project development. This description of how the architecture will be utilized, which equates roughly to a systems engineering concept of operations, may be explicitly expressed in the systems engineering management plan or in the actual architecture documentation, where it might exist as an implementation plan.

When developing an architecture, what aspect of this development relates to the requirements portion of the systems engineering process? The user needs represent a description of the high-level requirements that must be met and a detailed list of services that must be provided by ITS projects in the region, or by the ITS project itself, can represent the detailed requirements on the architecture.

What aspect of architecture relates to the design aspect of the systems engineering process? The high-level design could be equated to the architecture inventory, which is a set of elements that represent the ITS services. The inventory also includes non-ITS elements that interface with ITS services. An example of this latter type might be an element representing the media. The detailed design could be equated to the customized market packages defined in the district and statewide regional ITS architectures. These provide detailed definitions of how the elements interact.

The implementation aspect of the systems engineering process could be equated to the detailed definition of the set of interfaces and information flows defined by the architecture. Validation of the architecture is usually obtained through stakeholder review and comparison to the requirements (i.e., the services and elements).

Finally, the architecture is maintained (i.e., regional ITS architectures are required by Rule 940 to develop a maintenance plan that defines the process for updating the architecture and organizing the way that changes to the architecture are managed).

This set of connections between the development of ITS architectures and the systems engineering process is meant to indicate areas of comparison between the two, rather than provide a precise association.

5. Using Architecture to Support the Systems Engineering Process

This section addresses the question of how regional and statewide ITS architectures can be used to support the systems engineering analysis that will be required for the development of ITS projects? In order to answer this, this section will consider the definition and decomposition phase of the systems engineering process (i.e., the left side of the Vee in Figure 1) as applied to the development of ITS projects. Specifically, it will discuss:

- The relationship between the process steps that are part of the definition and decomposition phase and the requirements of Rule 940 for systems engineering analysis in the development of ITS projects; and

- How regional or statewide ITS architectures can be used to support the definition and decomposition phase of the systems engineering process as it is related to the development of ITS projects.

Each ITS project that uses federal funds is required by FHWA Rule 940 and the companion Federal Transit Administration (FTA) policy to meet certain systems engineering analysis requirements. These requirements are closely related to the systems engineering process steps that are described in the definition and decomposition phase of the Vee diagram (see Figure 1). Table 1 provides a mapping from the systems engineering process steps to the systems engineering analysis requirements of Rule 940.

Table 1 – Mapping of Systems Engineering Process to Rule 940 Requirements

System Engineering Process Step(s)	Corresponding Rule 940 Requirements
Concept of Operations	• Identification of participating agencies' roles and responsibilities • Procedures (and resources) necessary for operations and management of the system
Requirements: High-Level and Detailed	• Requirements definition
Design: High-Level and Detailed	• Identification of portions of the regional ITS architecture being implemented • Analysis of alternative system configurations and technology options to meet requirements • Procurement options • Identification of applicable ITS standards and testing procedures

Is there additional definition of the Rule 940 requirements? The answer is no. The information provided in the second column of Table 1 is the full text of the requirements and there is no supporting guidance or other documentation to give further definition of the form or level of detail that will be expected in meeting the Rule 940 requirements.

The following discussion identifies how regional or statewide ITS architectures can support the application of the above systems engineering process steps in the development of ITS projects. Specific instances of where the regional ITS architectures can address aspects of the process steps that represent requirements called out in Rule 940 are also identified.

The connections made between the systems engineering process steps and the regional or statewide ITS architecture outputs draw on the two (2) sources mentioned in Section 3, Review of Previous Efforts, specifically NHI Course 137024, *Introduction to Systems Engineering*, and FHWA's *Regional ITS Architecture Guidance Document*, dated October 12, 2001. The suggestions here are in line with these documents, but carry the connections to a greater level of detail. They constitute a suggested approach, rather than best practices, since no previous statewide or regional documentation could be found on this subject. Where applicable, alternate approaches for using regional ITS architectures in support of ITS project developments have been highlighted. The approach best suited for any given project will depend on the scope of the ITS project and the details of the regional or statewide architectures available to support the development.

6. Developing a Concept of Operations

As described by the systems engineering process, the initial step in the development of a project is the creation of a concept of operations. When compared to the requirements of Rule 940, this aspect of the process relates to the following systems engineering requirements of the Rule:

- Identification of participating agencies' roles and responsibilities; and
- Identification of procedures and resources necessary for the operations and management of the system.

