NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

NCHRP REPORT

Guide to Contracting ITS Projects

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FOREWORD

ACKNOWLEDGMENTS

This guide was prepared as a result of NCHRP Project 03-77. Edwards and Kelcey served as the prime contractor. Kenneth R. Marshall, P.E., Vice President, Edwards and Kelcey presided as the principal investigator and Dr. Phil Tarnoff presided as the co-principal investigator. In addition to the principal and co-principal investigators, Jim Haley, Tom Jacobs and James Witherspoon served as contributing authors. Javier Ordonez served as a research assistant and provided invaluable support in the preparation and analysis of the survey of state departments of transportation procurement policies, procedures and practices. Mr. Ordonez also developed the website that automates the decision process presented in the guide. We would like to thank the Kentucky Transportation Cabinet, Illinois Department of Transportation, New York State Department of Transportation, Texas Department of Transportation, and Virginia Department of Transportation for participating in the survey. This research was positively influenced by the cumulative experience and knowledge of the review panel, chaired by Larry Yermack. In several instances, the review panel provided insight and the necessary resources needed to produce this guide. Lastly, we are especially appreciative for editorial contributions provided by the Edwards and Kelcey administrative staff.

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ABOUT THIS GUIDE

A corridor within the operating jurisdiction of your transportation agency has experienced a high accident rate. Funding has been made available for your agency to design, procure and install CCTV to monitor the corridor. You have been assigned as the project manager. How will you procure the goods and services needed to successfully complete the project?

Most likely, your agency is responsible for maintaining mobility and safety goals for a defined[1] transportation network. Traditionally, this has been accomplished by increasing capacity through the development of infrastructure. Throughout the years, the processes and procedures required to successfully facilitate infrastructure development have been institutionalized within your agency. In recent years, primarily due to land use decisions and right-of-way restrictions, it has been realized that infrastructure development is no longer the principal solution to address mobility issues. Transportation agencies, similar to yours, are beginning to reallocate resources to support infrastructure management and operations versus infrastructure development. This phenomenon has resulted in an institutional shift requiring the use of new processes and procedures [including innovative procurement processes and procedures] for improved management and operation.

Federal legislation[2] dating back to 1991 recognizes Intelligent Transportation Systems (ITS) as a viable tool for improving the management and operation of existing transportation network infrastructure. ITS is generally defined as the application of advanced technologies (i.e. CCTV) to improve the efficiency and/or safety of a transportation system. The ITS functions are defined by the Federal Highway Administration (FHWA) National ITS Architecture.

The successful procurement of Intelligent Transportation Systems (ITS) is a challenging task for state and local transportation agencies. The procurement process must be flexible to accommodate the uncertainties of complex system acquisitions, while at the same time structured enough to ensure that the responsibilities of the participants are fully defined and their interests protected. This process should also ensure that the most qualified organizations are selected for the system implementation.

Although you have several options for procuring your ITS project, some options are more appropriate than others. This guide presents a decision model that will help you identify the most appropriate procurement options.

[1] A transportation network is generally defined by state and local geographic boundaries.
[2] The Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991

ASSUMPTIONS ABOUT THE READER

This guide is intended for individuals responsible for procuring intelligent transportation systems (ITS). It is recommended that users of this guide have the following basic skills and/or background:

- An understanding of ITS.
- An understanding of the risks associated with the procurement of ITS.
- An awareness of state procurement regulations, policies and practices.
- An awareness of federal procurement regulations, policies and guidelines.
- A general understanding of systems engineering with respect to project development.
- Familiarity and experience with project management principles of high technology projects.

GUIDE ORGANIZATION

Many factors must be considered when you are tasked with identifying an appropriate procurement process for an ITS acquisition. A Decision Model has been developed for this guide to aid in this activity. The Decision Model is rooted in the relationship between the four dimensions of procurement along with the systems and systems engineering concepts they support. This guide is organized based on the Decision Model presented in Figure 1 below.

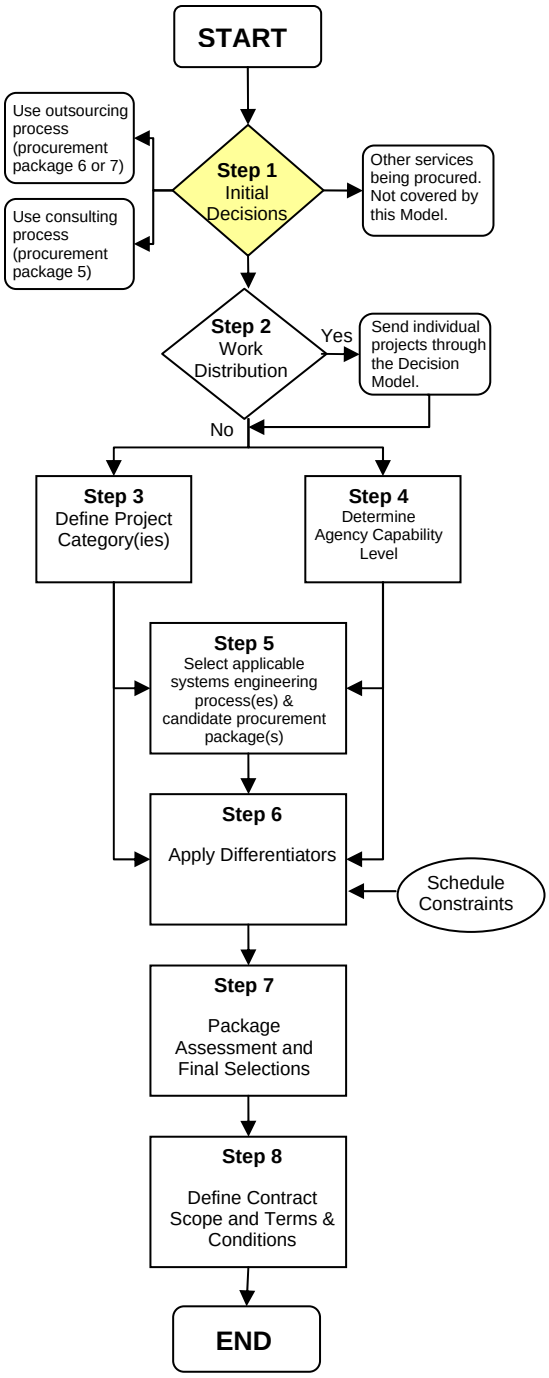


Figure 1. Decision Model

The Decision Model includes eight steps that must be performed to complete the process of defining the most appropriate procurement approach for your project:

Step 1 – Initial Decisions: Step one will aid you in making fundamental procurement decisions that will ultimately affect the overall procurement strategy. These fundamental decisions consider the possibility of outsourcing and the procurement of consultant services. This step also directs you to skip to Step 7 of the Decision Model if either outsourcing or consultant services are used.

Step 2 – Work Distribution: Step two will help you determine whether the procurement should be performed as a single contract or multiple contracts.

Step 3 – Define Project Category: Step three will help you categorize your project with respect to complexity and risk. Understanding project complexity and risks is critical to determining an appropriate procurement package.

Step 4 – Determine Agency Capability Level: Step four will assist you in assessing your agency's resources and capabilities as well as the environment in which your project will be procured.

Step 5 – Select Applicable Systems Engineering Process & Candidate Procurement Package: Step five uses the results of steps three and four to select applicable systems engineering processes and candidate procurement packages.

Step 6 – Apply Differentiators: Step six applies differentiators to the candidate procurement packages identified in step five. This step will help you reduce the number of procurement packages identified in step five.

Step 7 – Package Assessment and Final Selection: This step suggests the involvement of agency procurement personnel to assist in making the final selection of the most appropriate procurement package.

Step 8 – Define Contract Scope & Terms and Conditions: The final step will assist you with the selection of the necessary terms and conditions to be included in the contract.

Each step is explained in the corresponding section of the guide. The Decision Model graphic is used throughout the guide to highlight your progress.

