MARICOPA ASSOCIATION of GOVERNMENTS

# MAG Regional ITS Architecture

## How to Use the MAG ITS Architecture and Website

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June, 2013

# 1. HOW TO USE THE MAG ITS ARCHITECTURE AND WEBSITE

An important goal of the MAG RIA was to make the regional ITS architecture a valuable resource to member agencies to support agency ITS project planning and development, ITS integration, and required systems engineering processes. An agency that intends to develop an ITS project in their jurisdiction or in partnership with other agencies and will be applying for MAG TIP funding will be required to use the MAG RIA. First, to identify where in the MAG RIA the project is represented – this shows the pre-planning done in support of that project development. Second, agencies may be required to complete a systems engineering analysis – for documentation of the project development process that is using federal funds. This section will describe how to use the MAG RIA in support of ITS project implementation from project development through the systems engineering analysis.

## 1.1 Project Identification/TIP Application

In order to use the RIA to support project development, the portion of the RIA that will be included in the project must be identified. This is a key step in architecture use because this is when the ITS project will be viewed in the broader context of the RIA. This is when the services, functionality, and integration opportunities envisioned in the region are reviewed and considered as the basic scope of the project is defined. This step is also required to meet the FHWA Rule/FTA Policy.

If integration opportunities are to be considered, the RIA should be used as early in the project development lifecycle as possible. The architecture should be reviewed before firm project cost estimates are established, while there is still opportunity to adjust the scope to accommodate the functionality and interfaces identified in the RIA. This opportunity may occur before or after programming/budgeting, depending on how specifically the ITS project is defined in the TIP/STIP or other programming/budget document.

In order to define the full benefits that the MAG RIA provides to project development and application for funding, **Table 1** has been developed to highlight the location of information in this document and on the website for agencies to use to develop various types of ITS projects. When agencies are reviewing the architecture document and website for their project applicability, selecting the appropriate inventory item will identify the service packages and equipment packages that would apply to that project.

Agency requirements for projects to be mapped to the architecture for compliance with the MAG TIP application process includes:

- Associated Service Packages – listing of the service packages from the MAG ITS Architecture that are supported by this project.
- User Services – listing of the user services from the MAG ITS Architecture that are supported by this project.
- Subsystems – listing of the subsystems from the MAG ITS Architecture that are supported by this project.

These three components define the system/s that will be created or impacted by the project, the functionality that will be implemented, and the interfaces that will be added or updated. The current ITS projects in the MAG TIP have been included on the website, as shown in the links list from the website to the right, which also link to applicable agency-specific service packages.