The first aspect of the concept of operations is the identification of the stakeholders involved in the project and the roles and responsibilities of the stakeholders. To use regional or statewide ITS architectures as an input to this part of the process, first identify the architecture or possible architectures that would apply to the project. To do this, you need some idea of the geographic or service scope of the project. Once the proper architecture(s) is selected, the operational concept contained within the architectures can serve as a useful starting point for the project level definition of roles and responsibilities. The best way to use the regional ITS architecture outputs depends on the level of detail in the operational concept.

If the regional or statewide ITS architecture contains a high-level description of stakeholder roles and responsibilities, then edit the description based upon the scope of the project (i.e., what aspects of the regional or statewide role or responsibility are relevant to the project). If the regional or statewide ITS architecture has defined its operational concept in greater detail (i.e., role and responsibility by service, or using customized market packages to define the service role and responsibility), then pick the appropriate portions of the detailed descriptions to create an initial draft of the roles and responsibilities of the stakeholders in the context of the project.

A step beyond roles and responsibilities is the definition of the procedures necessary for the operations and management of the system. This aspect of the concept of operations addresses a portion of the systems engineering requirements of Rule 940. A definition of the procedures needed for the stakeholders to use the system(s) that the project is creating and upgrading might include:

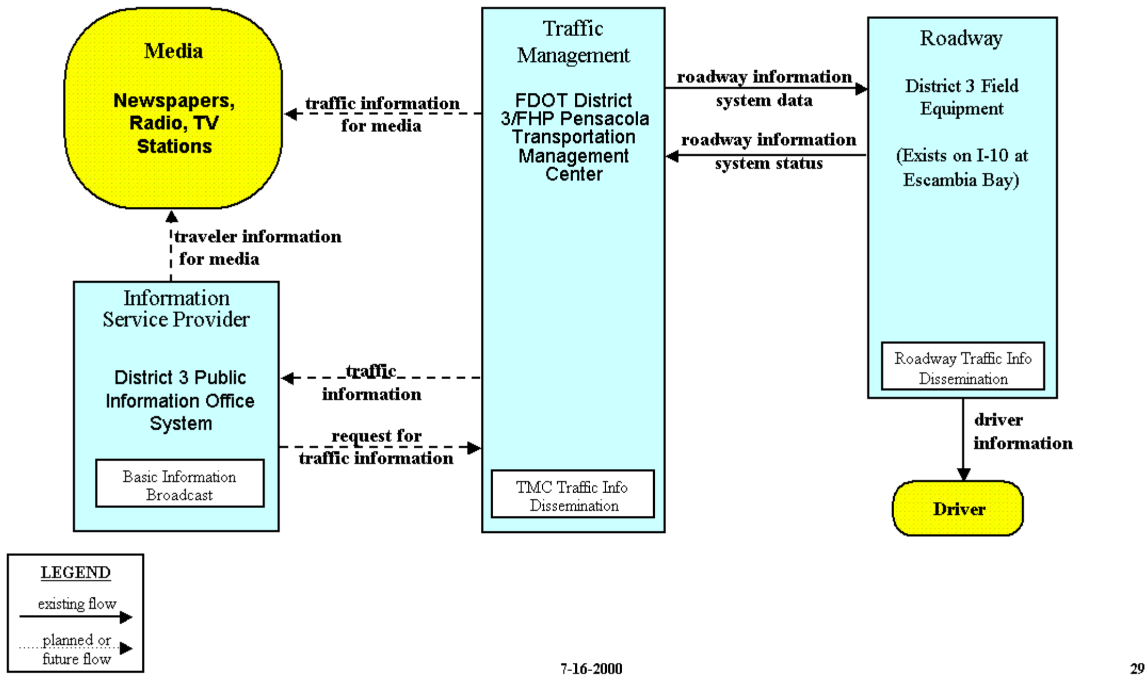
- Activities to be performed;
- Organizational relationships and responsibilities;
- Information flows;
- Message priorities;
- Archiving needs; and
- Administration, including security.

Here again, the regional or statewide ITS architecture can provide information to support development of these procedures. The customized market packages contain information that can be further customized to create a definition of the procedures associated with the project. Identify the market packages that describe the intended transportation service(s) of the project. These have an indication of the activities to be performed (i.e., the equipment packages that show up on the diagrams), the information flows, and the organizations/elements involved. The suggestion would be to further customize these diagrams to reflect the scope of the project as well as the current versus planned procedures, create a textual description of the procedures to go along with the diagrams, and obtain input from the affected stakeholders regarding the completeness and accuracy of the procedures.