In an effort to bring forward pertinent information - tips, notes, key points, references and innovative concepts are highlighted throughout the guide. The icons presented below will be used to alert you of pertinent information.

TIP ICON – The tip icon is used to alert the reader of lessons learned that guide authors and contributors have gathered through experience in the procurement of ITS.

NOTE ICON – The note icon is used to explain to the reader, in greater detail, concepts that are put forth throughout the guide.

KEY POINT ICON – The key point icon is used to alert readers of points critical to the successful procurement of ITS.

REFERENCE ICON – The reference icon is used to inform readers of additional references that provide further explanation of a specific topic discussed in the guide.

INNOVATIVE CONCEPT ICON – The innovative concept icon is used to alert readers of novel strategies and practices used to procure ITS.

For more information on this Subject, refer to the final report [NCHRP #03-77 – Final Report] submitted in conjunction with this guide.

BEFORE WE GET STARTED

As stated earlier, the procurement of ITS is a challenging task. This guide should be considered as a tool to be used to overcome this challenge. But before you begin using the guide, you should review with the following topics:

1. Project Planning
2. The Procurement Process
3. Systems Engineering as it Relates to Contracting

PROJECT PLANNING

Project planning is further explained in the final report [NCHRP 03-77 – Final Report] submitted in conjunction with this guide.

Prior to identifying appropriate procurement options (termed *procurement planning* in this guide) for your ITS project, you must first establish project feasibility and then consider commercial off-the-shelf (COTS) vs. custom system development and outsourcing.

These initial considerations (termed *project planning* in this guide) ensure that project stakeholders achieve consensus with respect to functional expectations and resource requirements in order to facilitate a successful project. These activities should be performed prior to the actual procurement of services or equipment and can roughly be divided into the two major categories of Project Planning and Procurement Planning (see Figure 2).

Establishing Project Feasibility

Stakeholders establish project feasibility by first agreeing on the project concept of operations (how the project will be used). Institutional, financial and temporal constraints should be considered. Based on the identified concept of operations, stakeholders develop a project scope and schedule and project cost estimations. Project feasibility is established once the project scope, schedule and cost estimations have been validated and verified against available agency resources.

Establishing project feasibility will help you answer the following questions:

- How much will the system cost and can we afford it?
- Do we have a reasonable schedule, or are our deadlines unrealistic?
- Do we have adequate personnel (both numbers and skills) to manage and support the development?
- Does everyone share the same vision for the system? Is there universal agreement regarding the manner in which the system will be used?

Once the project's feasibility has been established, you should consider the use of commercial off-the-shelf products (hardware and software). In addition, you should consider the possibility of outsourcing.

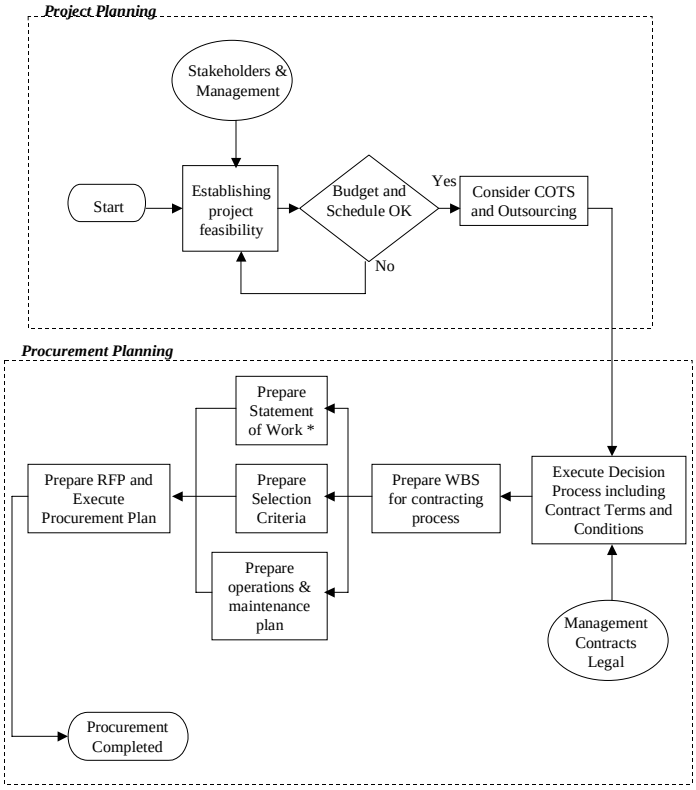


Figure 2. The Planning Process

Commercial Off-the-Shelf (COTS) vs. Custom System Development

Frequently, the system that your stakeholders defined while establishing project feasibility has been developed and procured by another agency. This reality results in a favorable scenario for you. ITS systems that have been previously installed are considered as Commercial Off-the-Shelf (COTS) ITS systems. *If at all possible, you should contact peer agencies to acquire lessons learned from their experience procuring the system that your agency is interested in procuring*. Additional benefits of procuring COTS systems include:

- The system has been previously tested.
- The cost for system upgrades can be shared with other agencies.
- The ability to acquire a system that can be viewed in operation prior to system procurement.

In contrast, your project stakeholders may define a system that has not previously been installed. This is known as a custom system development. In some cases, it may be best to procure a hybrid system that includes both COTS and custom components.

Outsourcing

Outsourcing is the process by which organizations (public or private) use external providers to manage or maintain certain aspects of their business. *While establishing project feasibility, stakeholders may realize that the group does not have the personnel (skills or resources) to design, procure, deploy, operate and/or maintain the defined system. In this case, it may be prudent to consider outsourcing*.

You should look for opportunities to use COTS products wherever possible. It may be that minor adjustments to the concept of operations will permit this approach.

THE PROCUREMENT PROCESS

The procurement process includes four dimensions: work distribution, method of award, contract form and contract type. Once these key procurement decisions have been made then appropriate terms and conditions can be identified.

Work Distribution

The work distribution category represents the project responsibilities defined by the agency for the contractor by the contract statement of work. These assignments are expressed in the systems engineering terminology – concept of operations, requirements, design, implementation and testing. They also include the crosscutting activities of configuration management, risk management, validation and verification, and metrics. The types of work allocation are:

- Low-Bid Contractor - the selection of a contractor for system installation using the low-bid process. The low-bid contractor is responsible for furnishing a fully operational system including all hardware, software and construction services required to satisfy a detailed design defined by plans and specifications.
- Systems Manager - utilizes an organization known as the systems manager whose responsibilities may include all project activities associated with a system acquisition except for the provision of equipment, electrical contracting and construction contracting.
- Systems Integrator - similar to that of the systems manager, except that the integrator is not involved in the planning and design stages. The systems integrator provides all of the personal services associated with the systems implementation except for the provision of equipment, electrical contracting and construction.
- Design Build (Operate and Maintain) (DB (OM)) - based on an agreement that provides for design and construction of improvements by a (single) contractor or private developer. The term encompasses design-build-maintain, design-build-operate-maintain, design-build operate, design-build-finance and other contracts that include services in addition to design and construction. The design build contractor's work is based on an initial design that may be prepared by a consultant.
- Commodity (COTS) - Contracting for the acquisition of commodities is applicable to ITS contracting to the extent that an agency is procuring commercial-off-the-shelf (COTS) products. These may include field equipment such as variable message signs, traffic signal controllers, radios, or computers. It may also include COTS software and systems.
- Consultant Services - Work provided by consultants is limited to provision of personal services. Some of the ways in which consultant contracts may be used include system design and installation support, inspection, design, and documentation and training.

- Services - Contracts for other forms of services are frequently awarded during the life cycle of an ITS system. The differentiation is made here to identify services that are outside the mainstream of system development, such as inspection, IV&V, outreach, information service providers (ISPs), and staff supplements.