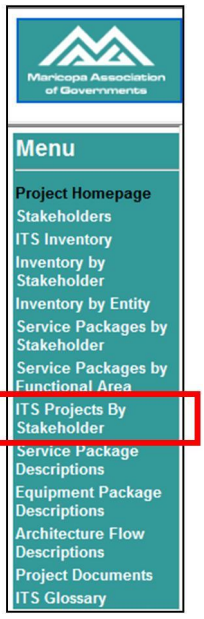


**Table 1 – Example Project Type Mapping to MAG Regional ITS Architecture Components**

| Project Type | ITS Inventory ("ITS Inventory" Link from Website or Table 11) | Example Subsystems ("Mapping" Category) | Example Associated Service Packages* | Example Equipment Packages* | Example Functional Requirements* (Select the appropriate equipment package/s) | Example User Services* (Table 10 – choose based on descriptions provided) |
|---|---|---|---|---|---|---|
| Installation of new CCTV cameras / expansion of existing camera system and integrating the cameras to be operational from a control center. | CCTV, TMC | Roadway Subsystem, Traffic Management | ATMS01 - Network Surveillance | Roadway Basic Surveillance | 1 - The field element shall collect, process, and send traffic images to the center for further analysis and distribution. | 1.6 Traffic Control<br>1.7 Incident Management |
| Installation of new DMS and integrating DMS to be operational from a control center. | DMS, TMC | Roadway Subsystem, Traffic Management | ATMS06 - Traffic Information Dissemination | Roadway Traffic Information Dissemination | 1 - The field element shall include dynamic messages signs for dissemination of traffic and other information to drivers, under center control; the DMS may be either those that display variable text messages, or those that have fixed format display(s) (e.g. vehicle restrictions, or lane open/close). | 1.2 En-Route Driver Information |
| Synchronization of traffic signals along key corridor and integrating system to be operational from a control center. | Traffic Signals, TMC | Roadway Subsystem, Traffic Management | ATMS03 - Surface Street Control | Roadway Signal Controls | 1 - The field element shall control traffic signals at intersections and on main highways for urban and rural areas, under center control. | 1.6 Traffic Control |
| Deployment of traffic detection for use at mid-block locations and intersections. | Vehicle Detectors, TMC | Roadway Subsystem, Traffic Management | ATMS01 - Network Surveillance | Roadway Basic Surveillance | 1 - The field element shall collect, process, digitize, and send traffic sensor data (speed, volume, and occupancy) to the center for further analysis and storage, under center control. | 1.6 Traffic Control |
| TMC to TMC communications installation to facilitate interagency coordination | TMC | Traffic Management | ATMS07 - Regional Traffic Management | TMC Regional Traffic Management | 1 - The center shall exchange traffic information with other traffic management centers including incident information, congestion data, traffic data, signal timing plans, and real-time signal control information. | 1.6 Traffic Control<br>1.7 Incident Management |
| Implement a project to archive data and send applicable information to a regional server for dissemination via 511 or another traveler information service. | Local City and Municipal Archived Data | Archived Data Management Subsystem | AD1 - ITS Data Mart<br>AD2 - ITS Data Warehouse | ITS Data Repository | 2 - The center shall collect data catalogs from one or more data sources. A catalog describes the data contained in the collection of archived data and may include descriptions of the schema or structure of the data, a description of the contents of the data. | 7.1 Archived Data |

** Projects will likely map back to more than one service package, equipment package, and requirement.*

The MAG Transportation Improvement Program (TIP) is a five year schedule of specific projects to be constructed across the MAG Region. The "*Guide to Transportation Programming*" for MAG (developed in October 2007 for fiscal year 2008) provides MAG member agencies background information, instructions, and deadlines on the different transportation programs and requirements for the MAG TIP for each fiscal year. The MAG TIP process is outlined in **Table 2**. The important dates for agencies to be aware of are bolded in the table: initial project recommendations from agencies are due in August and the final MAG TIP is not typically approved until the next year. The TIP application process could vary and agencies should periodically check with MAG to determine the application deadlines for the next TIP update cycle.

**Table 2 – MAG TIP Process**

| **Transportation Improvement Program - Fiscal Year** | |
|---|---|
| **Year 1** | |
| **August** | • **Member agencies develop project requests for MAG Federal funds**<br>• **Stakeholders meeting/workshop on applying for MAG Federal funds** |
| **September** | • **1st Week - Member agencies submit project requests for MAG Federal funds**<br>• 3rd Week - Transportation Review Committee (TRC) review/recommend/approve draft list of MAG Federal Fund project requests |
| October | • Modal Transportation Advisory Committees (TACs) first review of requests for MAG Federal funds |
| November | • Modal TACs second review and rank modal projects |
| November/December | • TIP Data Entry System available to member agencies for project updates |
| December | • First Week - TRC review/recommend/approve second draft of MAG federally funded program |
| **Year 2** | |
| January | • 1st Week - Member agencies submit privately and locally funded projects for inclusion in TIP for an Air Quality Conformity Analysis (AQCA)<br>• Managers, TPC, and RC review/recommend/approve second draft of MAG federally funded program<br>• Draft MAG TIP (Listing of Projects) produced |
| February | • TRC recommends Draft TIP Project Listings for AQCA |
| February/March | • Draft TIP Project Listings for TAC and public review |
| April | • Managers, TPC and RC review/recommend/approve Draft TIP for an AQCA |
| April/May | • TIP undergoes AQCA |
| June | • AQTAC recommends approval of the AQCA<br>• TRC review/recommend/approve TIP |
| **July** | • **Managers, TPC and RC review/recommend/approve TIP** |
| August | • Governor's designee approves TIP |
| August/September | • First Four Years of the TIP included in the Arizona STIP |

For ITS projects, MAG allocates a specific amount per year, and agencies in the region apply for funding for specific ITS projects. Applications are reviewed and consolidated by MAG, and then presented to the MAG ITS Committee for review and discussion. In many cases, funding requests exceed available funding, and it is up to the MAG ITS Committee to agree on an appropriate strategy, which could include reducing federal funding for some or all projects to be able to fund the majority of projects, or even eliminating some projects from consideration.

