Design/development and construction process is needed for the signs and controllers at each location, there will be a need for systems engineering to address the software development and integration efforts. In this example, revisions to the existing "concept of operations" and development of agreements for interagency coordination will be especially important to clarify expectations and avoid future disputes.

Additional examples of **High-Risk** ITS projects include:

- Multi-jurisdictional or multi-modal system implementation -- Because of the external interfaces required, these projects generally include substantial software development. For example:
  - A traveler information system that collects data from multiple agencies or modes
  - A Bus Traffic Signal Priority system between City Traffic and Regional Transit, or one that crosses multiple jurisdictions.
- The first stage of an "umbrella" system implementation. During this first stage, the full system engineering process would be used to develop the overall system framework plus the first implementation of that framework. For example:
  - New Traffic Signal Coordination system design plus implementation at an initial number of signals, with more signals added in later project(s).
  - New Traffic Information System design plus the first implementation in Cities X and Y, with more cities added in later project(s).
  - New Electronic Fare-Payment System design and initial implementation on Metro buses, with other transit agencies added in later project(s).

  If subsequent stages replicate the initial implementation, they would not be high risk. Instead, they fit the definition of a low risk ITS project, expanding the existing system with no new capabilities, and no new interfaces.

13.3 ITS PROJECT DEVELOPMENT AND FUNDING

The three types of ITS projects (Exempt, Low-Risk, and High-Risk) are linked to specific process by way of their risk characteristics. The traditional road building process as shown in Figure 13-2 has been used for many years. Design and installation is well documented. Over the years, requirements have become well defined, product performance is solid, and the technology is proven. As with roadway elements (pavement, drainage), ITS field elements (signals, CMS, CCTV, RWIS) are designed and constructed with Standard Plans, Standard Specifications, and Standard Special Provisions that are well documented. Risk of failure is low for these ITS projects, except when changing to new technology.

For **Exempt and Low-Risk** (formerly "Minor") ITS projects, the traditional single-phase PE obligation and authorization process will be followed. Work will include all activities of the traditional roadway project development life-cycle process leading up to construction. Funding steps for Low-Risk ITS Projects can be seen in Figure 13-2.

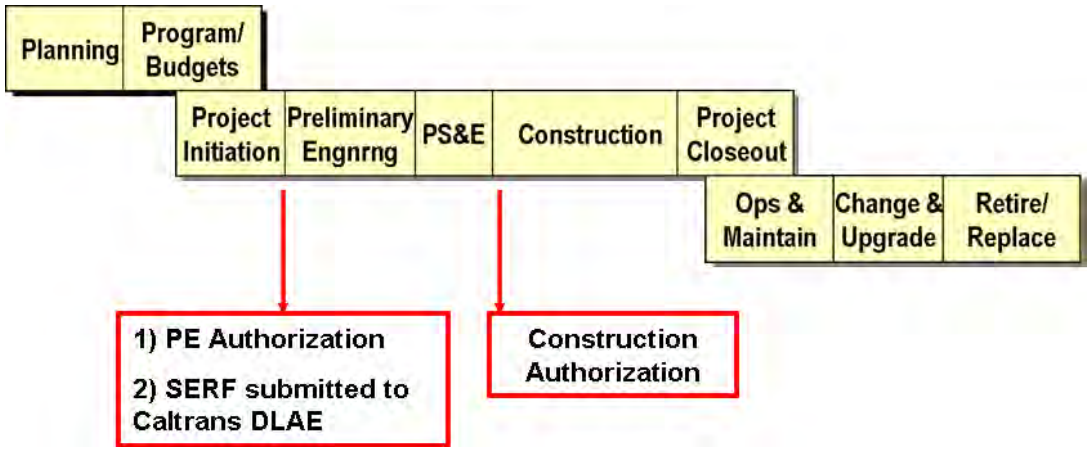

Figure 13-2: Process and Funding Steps for Low-Risk ITS Projects

More complex ITS projects lead to higher risk of failure (termination, time delays or cost increases). Additional elements are needed in the process of development to mitigate the higher risks. These additional elements can be thought of as extensions to the traditional road building process. The systems engineering approach is graphically depicted in Figure 13-3. To learn more about the Systems Engineering process, see the USDOT ITS Professional Capacity Building Program website: http://www.pcb.its.dot.gov, and FHWA/Caltrans "*Systems Engineering Guidebook for ITS*" at: http://www.fhwa.dot.gov/cadiv/segb/views/process/index.htm.