Method of Award

The method of award category of contracting defines the criteria used and steps taken to select a contractor to perform the work. The form of work allocation that has been selected determines the method of award. As indicated below, there are distinct differences between the various methods of award. These differences should be taken into account when selecting a form of work allocation. The types of method of award are:

- Low Bid - Low-bid contracting, commonly referred to as sealed bidding, is a contracting method that employs competitive bids, public openings of bids and contractor selection based on the lowest price offered.
- Negotiated - Unlike formal advertising of a contract requirement which is precise, highly structured method of procurement with one definitive set of procedures, negotiation allows considerable flexibility, permitting the use of a number of different procedures in making awards. The negotiated selection is typically based on the evaluation of a technical approach, qualifications and experience as represented in a technical proposal and possible subsequent presentations to the agency.
- Sole Source - Sole source procurement is the direct selection of a contractor without competition.
- Best Value-Selection is made on a weighted combination of the technical approach, qualifications, experience and price of the offeror. Best value is in effect, a combination of the low bid and negotiated methods of award.

Contract Form

The contract form defines the manner in which work is authorized. Three contract forms are:

- Phased Contracts - Phased contracts are the conventional form of contracting that is in use for the majority of projects including ITS acquisitions. Phased contracts divide the work into sets of predefined activities (or phases) with specified deliverables.
- Task Order (or Indefinite Quantity) Contracts - Indefinite-delivery contracts are used with contracts in which the required supplies and services are unknown at the time of contract execution. They provide a mechanism for the agency to place orders for these supplies and services during the life or term of an overarching "umbrella" contract.
- Purchase Orders - A purchase order is a form of sole-source contracting used for relatively small procurements. Purchase orders are a simple, rapidly executed form of contract that usually contains a standard set of terms and conditions (payment, insurance, cancellation clauses, etc.) and a relatively brief description of the work to be performed.

Contract Type

Numerous types of contracts are available for use with different types of projects and under various circumstances. Contract types may vary according to the degree and timing of responsibility assumed by the contractor for the costs of performance and the amount of time and nature of the profit incentive offered to the contractor for achieving or exceeding specific standards or goals. Contract types include a range of alternatives, such as:

- Firm Fixed Price - the contractor assumes full responsibility for the performance costs and any profit or loss at a fixed price.
- Cost Reimbursable - the contractor is paid (reimbursed) for his actual costs of performing the work and the fee (profit) is fixed.
- Time and Materials - the contractor is paid for his actual costs of performing the work, and a percentage fee is added to all payments.
- Incentives - the contractor's responsibility for performance costs and profit and/or fee incentives are dependent upon the uncertainties associated with the desired outcomes of the procurement. Incentives are paid over and above the three types of reimbursements described above.

For firm fixed price contracts, the contractor assumes all of the financial risk. The agency assumes all of the financial risk for time and materials contracts. Cost reimbursable contracts are a form of contracting in which the financial risks are shared.

Terms and Conditions

Terms and conditions have been defined in Step 8 of the Decision Model process.

The procurement process is defined by the Federal Acquisition Regulations (FAR). Title 48 of the Code of Federal Regulations Chapter 1 codifies the FAR. The FAR presents policies for acquisition of supplies and services by executive agencies. The FAR is available on the Internet at *www.arnet.gov/far*. But the FAR is not the only source of regulations. All State and local government agencies have their own processes that must also be followed.

SYSTEMS ENGINEERING AS IT RELATES TO CONTRACTING

The "V" diagram, shown in Figure 3 below, has been developed by the systems engineering profession to define the relationship among the phases of the system life cycle. As represented in the figure, the systems engineering process begins with the early planning activities, during which the systems relationship with regional needs and other regional systems is defined. The central "V" shape, which begins with the systems engineering plan and ends with operations and maintenance includes the activities specifically associated with the acquisition of the specific system with which these procurement guidelines are concerned. The arrow in V diagram shows the time sequence of these activities. The oval shapes are known as control gates, and identify the points in the process at which specific documentation is required and decisions regarding the ongoing development must be made.

As indicated in the diagram, the life cycle must not only consider the specific steps associated with the system planning, design and development, but also the regional context for the system (on the left side of the diagram), and the need for system upgrades and enhancements as shown on the right side of the diagram.

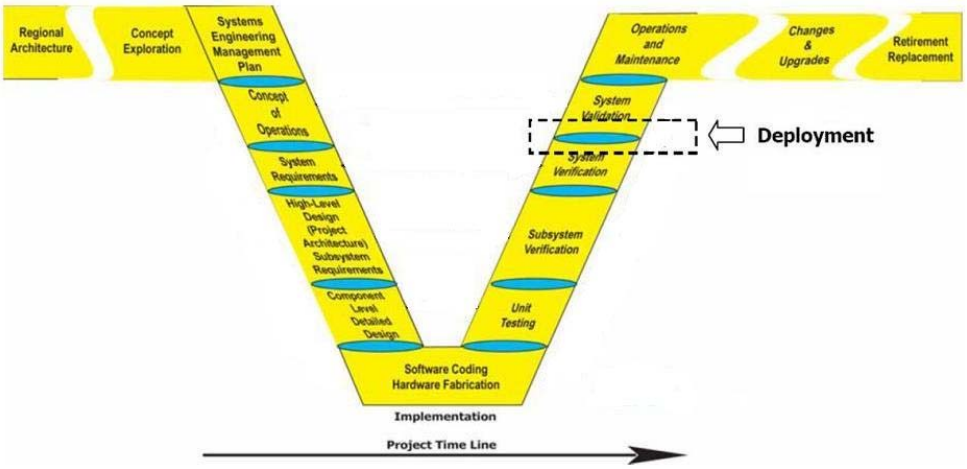


Figure 3. 'V' Model of Systems Engineering

Systems engineering process models define alternative applications of the "V" diagram to the systems engineering process. A well-developed model also supports the project management process in that it defines the system acquisition steps, and helps convey to the team and others how a project will be managed. *The process model influences the selection of the procurement approach being used for the system acquisition*. The process model must define the procurement approach rather than permitting the procurement approach to define the systems engineering process. In addition, the model helps communicate with others about the progress being made, it helps assess the risk of alternate paths, and it helps to take advantage of emerging opportunities. Alternative system development processes include:

- Waterfall Model – Linear process used for relatively simple projects.
- Evolutionary Model – Incremental approach to systems development in which the system is implemented in "bite size" pieces. Applicable to complex systems.
- Spiral Model – A model characterized by extensive prototyping and planning. This model is used where a complex system includes new untested concepts and functionality.

THE DECISION MODEL

The following considerations set the stage for applying the Decision Model, which is based on the project characteristics and agency capability level. More precise terminology will be defined later. The model has been developed with the following considerations in mind:

- The characteristics of the ITS project you are implementing has a major influence on the contracting approach.
- *Your agency's experience/environment has a major influence on the contracting approach.*
- The systems engineering process has major influence on contracting approach.
- Defining the project, agency experience with ITS, and system engineering process will allow selection of the appropriate contracting approach.
- In actuality, there are four basic contracting alternatives (or procurement packages). The other contracting dimensions are adjustments to these packages.
- Contract terms and conditions are an important element of the contracting process. They are defined once a package has been selected.

The Decision Model used in this guide represents the results of multiple reviews, as well as the testing of the process with five real-world systems.

The Basic Model (Structure and Packages): The four dimensions of procurement shown in Figure 4, along with the terms and conditions, provide a structured representation of the contracting process (procurement). The purpose of the procedure described in this section is to select the combination of items (one from each of the four dimensions) that are most appropriate for the project characteristics and the agency's capabilities.

There are only a few practical combinations of procurement characteristics that are practical. Contracting packages are unique combinations of procurement characteristics, selected from each of the dimensions of Figure 4. Contract terms and conditions are not included in the procurement packages, but are selected as a separate step. These packages are based on the work allocation dimension of Figure 4, which is the fundamental variable that drives the entire process.

The characteristics contained in each of the seven procurement packages (named to correspond with their associated work allocation), are shown in Table 1.