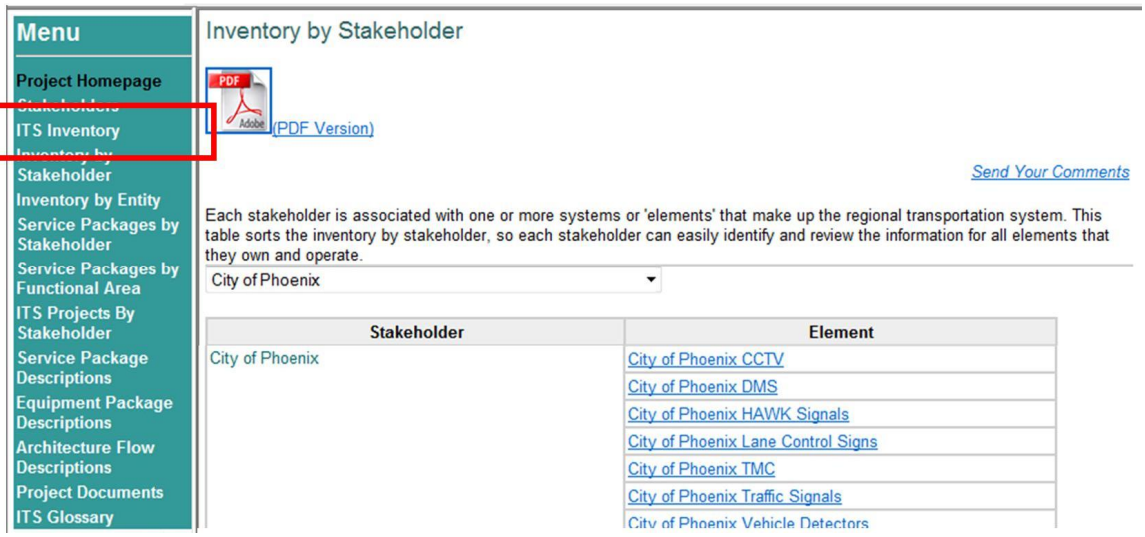
There have been opportunities for close-out funding through MAG, whereby there is a small surplus of funds available after all projects have been funded. This is not the case for every year, and should not be viewed as a consistent funding source. Often, with such short turn-around for the close-out process, projects that are funded are typically smaller in nature, do not require any design, or have designs complete and just need funding for implementation.

## 1.2 Project Development

Once funding has been identified for the ITS project and the development is underway, the MAG RIA is beneficial for providing a context in which the project will fit within the regional ITS implementations (either existing or planned). Agencies can use the RIA website to determine the functionality for the project, and also detailed communications and operating requirements of the project based on the functionality desired. Potential inventory items will also be identified (centers, roadside, other stakeholders, etc.). This section will describe how to navigate the project architecture website from the agency perspective as well as how to integrate architecture components into the agency project.