Consider the following example from the FDOT District 3 regional ITS architecture. Suppose the project in question has as one of its aspects the dissemination of traffic information from the FDOT District 3 Tallahassee Transportation Management Center. The market package from the web-based version of the architecture is shown in Figure 2. This identifies the elements and interfaces for this service. As shown in the market package, there are two (2) paths for traffic information to be sent to the media – directly from the traffic management center (TMC) or through the District 3 Public Information Office. Will the project implement both interfaces or only one? Will there be procedures put into place regarding the dissemination of information to the media? Editing the diagram and describing the procedures needed provides a good concept of operations for this aspect of the project.

Figure 2 – Example of Regional ITS Architecture Market Package

ATMS06 – Traffic Information Dissemination
FDOT District 3



7. Requirements

The next step in the systems engineering process is the development of requirements. These requirements focus on "what" the system must do, not "how" the system does it, and include:

- Functions;
- Expected outcomes;
- Definition of expected interfaces; and
- Performance objectives.

The requirements defined should be based on the concept of operations developed previously.

When considered against the requirements of Rule 940, this step of the process relates to the requirements definition aspect of the systems engineering analysis.

There are many types of requirements that should be developed for the project, including:

- Functional requirements;
- Interface requirements;
- Data requirements (i.e., what type of information should be stored);
- System life cycle cost requirements;
- Performance requirements; and
- Testing requirements.

As indicated in the Vee diagram, the requirements definition entails both high-level and detailed requirements.

As part of the regional ITS architecture requirements in Rule 940, regional or statewide ITS architectures contain a set of functional requirements that can serve as a starting point for the definition of project requirements. These functional requirements identify the existing and planned functions of the key elements in the architecture. The current versions of Florida's district regional ITS architectures and Florida's statewide ITS architectures were created prior to the publishing of Rule 940 and an explicit description of functional requirements was not done for these architectures. However, the architectures do contain pertinent functional information that can be accessed in several ways.

Consider the following example from the FDOT District 3 regional ITS architecture. Suppose the project in question is to add incident management capability to the planned FDOT District 3 Tallahassee Transportation Management Center. The element in question is defined in the web-based architecture by the web page that is partially shown in Figure 3.

Selecting the Functionality Details link shown in Figure 3 will lead to a definition of the equipment packages that may be applicable to the element. A portion of the web page is shown in Figure 4. Note that these equipment package names and descriptions represent an initial set of functional requirements for the TMC element. The suggested approach is to copy the list of equipment packages and edit them as needed to create the functional requirements for the project element.

Figure 3 – Example of Florida's District ITS Architecture Element Web Page

Figure 4 – Example of Equipment Package Web Page

FDOT District 3 Tallahassee Transportation Management Center Equipment Packages

Home
Statewide
District 1
District 2
District 3:
by Stakeholder
by Entity
District 4&6
District 5
District 7
Turnpike

Send Your Comments

The following National ITS Architecture equipment packages are associated with the "FDOT District 3 Tallahassee Transportation Management Center" element. Select the "Details" icon to see the detailed process specifications that support each equipment package, or consult the National ITS Architecture web site for more information.

Collect Traffic Surveillance Details
This Equipment package collects, stores, and provides electronic access to the traffic surveillance data.

TMC Freeway Management Details
Control system for efficient freeway management including integration of surveillance information with freeway road geometry, vehicle control such as ramp metering, CMS, HAR. Interface to coordinated traffic subsystems for information dissemination to the public.

TMC HOV Lane Management Details
This Equipment package provides the capability to manage HOV lanes by coordinating freeway ramp meters and connector signals with HOV lane usage signals, and giving preferential treatments to HOV lanes to encourage drivers to carpool.

TMC Incident Detection Details
This Equipment package provides the capability to traffic managers to detect and verify incident. This capability includes analyzing and reducing the collected data from traffic surveillance equipment, including planned incidents and hazardous conditions.

TMC Incident Dispatch Coordination/Communication Details
This Equipment package provides the capability for an incident response formulation function minimizing the incident potential, incident impacts, and/or resources required for incident management including proposing and facilitating the dispatch of emergency response and service vehicles as well as coordinating response with all appropriate cooperating agencies.

8. Design

The final steps in the definition and decomposition portion of the systems engineering process are the high-level design and the detailed design. And what is design? As defined in the NHI's *Introduction to Systems Engineering* course referenced earlier, design is the:

- Appropriate selection of system components and their interconnection so as to meet the system requirements; and
- Preparation of specifications that describe the design.