The objective of the selection process is to identify the most appropriate procurement package for a given project. The package numbers shown in the table are referenced in the initial steps of the decision process. Generally, packages 1 through 4 are used for traditional system implementation, although they can obviously be used for other purposes. Package 5 is either a supporting function for the system implementation, or may be used for numerous other consultant activities. Packages 6 and 7 are used for the provision of activities (an internal agency process such as inspection, maintenance, operations, mowing, or signal timing) and functions (an entire agency service such as traffic management, traveler information or toll collection) in a manner that reduces the agencies staffing requirements. Packages have not been defined for the "other" category of the work allocation dimension.

The objective of the selection process is to choose the most appropriate procurement package. This process is presented as a sequence of steps that must be followed to arrive at a conclusion, which in turn leads to the identification of the terms and conditions to be used with the selected package.

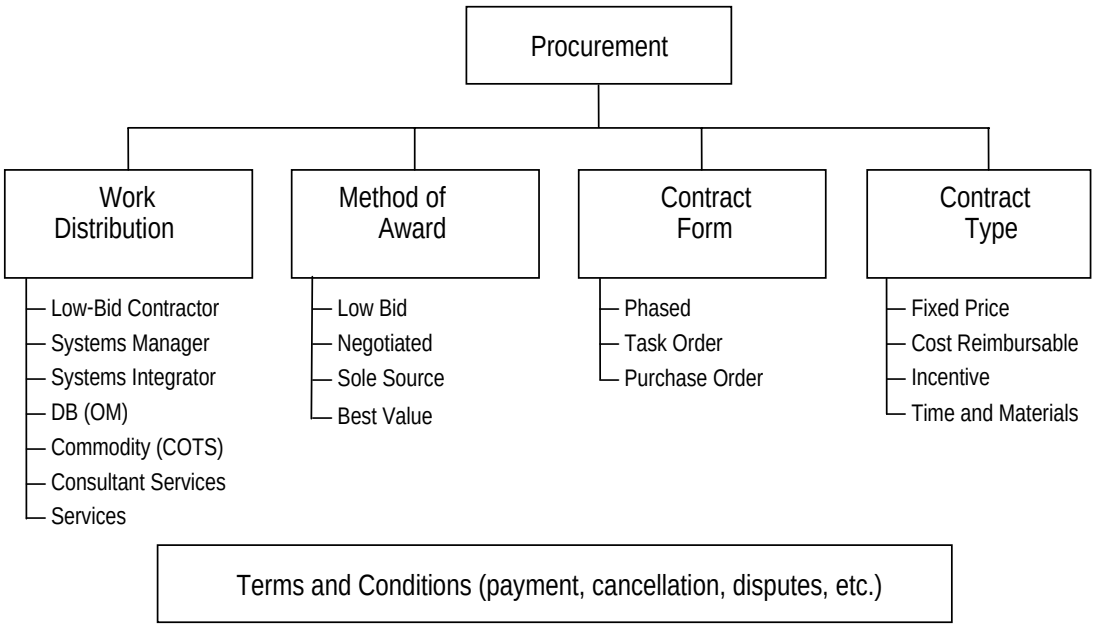
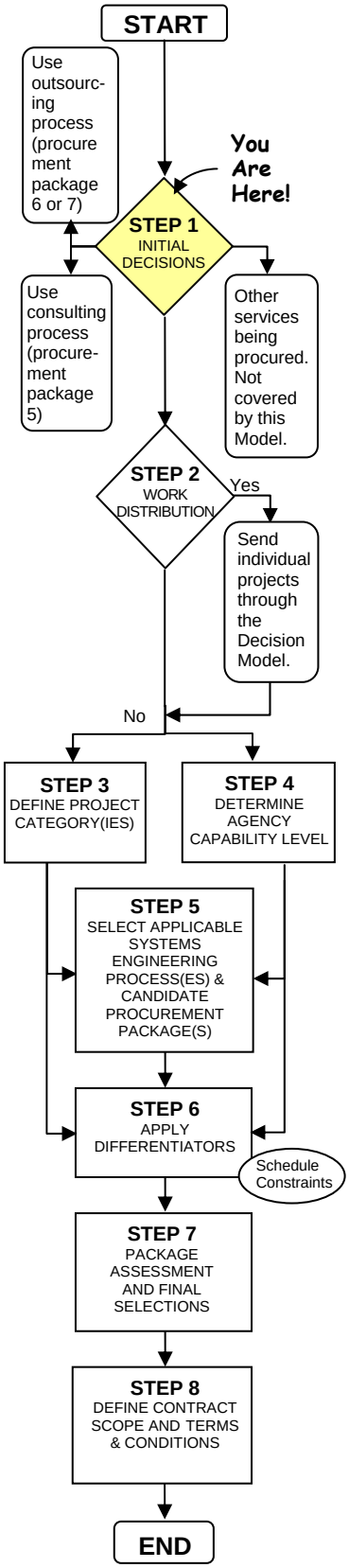


Figure 4. Four Dimensions of Procurement

Table 1. Procurement Packages

Package No.	Work Distribution (Package Name)	Method of Award	Contract Form	Contract Type	Comments
1	Commodity Supplier	Low-bid selection of prequalified packages	Single phase or purchase order	Fixed Price	Used for COTS procurements
2	Low-Bid Contractor with Consultant Design	Low-bid for contractor	Phased / Task Order	Fixed Price for contractor incentives optional	Consultant performs 100% of design. May provide additional services during implementation
3	Systems Manager	Quality-based selection (negotiated procurement)	Phased	Fixed price, cost reimburse. or time & materials incentives optional	Field equipment procured by agency using low-bid process
4	Design-Build Contractor with Design Consultant	Best-value selection (based on consideration of price and quality)	Phased	Usually fixed price, cost reimburse. or time & materials incentives optional	Consultant provides 30% design.
5	Consultant	Negotiated	Phased / Task Order	Fixed price, cost reimburse. or time & materials incentives optional	Used for system design and many other consultant services
6	Outsourcing Agency Activity	Low-bid may be based on rates	Usually single phase	Fixed price or time & materials incentives optional	Typical activities include maintenance, operations, signal timing, etc.)
7	Outsourcing Agency Function	Best value or low-bid	Single phase	Fixed price, cost reimburse. or time & material contracts Incentives optional	Typical functions include traveler information and toll collection. May be public-private partnership



STEP 1 – INITIAL DECISIONS

Now you are ready to get started with the first step of the Decision Model. This first step actually involves a series of sub-steps designed to help make some initial decisions about the fundamental project characteristics that differentiate between a system development, a consultant contract and an outsourcing contract. Recall that these subjects have been discussed earlier during the project planning activities.

The logic for the Step 1 initial decision process is formalized in Figure 5 below, which leads to four possible outcomes, one of which involves moving on with Step 2 (Work Distribution) of the Decision Model.