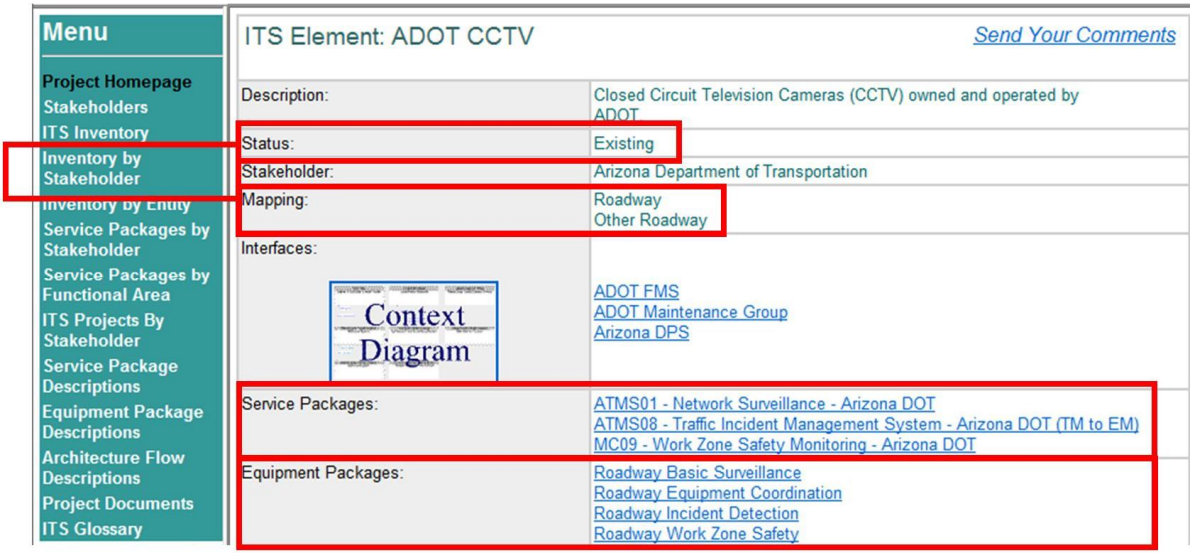
The ITS architecture and website were developed to be able to provide stakeholders with a tool that makes navigating the architecture a more streamlined process and points the stakeholder in the right direction quickly. This section is developed to guide the agencies in how to use the website through various screen captures of the actual website. Under each link there are PDF boxes that can be clicked to bring up a PDF of the full list of inventory, customized service packages by stakeholder or by functional area, and other options. This PDF tool is helpful in the review of service packages that need to be updated as part of a future architecture.

ITS inventory provides the foundation of information for which the entire architecture was built and information flows were created. Agencies can find their specific inventory items by using the "Inventory by Stakeholder" link if inventory has been defined specifically for their agency, or by using the "ITS Inventory" link and finding the agency-specific inventory item. If there is not an inventory item created specifically for your agency (for example, City of Phoenix DMS), the agency should find the "Local Cities and Municipalities" list which provides generic service packages and information flows for inventory that has not been specified. Below is a screen capture of the "Inventory by Stakeholder" link showing the list City of Phoenix inventory items.




When an inventory item is selected, as shown in the example below of ADOT CCTV, four very important types of information are displayed. The status of the inventory item, the subsystem that the inventory item maps to in the architecture (the way it is represented in

service packages), what service packages that inventory item is depicted in, and finally the equipment packages that are applicable to that inventory item. All of this information is applicable to the MAG TIP application process and to find functional requirements for a project to help with the design of the project.




Functional requirements can be found by selecting the equipment package that best represents the purpose of the project that the agency is developing. By selecting the equipment package, a list of functional requirements is displayed at the bottom of the screen which can be helpful for functional design considerations on the project.

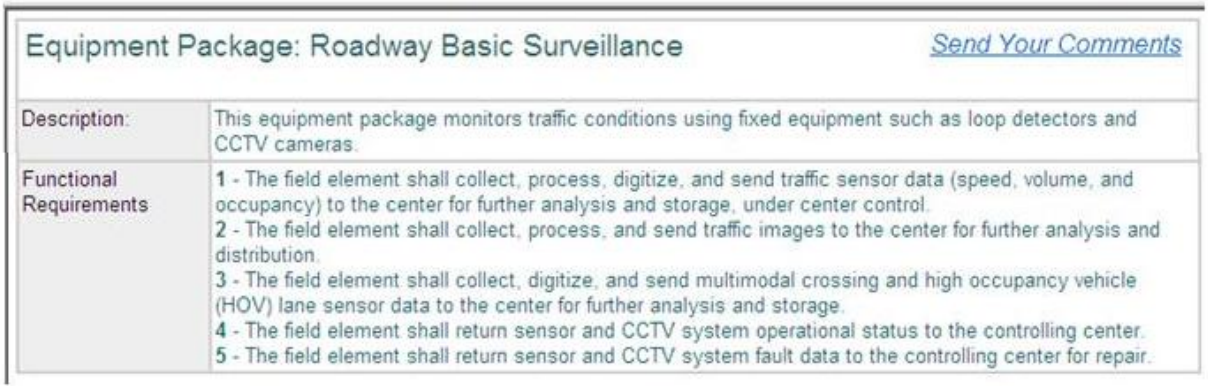
For example, in order to find the appropriate functional requirements for ADOT cameras to provide video images to the ADOT TOC, ADOT would follow the process of:

- Selecting "ADOT CCTV" in their Inventory list;
- Select "Roadway Basic Surveillance" in the Equipment Package list for providing video images to a center; and
- At the bottom of the screen is the list of functional requirements for that inventory element to be able to provide that function or service to ADOT. ADOT can then tailor these requirements to suit the needs of the project, but the RIA provides a starting point.

As another example, for the installation of arterial DMS in Avondale, Avondale would follow the process of:

- Selecting "City of Avondale DMS" in their Inventory list;
- Selecting "Roadway Traffic Information Dissemination" in the Equipment Package list for providing messages to travelers; and
- At the bottom of the screen is the list of functional requirements.

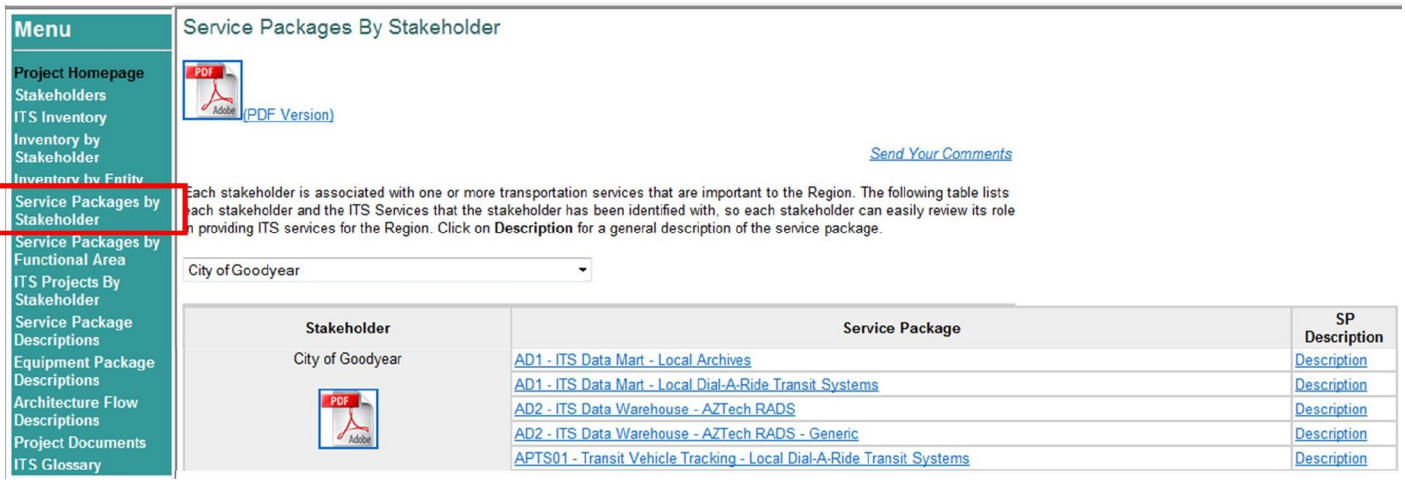
On the next page is a screen capture of the functional requirements that support the example equipment package "Roadway Basic Surveillance".