When considered against the requirements of Rule 940, this step of the process relates to the following aspects of the systems engineering analysis:

- Identification of portions of the regional ITS architecture being implemented;
- Analysis of alternative system configurations and technology options to meet the requirements;
- Procurement options; and
- Identification of applicable ITS standards and testing procedures.

Using the basic process defined in the referenced course, the following information contains the basic aspects of the design step(s) and how regional or statewide ITS architectures can support the step(s).

The first step in developing the design is to identify the systems and interconnections needed to meet the project requirements. Another way of stating this is to identify the portions of the regional or statewide ITS architecture that the project will implement. The Florida district regional ITS architectures and the *Statewide ITS Architecture* (*SITSA*) have all been developed using a software product called Turbo Architecture. This software tool creates a database representation of regional or project ITS architectures. (Note: Several of the other regional ITS architectures developed within the state have also made use of this tool to define the elements and information flows in a region.)

The best way for a project development effort to identify the systems and interconnections needed is to open the relevant regional or statewide ITS architecture in Turbo Architecture and create a project architecture by identifying the elements, market packages, and information flows that define the scope of the project from the regional ITS architecture. The regional or statewide ITS architecture can serve as an excellent start to the description of the project architecture, but additions, subtractions, or changes will probably be needed to create an architecture that completely meets the defined requirements. Once these changes are entered into the Turbo

Architecture file, then outputs describing the project can be created for distribution to affected stakeholders. In addition, the changes from the regional or statewide ITS architecture should be fed back into the maintenance process so that the project will be accurately reflected as it is developed. Completion of this step clearly satisfies the Rule 940 requirement for identification of portions of the regional ITS architecture being implemented.

The next step in the design process is to analyze alternative configurations and technology options to meet the requirements. Alternate configurations may mean alternate architectures (i.e., identifying options for the connections of the project's elements). The recommendation is that the group performing the initial design (whether a private contractor or a public agency) identify several alternative architectures, identify the strengths and weaknesses of the alternatives, and select the best alternative based upon selection criteria that has been created by or discussed with the project management team. What are some alternative architecture choices that might be investigated? If the project involves integration of interagency systems, will the connections be made as a series of point-to-point connections or through some central communications hub? The pieces of these alternative architectures may in fact already exist within the regional ITS architecture, which often reflects more than one way to architect an ITS service, so selection of the alternatives becomes nothing more than creating several alternate project architectures using the Turbo Architecture tool.

Technology choices can play a large role in ITS project design. It is recommended that technology options for key elements in the project be considered, with selection of technologies based upon selection criteria that has been created by or discussed with the project management team. This selection is done within the context of the project's requirements (i.e., which choice meets the requirements based on the selection criteria). Another set of alternatives that could be examined at this step is procurement options. This may arise as part of an examination of whether off-the-shelf products will meet the requirements of the project.

Completion of the analysis of alternate architectures, technologies, and procurement options satisfies the Rule 940 requirements for:

- Analysis of alternative system configurations and technology options to meet requirements; and
- Procurement options.

The final step in the design process is to create specifications for the project design. This might entail a project procurement specification or a series of specifications of the key systems for the project, along with an overall project specification to cover the integration of the systems. The procurement or overall project specification can draw heavily from the requirements definition and the contribution to these requirements made by the regional or statewide ITS architecture. Specifications of individual systems, or even the overall project specification, may go into more detail than the requirements definition.