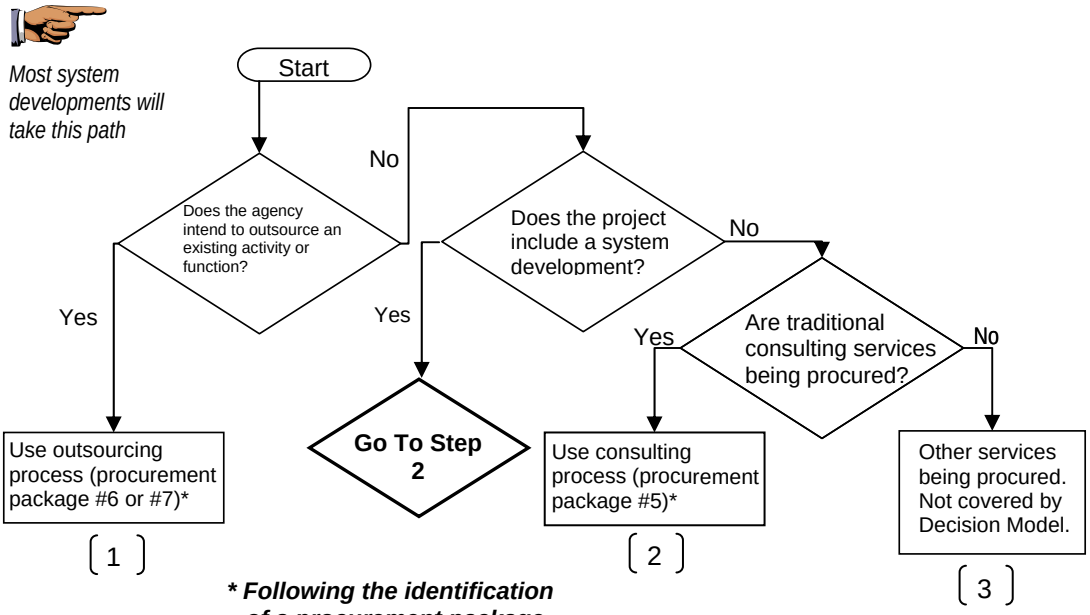


Figure 5. Step 1 - Initial "Project Planning" Decision Process

There are three other possible outcomes that may result from the Initial Decision Process. These outcomes, as described below, are delineated by the bracketed numbers (1 through 3) in the figure above and as shown in Step 1 of the Decision Model process diagram.

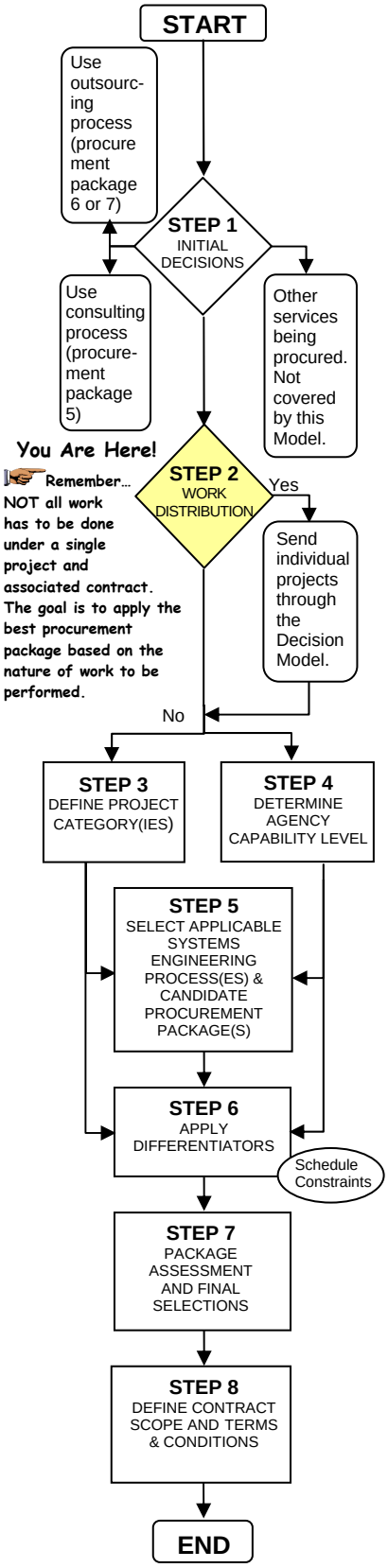
[1] This outcome indicates you are planning to outsource an existing agency activity of agency function. Use procurement package #6 or #7 and then go directly to Step 7 of the Decision Model process.

This outcome indicates a focus on the use of traditional consulting procurement processes as associated with procurement package #5.

After selecting procurement package #5, go directly to Step 7 of the Decision Model process.

[2] This outcome indicates that you are procuring services not addressed by any of the procurement packages covered within this guide. For example, procurement packages specific to public-private partnership contracts are not covered.

[2]



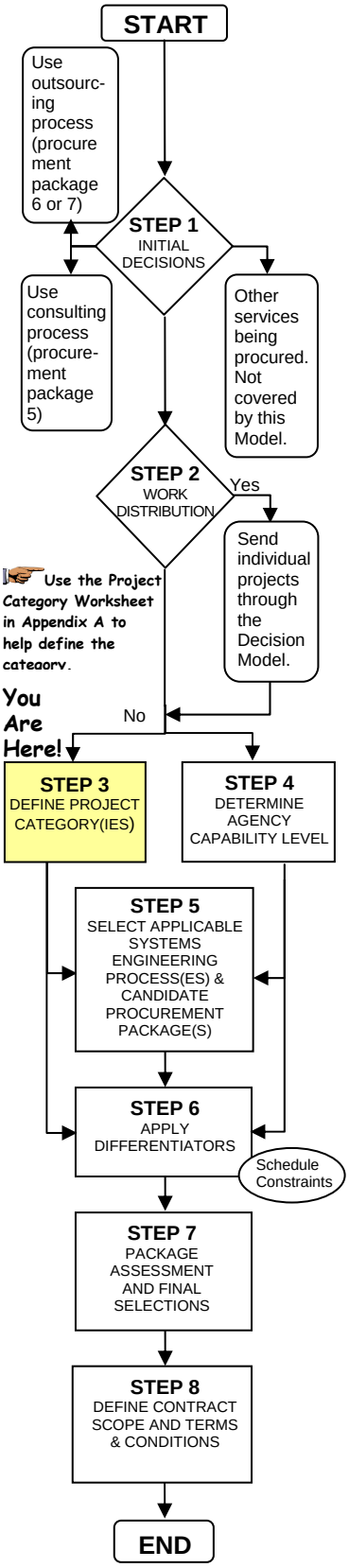
STEP 2 – WORK DISTRIBUTION

So now you've determined that you are, in fact, moving forward with the steps required for identifying an appropriate procurement package for your system development initiative. Don't worry, you've already done a significant amount of work to get to his point, and the Decision Model process will guide you the rest of the way. The second step in the Decision Model determines whether the acquisition should be performed as a single project or multiple projects. Step 2 has been highlighted to identify the relationship between this step and the overall Decision Model. It is shown as one of the initial activities since the model must individually consider each of the specific contracts resulting from this step. Why is this important? Because each contract can be executed using a contracting process and associated procurement package that best addresses the nature of work to be performed. For example, one contract may include the central system (including software) implementation, while another contract might consist only of field equipment installations. Many ITS procurements involve multiple contractors who have been selected using different procurement packages.

Thus, this step of the Decision Model allocates the total work associated with a project to multiple sub projects and their related contracts. It may very well be that only a single contract is required for the entire project. However, even if all of the project work can be performed by a single contractor (i.e. none of the reasons listed below apply), there may be a need for supporting contractors who might be performing such tasks as general advisory support, site inspection, system design, website design, or independent validation and verification (IV&V) of the contractor's work. The reasons to allocate work to multiple projects and associated contracts as opposed to performing all work under a single contract may include:

- Significant amount of software and systems development, but largest dollar amount is in construction (i.e. systems contractor will not be prime unless separate contracts are issued for the systems contractor and the construction contractor).
- Uncertain of the likelihood of selecting a satisfactory prime contractor for the overall project (i.e. not putting all of "ones eggs in the same basket").
- "Political" requirement to spread the work around (this might be particularly true if the project involves a significant amount of field construction).

Unless there are compelling reasons to do otherwise, it is always best for software development and systems integration work to be performed by the prime contractor, to ensure a single point of responsibility and to minimize the complexities of managing the development environment.



STEP 3 – DEFINE PROJECT CATEGORY(IES)

Now that the work has been allocated to a single project or multiple projects, the third step of the Decision Model involves "categorizing" each project in terms of its overall complexity and risk. A number of factors have been selected to help define complexity and risk, which includes: level of new development, scope and breadth of technologies, interfaces to other systems, technology evolution, requirements fluidity, and institutional issues.