Equipment Package: Roadway Basic Surveillance — Send Your Comments

| | |
|---|---|
| Description: | This equipment package monitors traffic conditions using fixed equipment such as loop detectors and CCTV cameras. |
| Functional Requirements | 1 - The field element shall collect, process, digitize, and send traffic sensor data (speed, volume, and occupancy) to the center for further analysis and storage, under center control.<br>2 - The field element shall collect, process, and send traffic images to the center for further analysis and distribution.<br>3 - The field element shall collect, digitize, and send multimodal crossing and high occupancy vehicle (HOV) lane sensor data to the center for further analysis and storage.<br>4 - The field element shall return sensor and CCTV system operational status to the controlling center.<br>5 - The field element shall return sensor and CCTV system fault data to the controlling center for repair. |

The customized service packages are included in the final ITS architecture and are available on the architecture website. They are categorized by "Service Packages by Stakeholder" or "Service Packages by Functional Area" to assist the stakeholder in finding the applicable service package for their project. Below is a screen capture of the "Service Packages by Stakeholder" link showing the City of Goodyear in the list of stakeholders. The "Service Package by Functional Area" selection could be helpful for agencies that do not have a specific service package for the project/program they plan to implement.



Menu

- Project Homepage
- Stakeholders
- ITS Inventory
- Inventory by Stakeholder
- Inventory by Entity
- Service Packages by Stakeholder
- Service Packages by Functional Area
- ITS Projects By Stakeholder
- Service Package Descriptions
- Equipment Package Descriptions
- Architecture Flow Descriptions
- Project Documents
- ITS Glossary

Service Packages By Stakeholder

(PDF Version)

Send Your Comments

Each stakeholder is associated with one or more transportation services that are important to the Region. The following table lists each stakeholder and the ITS Services that the stakeholder has been identified with, so each stakeholder can easily review its role in providing ITS services for the Region. Click on **Description** for a general description of the service package.

City of Goodyear

| Stakeholder | Service Package | SP Description |
|---|---|---|
| City of Goodyear | AD1 - ITS Data Mart - Local Archives | Description |
| | AD1 - ITS Data Mart - Local Dial-A-Ride Transit Systems | Description |
| | AD2 - ITS Data Warehouse - AZTech RADS | Description |
| | AD2 - ITS Data Warehouse - AZTech RADS - Generic | Description |
| | APTS01 - Transit Vehicle Tracking - Local Dial-A-Ride Transit Systems | Description |

The architecture has been developed for agencies to use as a tool to support project development and provide a consensus-based vision of ITS services in the Region. There are many agencies that have unique functionality or communications This architecture can be used for agencies to not only see what other agencies are doing to expand their own services, but also can be used to bridge the gap between similar projects that adjacent or similar agencies are doing in order to support more regionally-focused ITS programs moving forward.

## 1.3 Systems Engineering

During the development of an ITS project, an agency may be required to perform a systems engineering analysis to document the planning and purpose of the project for MAG federal funding requirements. This section has been developed provide an overview of the systems engineering process and purpose as well as guide agencies with the development of their project-specific analysis.

### *1.3.1 Systems Engineering Process*

Systems Engineering is a process for project development that considers the entire lifecycle of a project and emphasizes up-front planning and system definition. Systems Engineering is a requirement for the FHWA's Final Rule 23 CFR 940. As part of federal funding compliance, MAG requires that local and regional ITS projects using federal ITS funding apply the systems engineering process and principles.

Systems Engineering is a multi-step and iterative process for developing an ITS project that supports standards use and implementation. **Figure 1** shows the "Vee" diagram, which shows how each step of the process builds on the previous one. It stresses conceptual development and how the concept guides each of the key steps toward implementing and maintaining the system. This process typically applies to complex system design/integration/development efforts. This RIA maps to the beginning of the Systems Engineering process shown in the "Vee" diagram. Projects such as fiber design or a signal synchronization (which are represented as specific project types as part of the RIA) map to the high-level design and detailed design parts of the "Vee" diagram.

The structure provides for a process that asks critical questions along the way to make sure that important steps or issues that could impact a project and the Region are not overlooked. Systems Engineering is an effective risk management tool because by taking critical measures to identify project issues, benefits, risks and impacts, as well as going through a series of validation and approval points, there is less uncertainty about project objectives or expectations.