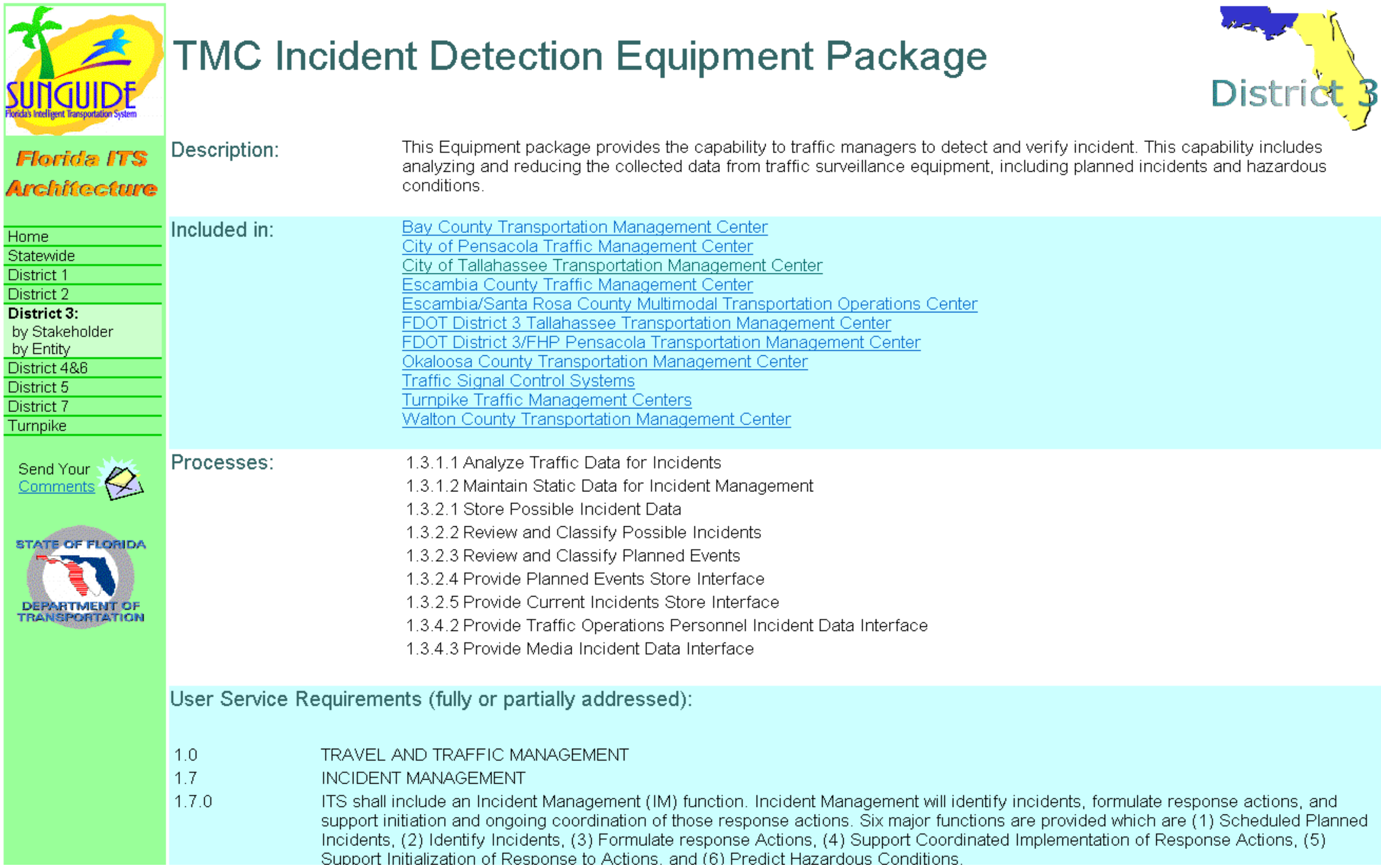
Florida's district ITS architectures and the statewide ITS architecture have an additional level of detailed functional specification that can be accessed from the database or from the web-based version of the architectures. The following is an example of how to access the additional detail on the web-based version of the architecture.

Consider the following example from FDOT's District 3 regional ITS architecture. Suppose the project in question is to add incident management capabilities to the planned FDOT District 3 Tallahassee Transportation Management Center. As indicated under the section on requirements, selecting the Functionality Details link on the FDOT District 3 Tallahassee Transportation Management Center page will lead to a list of equipment packages that provide high-level definitions of the possible functions of the TMC. This was shown previously in Figure 4, as representing a level of detail appropriate for functional requirements. There is, however, an additional level of requirements detail contained in the web-based architecture view. Selecting the Details link on the TMC Incident Detection Equipment Package leads to the equipment package details page shown in Figure 5. In addition to the equipment package definition, the details page contains a listing of the set of process specifications (P-Specs) from the *NITSA* that may be applicable. These P-Specs represent the definition of ITS functions in the *NITSA*. As shown in Figure 3, the page gives a list of P-Spec titles. For the complete description of the functions, refer to the *NITSA* CD-ROM (currently Version 4.0) under Logical Architecture, or to the Logical Architecture Database, which is also contained on the CD-ROM. The details page also includes a list of user service requirements that may be applicable. These user service requirements are the functional requirements that were used to define the *NITSA* and can be found as well on the *NITSA* CD-ROM. Here the complete functional requirements are reproduced so there is no need to go to the *NITSA* material to get the full information.