Table 2 identifies four ITS Project categories along with each factor and a description of the characteristics that support their definitions. *The worksheet in Appendix A has been developed to help guide project Category selection.* The worksheet essentially boils down the project category factors into the following definitions of complexity and risk:

- Category 1: Straightforward in terms of complexity and low overall risk
- Category 2: Moderately complex and moderate overall risk
- Category 3: Complex with high overall risk
- Category 4: Extremely complex with a very high overall risk

This step and all subsequent steps must be executed for each of the projects defined during Step 2.

It is unlikely that the project will fit all of the descriptors within a single category of Table 2. Thus the challenge of this Step is to find the overall set of descriptors that best match the project's characteristics. Since this is not an exact science, some degree of judgment must be used. As a general rule, the higher categories entail a greater development risk because these categories contain more unknowns. These unknowns are expressed using the factor descriptors such as the level of new development entailed and the requirements fluidity. These two characteristics should receive the highest priority when evaluating the project category. While the worksheet in Appendix A will identify an ITS Project Category range, in the event that the project appears to be equally suited to two different categories, the higher category should be selected.

Once you have selected the Project Category, don't forget your answer.

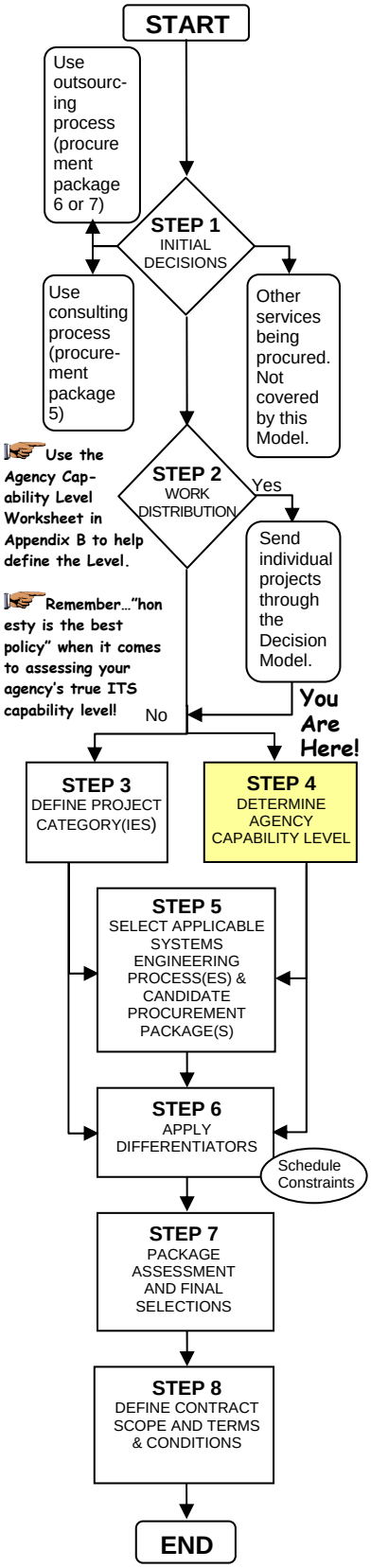
Don't forget the ITS Project category once you've decided upon it! It will be used along with your defined agency capability level (Step 4) to select an appropriate system engineering development process and initial procurement package(s) (Step 5).

Table 2. ITS Project Categories and Associates Characteristics

	Category 1	Category 2	Category 3	Category 4
Complexity	Straightforward	Moderately Complex	Complex	Extremely Complex
Level of New Development	Little to no new software development / exclusively COTS software and hardware based or based on existing proven software and hardware.	Primarily COTS software / hardware or existing software / hardware based with some new software development or new functionality added to existing software - evolutionary development.	New software development for new system, replacement system, or major system expansion including use of COTS software. Implementation of new COTS hardware.	Revolutionary development - entirely new software development including integration with COTS or existing legacy system software. Implementation of new COTS hardware or even prototype hardware.
Scope & Breadth of Technologies	Application of proven, well-known, and commercially available technology. Small scope in terms of technology implementation (e.g., only CCTV or DMS system). Typically implemented under a single stand-alone project, which may or may not be part of a larger multi-phased implementation effort.	Primarily application of proven, well-known, and commercially available technology. May include non-traditional use of existing technology(ies). Moderate scope in terms of technology implementation (e.g., multiple technologies implemented, but typically no more than 2 or 3). May be single stand-alone project, or may be part of multi-phased implementation effort.	Application of new software / hardware along with some implementation of cutting edge software, hardware, or communication technology. Wide scope in terms of technologies to be implemented. Projects are implemented in multiple phases (which may be category 1 or 2 projects).	New software development combined with new hardware configurations/components, use of cutting edge hardware and/or communications technology. Very broad scope of technologies to be implemented. Projects are implemented in multiple phases (phases may be category 1 or 2 projects).
Interfaces to Other Systems	Single system or small expansion of existing system deployment. No interfaces to external systems or system interfaces are well known (duplication of existing interfaces).	System implementation includes one or two major subsystems. May involve significant expansion of existing system. System interfaces are well known and based primarily on duplicating existing interfaces.	System implementation includes three or more major subsystems. System interfaces are largely well know but includes one or more interfaces to new existing systems / databases.	System implementation includes three or more major subsystems. System requires two or more interfaces to new and/or existing internal/external systems and plans for interfaces to "future" systems.

Table 2 (Cont.)

	Category 1	Category 2	Category 3	Category 4
Technology Evolution	Need to account for technology evolution perceived as minor. Example would be to deploy hardware and software that is entirely compatible with an existing COTS-based system. Ramifications of not paying particular attention to standards considered minor. System implemented expected to have moderate to long useful life.	Need to account for technology evolution perceived as an issue to address. Example includes desire for interoperable hardware from multiple vendors. Ramifications of not paying particular attention to standards may be an issue, as an agency may get "locked-in" to a proprietary solution. Field devices expected to have moderate to long useful life. Center hardware life expectancy is short to moderate. Control software is expected to have moderate to long life.	Need to account for technology evolution perceived as a significant issue. Examples might include implementation of software that can accommodate new hardware with minimal to no modification and interoperable hardware. Ramifications of not using standards based technology are considerable (costs for upgrades, new functions, etc.) Field devices expected to have moderate to long useful life. Center hardware life expectancy is short to moderate. Control software is expected to have an extendable useful life.	Need to account for technology evolution perceived as major issue. Examples include software that can easily accommodate new functionality and/or changes in hardware and hardware that can be easily expanded (e.g. add peripherals), maintained, and are interoperable. Ramifications of not using standards based technology are considerable (costs for upgrades, new functions, etc.) Field devices expected to have moderate to long useful life. Center hardware life expectancy is short to moderate. Control software is expected to have an extendable useful life.
Requirements Fluidity	System requirements are very well defined, understood, and unlikely to change over time. Formal requirements management a good idea, but not a necessity.	System requirements are largely well defined and understood. Addition of new system functionality may require more attention to requirements management.	New system functionality includes a mix of well defined, somewhat defined, and fuzzy requirements. System implementation requires adherence to formal requirements management processes.	System requirements not well defined, understood, and very likely to change over time. Requires strict adherence to formal requirements management processes.
Institutional Issues	Minimal- project implementation involves one agency and is typically internal to a particular department within the agency.	Minor- may involve coordination between two agencies. Formal agreements not necessarily required, but if so, agreements are already in place.	Significant- involves coordination among multiple agencies and/or multiple departments within an agency or amongst agencies. Formal agreements for implementing project may be required.	Major- involves coordination among multiple agencies, departments, and disciplines. Requires new formal agreements. May require new multi-agency project oversight organization.
Overall Risk	LOW	MODERATE	HIGH	VERY HIGH



STEP 4 – DETERMINE AGENCY CAPABILITY LEVEL

Now that you've done the work associated with defining the complexity and risk associated with your project(s), there's something you should know – selection of a procurement package *cannot* be based solely on a project's complexity and risk. Equally critical to procurement package selection is an honest assessment of your agency's resources and capabilities as well as the environment in which your initiative is planned, designed, deployed, and operated. Does your agency have personnel with relevant prior ITS project experience? Is there management support for dedicating adequate resources throughout your ITS project's life cycle? What exactly are the expectations of agency management and can these expectations be met (realistically!)?