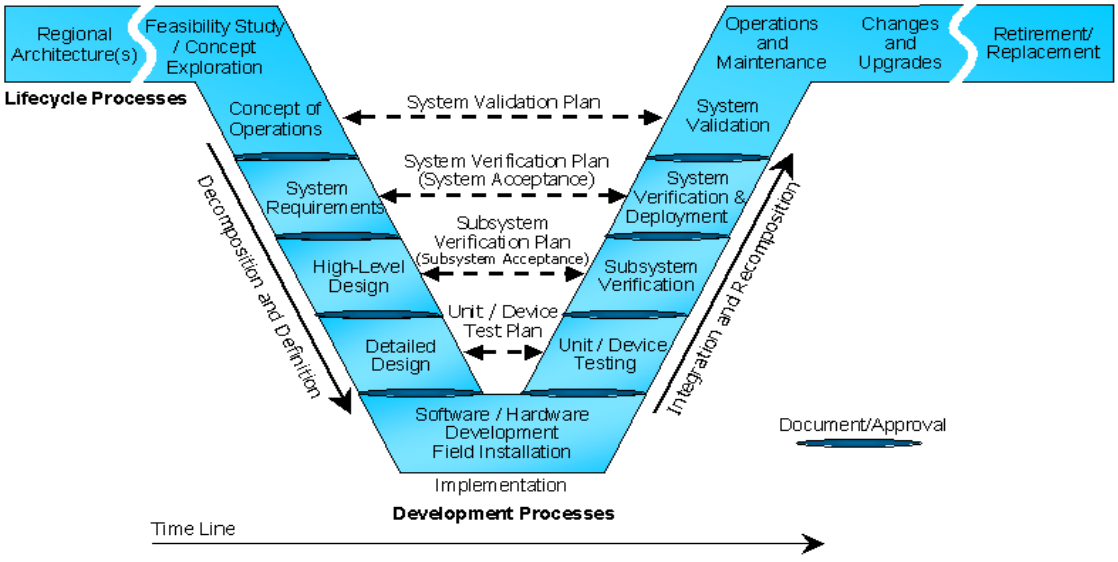



**Figure 1 – "Vee" Systems Engineering Process Diagram**

The purpose of using a systems engineering approach in developing a RIA and developing ITS projects are:

***Regional ITS Architecture –***

- Numerous project types are defined that together as a whole represent the MAG Region functionality;
- Allows stakeholders an opportunity to bring to the table the existing and planned functionality for their jurisdiction; and
- Allows stakeholders to understand the functionality of neighboring jurisdictions to ensure interoperability between the two or more jurisdictions.

***ITS Projects –***

- Improves stakeholder coordination;
- Develops more adaptable systems to the changing technologies of today's world;
- Verifies functionality of the project prior to making purchasing decisions;
- Supports the implementation of a system that meets the goals of the stakeholder and functions as planned; and
- Using a systems engineering approach reduces the risk of schedule and cost overruns.

### *1.3.2 MAG System Engineering Analysis Guidance*

MAG has developed Interim Guidance on Systems Engineering Analysis Required for ITS Projects (August 2006). This guidance document was developed to outline the steps that need to be included in a Systems Engineering Analysis for all federally funded ITS projects in the MAG Region. The steps include:

- ***Interfacing with the Regional ITS Architecture –*** identify the relevant subsystems, user needs, user services, service package and architecture flows in the RIA that are covered by the project.
- ***Feasibility Study –*** technical, financial and institutional feasibility is explored in this step.
- ***Project Planning and Concept of Operations –*** defines the operation of the system developed/enhanced by the project and roles and responsibilities of each stakeholder as part of the project.
- ***System Requirements Definition –*** user service and functional requirements need to be defined in order to verify that the system performs as expected.
- ***System Design –*** a high-level and low-level design are developed to meet the system requirements.
- ***System Implementation –*** this step reviews the processes that are required to implement a project including procurement, hardware fabrication, software coding, configuration, etc.
- ***System Test and Verification –*** development of plans for testing, verifying and validating the functions of the new ITS project.
- ***System Operation and Maintenance –*** defines requirements for operations and maintenance and for ensuring that the system performs as planned.
- ***System Update, Retirement and Replacement*** – alternative studies for system upgrade and strategy plan for updating, retiring and replacing the system.