One final connection that can be made between the regional or statewide ITS architecture and the design step is in the identification of applicable ITS standards for the project. The regional ITS architecture contains a mapping of information flows to ITS standards. When the ITS project architecture is created as described above using the Turbo Architecture software, an output that is readily available from the tool is a set of applicable standards for the project. This set serves as a starting point for the specification of ITS standards as part of the project specifications (either in procurement specifications, system specifications, or possibly communications specifications). In addition to the identification of standards, the testing procedures should be considered as part of the project specification. These procedures are critical to the later validation steps of the overall systems engineering process. Documenting the set of applicable standards and testing procedures, along with the rationale for the standards selected for the project, will satisfy the Rule 940 requirement for:

- Identification of applicable ITS standards and testing procedures.

Figure 5 – Example of the Detailed Requirements Information Selectable from each Equipment Package Web Page



TMC Incident Detection Equipment Package

District 3

SUNGUIDE
Florida's Intelligent Transportation System

Florida ITS Architecture

- Home
- Statewide
- District 1
- District 2
- **District 3:**
  - by Stakeholder
  - by Entity
- District 4&6
- District 5
- District 7
- Turnpike

Send Your Comments

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

Description: This Equipment package provides the capability to traffic managers to detect and verify incident. This capability includes analyzing and reducing the collected data from traffic surveillance equipment, including planned incidents and hazardous conditions.

Included in:
- Bay County Transportation Management Center
- City of Pensacola Traffic Management Center
- City of Tallahassee Transportation Management Center
- Escambia County Traffic Management Center
- Escambia/Santa Rosa County Multimodal Transportation Operations Center
- FDOT District 3 Tallahassee Transportation Management Center
- FDOT District 3/FHP Pensacola Transportation Management Center
- Okaloosa County Transportation Management Center
- Traffic Signal Control Systems
- Turnpike Traffic Management Centers
- Walton County Transportation Management Center

Processes:
- 1.3.1.1 Analyze Traffic Data for Incidents
- 1.3.1.2 Maintain Static Data for Incident Management
- 1.3.2.1 Store Possible Incident Data
- 1.3.2.2 Review and Classify Possible Incidents
- 1.3.2.3 Review and Classify Planned Events
- 1.3.2.4 Provide Planned Events Store Interface
- 1.3.2.5 Provide Current Incidents Store Interface
- 1.3.4.2 Provide Traffic Operations Personnel Incident Data Interface
- 1.3.4.3 Provide Media Incident Data Interface

User Service Requirements (fully or partially addressed):

1.0	TRAVEL AND TRAFFIC MANAGEMENT
1.7	INCIDENT MANAGEMENT
1.7.0	ITS shall include an Incident Management (IM) function. Incident Management will identify incidents, formulate response actions, and support initiation and ongoing coordination of those response actions. Six major functions are provided which are (1) Scheduled Planned Incidents, (2) Identify Incidents, (3) Formulate response Actions, (4) Support Coordinated Implementation of Response Actions, (5) Support Initialization of Response to Actions, and (6) Predict Hazardous Conditions.

9. Summary

The following outlines the three (3) aspects of architectures and systems engineering reviewed in this paper.

- The previous efforts relating architectures and systems engineering were reviewed and no previous efforts were found with regards to statewide or regional ITS architecture documentation. The most applicable previous efforts were an FHWA course (NHI Course 137024, *Introduction to Systems Engineering)* and an FHWA guidance document on developing regional ITS architectures.

- The relationship of the development of an architecture to the systems engineering process was reviewed.

  Regional and statewide ITS architectures have been developed in Florida. The process used to develop these, and the outputs created, indicate that many of the steps of the systems engineering process were in fact followed in the architecture development.

- How can regional and statewide ITS architectures be used to support the systems engineering analysis that will be required for the development of ITS projects?

  This paper discussed the systems engineering analysis requirements of FHWA Rule 940 and mapped these requirements to steps in the systems engineering process. Then the paper reviewed how the outputs of the regional and statewide ITS architectures could be used to support the application of some of the systems engineering process steps in the development of ITS projects. Specifically, the regional ITS architecture outputs can assist in the development of a concept of operations for a project, in the requirements definition for a project, and in the high-level and detailed design aspects of a project. Therefore, the Florida's regional architecture and the *Statewide ITS Architecture* (*SITSA*) are an important resource for supporting the definition and decomposition phase of the systems engineering process as applied to ITS projects and for meeting the Rule 940 requirements relating to systems engineering analysis.