The fourth step in the Decision Model is designed to help you answer these questions. *This step uses the information in Table 3 and the worksheet in Appendix B to determine the level that best suits your agency's capability to manage the system acquisition.* In essence, this step is used to assess your agency's organization, experience and resources relative to ITS procurements.

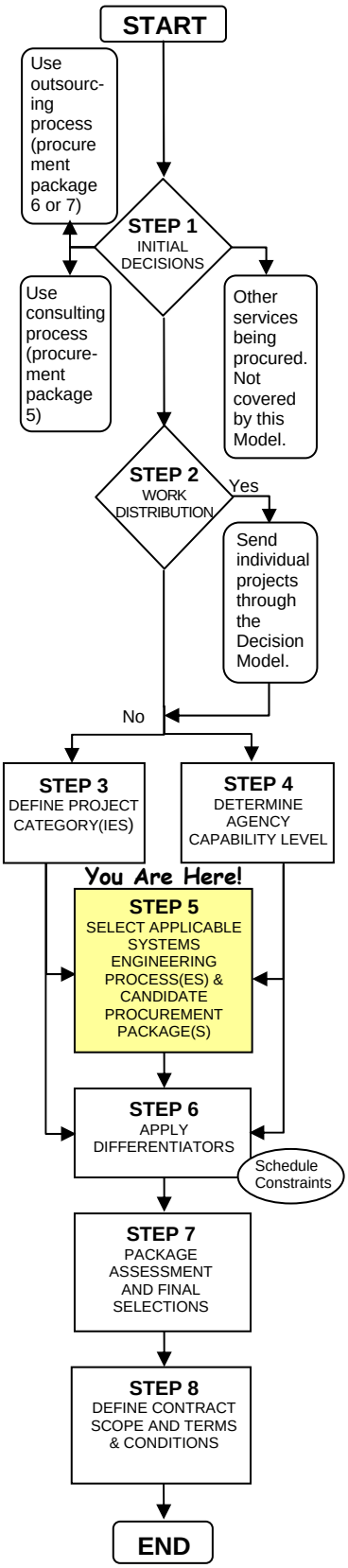
A careful and thorough assessment is important. While the tendency may be to look at your agency's capabilities in a favorable light, overlooking deficiencies in, for example, experience and resources is a recipe for failure. Major ITS projects with significant software development, hardware integration and, perhaps most critical, *long term* operations and maintenance support, can be challenging for even the most experienced agency. *If you and your agency are not quite ready to take on a project, then either don't do it or reduce the project scope to a manageable size and complexity.* It might also be prudent to bring on additional consultant resources. Don't take on a system that will result in having to maintain a long term operations and maintenance commitment if you haven't identified the resources. If pressure "from above" is an issue, use this guide to make a case for performing the additional planning and preparation necessary to acquire the experience, resources, and management support for taking on the challenges of an ITS project and making it a success.

As in the previous step where project categories were defined, some degree of uncertainty is likely to exist regarding the capability level of the agency's organization. In this case, personnel and organizational experience should receive the greatest weight. In the event that you think your agency is described equally well by two levels, be conservative and select the lower one.

Now that you've figured out your project category(ies) and have done an assessment of your agency's ITS related capabilities, you're ready to move on to the next step, which will begin to reveal some initial results of the Decision Model.

Table 3. Agencies Capability Levels as a Function of Characteristics

	Level 1	Level 2	Level 3
Personnel Experience	ITS assigned as part-time job to person with no staff and little to no specific ITS experience.	ITS assigned as full-time job with no staff or some part-time staff support. Person assigned has some specific ITS experience with Category 2 or 3 projects. Staff support (if it exists) has little to no ITS experience.	Full-time ITS Manager and staff with significant prior ITS experience. Staff support includes system administration, operations, and maintenance responsibilities.
Organizational Experience	Little to no experience with the possible exception of Category 1 ITS projects.	Experience with at least one Category 2 or greater project.	Experience with at least one Category 3 or greater project.
Organizational Structure	ITS responsibility not defined. Responsibility housed within organization with other mission or primary responsibility. Responsibility may also be scattered amongst organizational entities with no clear lines of responsibility.	ITS responsibility somewhat, but not adequately defined. Individual organizational units have ITS responsibility and have their own budgets, management and priorities; however, there are no definitive linkage between these units. An umbrella ITS organizational unit may exist, but may not have the budgetary authority to effectively manage sub-units.	Established organizational unit with budgetary authority and clear ITS responsibilities. Organizational unit ties all ITS responsibilities together and includes a procurement process that supports ITS acquisition (e.g., personnel, policies, and procedures).
Resources	Little to none. No identifiable ITS budget categories or identification of specific ITS funding within existing organizational units.	Some budget resources (e.g., ITS earmark funding) assigned to one or more existing organizational unit(s). Support for personnel, equipment, office space, and training expected to come from organizational unit(s) existing budget.	Identifiable budget category set aside for ITS. Budget includes support for all required personnel, support equipment, office space, training, and (if necessary), consulting support.
Management Support	Some mid-level management support for ITS/Operations, but little to no interest at top management levels. ITS/Operations not recognized as an agency priority.	Strong mid-level management support for ITS/Operations, with some interest/ involvement at top management levels.	Top level management support. ITS/Operations considered an agency priority within its overall mission.
Expectations	Not defined or limited to a lower category ITS project that's under consideration for deployment, expansion, or replacement.	Expectations exist for a few "special" ITS related projects. Expectations may or may not be realistic depending on if they've been managed properly.	ITS/Operations is part of both short and long range planning. Expectations are well defined with actual performance measures. ITS/Operations expectations focus on improvement and no on "status-quo."



This Step is based on work associated with Task 4 of the NCHRP Project that supported development of this Guide. Please refer to the NCHRP final report for additional detailed information on the systems engineering process models.

STEP 5 – SELECT APPLICABLE SYSTEMS ENGINEERING PROCESS(ES) AND PROCUREMENT PACKAGE(S)

Step 5 is one of the key steps of the Decision Model in that at the completion of this step you will have identified the appropriate contracting package and systems engineering process for your system development initiative. However, if you expect this step to provide a definitive answer as to the procurement package and systems engineering process you should use -- be warned – because it will, in all likelihood, result in a number of candidate alternatives. Subsequent steps will be used to help you make a final decision.

Prior to executing this step, let's first review the alternative systems engineering processes that could be applied to your situation. The alternative processes (also known as models) are the Waterfall Model, the Evolutionary Model, and the Spiral Model, all of which are explained in detail in the NCHRP Report.

The Waterfall Model is representative of typical highway design and construction processes in which steps of planning, designing, and implementing are performed sequentially. This model is used for less complex ITS projects and can be applied under all Agency Capability Levels.

The Evolutionary Model defines a repetitive sequence of phased planning, requirements, design, and implementation stages resulting in the deployment of phased versions of a system such that each version is closer to the ultimate system vision. It is applicable to all but the simplest ITS projects, or those that require the development of new, unproven technologies. It should be used by all organizational levels for most system developments. The idea behind this model is to divide your complex system development into relatively simple implementation stages (bite-size pieces) that will ultimately result in the successful deployment of the complete system by the "end" of the final phase. Remember though that an ITS project will never truly "end" as your deployed system will *always* require ongoing operations and maintenance.

The Spiral Model is appropriate for the development of new applications involving previously untested capabilities requiring a lot of planning, prototyping and evaluation. This model is rarely used by the ITS community, since its application is expensive and time consuming. It is most commonly used by the Department of Defense and NASA for the development of new weapons systems, or space platforms. It has been used within the ITS community for such advanced developments as the automated highway system and some of the new in-vehicle safety systems. To use the Spiral Model, a Level 3 organization with an experienced full time ITS manager and staff is recommended. The spiral methodology involves lots of prototyping and feedback requiring significant agency staff time. A Level 2 organization, with significant consultant resource support (assuming this can be obtained), could oversee this development model but at greater risk for failure. A Level 1 organization would not have the experience, structure, or resources to appropriately manage and be involved in this development process.