Some ITS projects that do not use the Highway Trust Fund need to apply for MAG funding and are therefore not subject to the Rule/Policy requirements. Projects developed exclusively with local funds and projects developed by non-transportation agencies (e.g., public safety

agencies) fall into this category. For these projects, use of the architecture is voluntary and can be motivated by the potential multi-jurisdictional and regionally significant benefits of use and the need to reduce risks.

### *1.3.3 Using The MAG RIA to Support Systems Engineering Analysis For Projects*

The MAG RIA supports the initial project planning, concept development, and requirements building for ITS projects. These steps are shown in the first leg of the "Vee" diagram as the foundation components of developing a project. The initial planning steps are used to be able to develop more detailed requirements and provide a back check for functionality throughout the project cycle to make sure that the project continues to address goals and needs defined in the initial planning stages of the project. This process has been required for ITS projects in the MAG Region because it is not efficient to redevelop or reinvest in an ITS project that been implemented in a fashion that changed in scope and purpose dramatically over the course of the project which could have been mitigated through proper project planning.

If an agency is required to develop a systems engineering analysis for an ITS project, this section defines the pieces of the architecture that will be useful in the analysis process. The MAG RIA supports the systems engineering analysis steps as defined in the MAG guidance document as follows:

- ***Interfacing with the Regional ITS Architecture***
  - Identify the subsystems, user services, customized service package and information flows that apply to the project following the example projects shown in Table 20 in Section 6.1.
  - The components applicable to the project are identified on the architecture website as described in Section 6.1 and 6.2.
- ***Feasibility Study***
  - This step will not require the use of the MAG RIA.
- ***Project Planning and Concept of Operations***
  - This step is supported by the customized service packages and information flows defined in the MAG RIA. Each service packages provides a 'mini' concept of operations for how various systems and stakeholders are envisioned to interact and share information.
  - ITS project types can be found in the customized service packages based on the functionality the project will provide, the types of communications that the project will use, and which inventory items will be needed for the project to support interfaces for data sharing and control.
  - The Concept of Operations will require agencies to describe the operations of the system provided by the project and this can be supported by identifying which service package/s and what functionality will be provided by the project in the architecture.
  - The roles and responsibilities of each stakeholder as part of the project can be supported by reviewing the inventory interfaces defined in the architecture.
  - Regional systems/servers that the project will link to can also be defined in the architecture to document the potential regional use of the project.
  - The RIA identifies types of agreements that may be required to support the functionality of different levels of information sharing and integration. Agencies can use these descriptions to identify where specific agreements might be needed. These are included in Section 5.3.3.

- ***System Requirements Definition***
  - Equipment packages, user services and functional requirements can be identified in the architecture to support project development as described in Section 6.1. Functional requirements are derived from equipment packages; these equipment packages outline specific functionality delivered by elements of the regional ITS. User services are contained in Section 4.2 and subsystems and equipment packages are shown in Section 4.3. Functional requirements are also detailed in Section 5.3.
  - These system requirements describe the intended project functionality and are used later in the project development process to verify that the project is performing according to the requirements set forth at the beginning.
- ***System Design***
  - Functional requirements are detailed requirements for the interfaces between field/center/server and can support the development of the high-level design for the project by qualifying a particular strategy for design.
  - Specific user services can be documented in this step to back check that the design will meet the intended project functionality.
- ***System Implementation***
  - This step will not require the use of the MAG RIA.
- ***System Test and Verification***
  - The agency is required to document how the functions provided by the ITS project will be verified and tested. This step can refer to back checking functionality with the system requirements defined in a previous step.
- ***System Operation and Maintenance***
  - Specific agency agreements as well as general agreement types that could support operations and maintenance of ITS projects are defined in Section 5.3.3.
  - It is important for the agency to evaluate the applicability of agreements that are defined in this architecture to provide more detail in this step of the systems engineering analysis as to the roles and responsibilities for operations and maintenance.
- ***System Update, Retirement and Replacement***
  - This step will not require the use of the MAG RIA.

The systems engineering analysis developed for an ITS process documents the project planning from initial concept development through design, implementation, system acceptance, and ultimately system retirement/replacement. The MAG RIA is a useful tool in the development of the systems engineering analysis for an ITS project through a majority of the steps required.