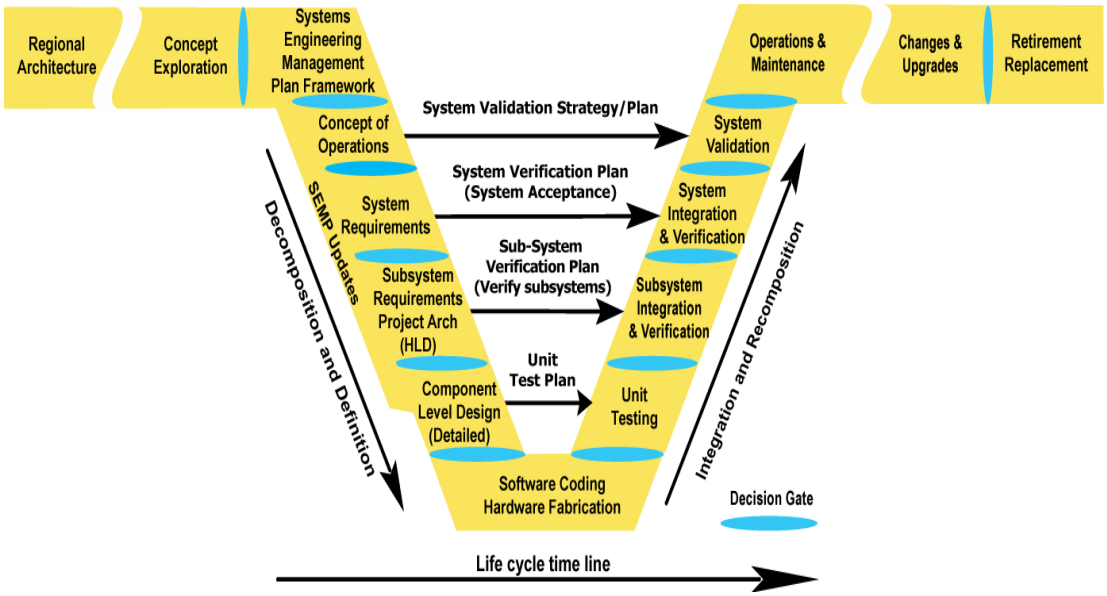

Figure 13-3: Systems Engineering Vee Life Cycle Process

For **High-Risk** (formerly "Major") ITS projects, a 2-phase PE obligation and authorization process will be followed. Figure 13-4 pinpoints when each Phase begins. A separate construction obligation and authorization will be needed for traditional roadway (infrastructure) improvements that accompany system development. Figure 13-4 does not infer that work provided by the PE contractor ends with Construction authorization. As shown in Fig 13-6 in Section 13.9, the same PE contractor will often be involved in system engineering activities on the right side of the Vee Life Cycle Process in support of verification and validation.

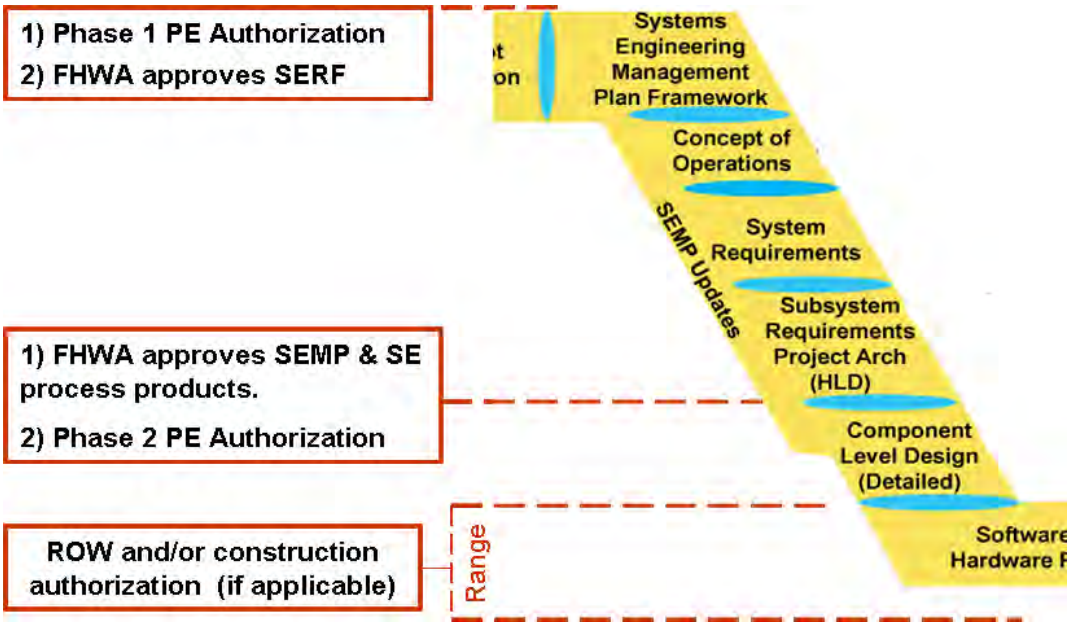

Figure 13-4: Funding Steps for Systems Engineering Process

Early determination of risk leads to early determination of type of ITS project, which leads to an early determination of budgeting approach. The systems engineering Vee process concentrates more time and cost on the up-front engineering activities relative to the traditional road building process that typically concentrates funding and scheduling priorities to the construction (back-end) phase.

For more information on Systems Engineering, the reader is encouraged to access the FHWA/Caltrans *Systems Engineering Guidebook for ITS* website at: http://www.fhwa.dot.gov/cadiv/segb/views/process/index.htm.

13.4 General ITS Responsibilities

This section describes ITS responsibilities, during planning and implementation of the project, from the perspective of four different roles:

1.) Regional/Metropolitan Transportation Planning Agency (RTPA/MPO)
2.) Local agency (including their consultants in a project management role)
3.) Caltrans Division of Local Assistance
4.) FHWA Project Engineer
5.) Communities

The user ***should*** read the section that corresponds to their role. The other sections are optional. For each role, the responsibilities are described for each of the three steps in the Roadmap below in Figure 13-5, which can be briefly described as Planning, Funding, and Implementation.