Now that you've completed our review of systems development processes and their relationship to project categories and agency levels, let's actually execute Step 5. Use the columns (Agency Capability) and rows (Project Category) of the matrix in Table 4 to identify the cell that defines the applicable procurement package or packages.

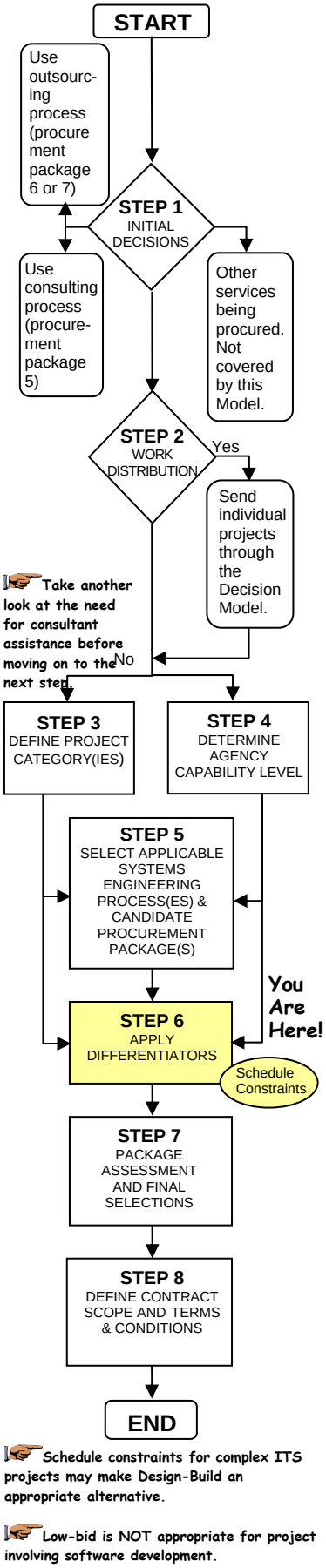
The commodity entries in this table reflect the fact that a simple system, based entirely on a commercial off-the-shelf (COTS) product should be acquired using the commodity procurement package. When COTS products are part of a larger system, other procurement packages may be used (i.e. the product may be part of a proposal for low-bid, systems manager, or design-build procurements). A design-build contractor or a systems manager may decide to acquire a COTS product during the system implementation. If this is the case, the product may be acquired by the contractor or in some cases, the agency will procure the COTS product for the contractor using a commodity procurement.

Many of the cells in the matrix provide you the flexibility to choose between multiple procurement packages and systems engineering techniques. You were warned that this step would probably not result in a definitive answer! Step 6, discussed next, will provide you with information that can be used to provide additional differentiation between multiple solutions. If a cell indicates that the project is "Not recommended," the agency should either seek more experienced staff support or redefine and simplify the project. *Remember, as with the previous step, no amount of optimism can be used to overcome fundamental shortcomings in experience or resources!*

Table 4. The Decision Matrix - Step 5

Project Category	Agency Capability Level		
	Level 1	Level 2	Level 3
1 – Low	• Waterfall • SM*	• Waterfall • Low Bid*, commodity, or SM	• Waterfall • Low Bid, commodity, or SM
2 – Moderately Complex	• Evolutionary • SM or DB*	• Waterfall or evolutionary • Low Bid*, SM or DB	• Waterfall or evolutionary • Low Bid, SM or DB
3 – Complex	Not recommended	• Evolutionary • SM or DB	• Evolutionary or spiral • SM or DB
4 – Extremely Complex	Not recommended	• Evolutionary or spiral • SM or DB	• Evolutionary or spiral • SM or DB

Notes:
First line is the systems engineering technique; second line is the procurement package
DB = Design Build
SM = Systems Manager
* - Consulting services should be used while project is underway



STEP 6 – APPLY DIFFERENTIATORS

The next step in the process, Step 6, should be used when more than one procurement package type is identified by the table referenced during Step 5. This step uses additional criteria to help you try and reduce the number of alternatives. These criteria are listed below:

Note that the "Schedule Constraints" input into this step as depicted in the Decision Model diagram highlights the time constraint of implementing a complex system making Design-build a potentially attractive alternative.

- Systems manager is preferred to design-build when significant amount of new software development is required.
- Design-build is preferred over systems manager only for major projects when significant amounts of field construction are involved and there is a desire to reduce implementation delays associated with having to administer multiple procurement contracts. Note that the "Schedule Constraints" input into this step as depicted in the Decision Model diagram highlights the time constraint of implementing a complex system making Design-build a potentially attractive alternative.
- The evolutionary systems engineering model is generally preferred over the spiral model because it is less costly and easier to apply. The spiral model should only be used in the event that complex, untested, new developments are required.
- If a project includes both new software and field construction, consider splitting it into multiple contracts.
- Low-bid contracting should only be used:
  - In the unlikely event that it is required by agency policy, or
  - If projects are limited to field construction and supply of off-the-shelf equipment.
- Commodity procurement is applicable if an existing package is available that does not require any modification to meet agency's requirements except for:
  - New drivers for interface with communications and field equipment,
  - New database reflecting system configuration, and
  - New map graphics.

If after considering these differentiators, you still find yourself with multiple solutions, work with your agency's procurement officials to select the preferred alternative (which is Step 7).

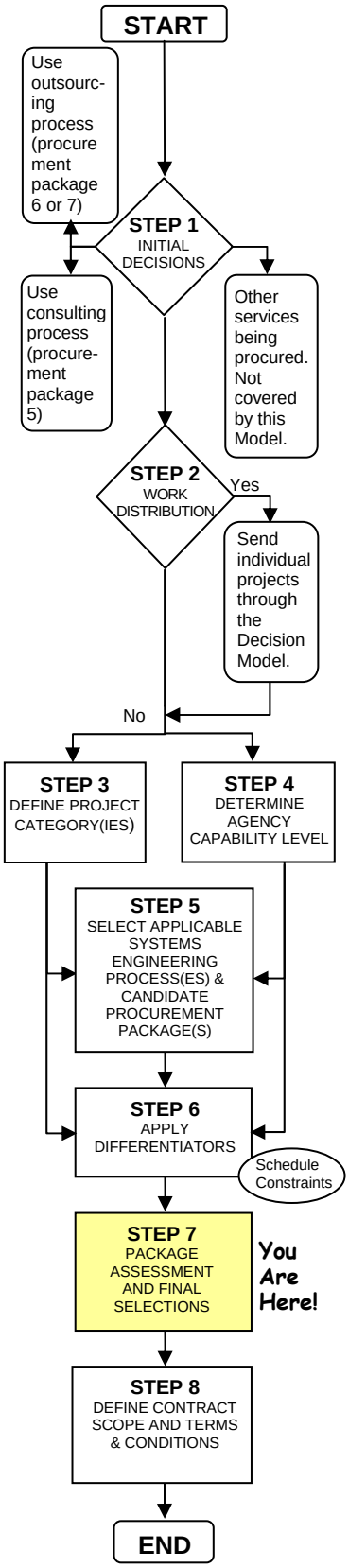
But before you move on to Step 7, it may be necessary to re-assess the need for consulting assistance and/or provision of field construction and field equipment supply. The first time (back in Step 1) this assessment was based on overall considerations of the extent and type of work to be performed. During Step 7, the needs of the contracting package for consulting assistance should be reviewed. Other approaches might also require consulting assistance as defined by procurement package number 5. The requirements for consulting assistance include:

- A design consultant must prepare the 100% design and a package of plans, specifications and estimates (PS&E) to be used during the low-bid process. So two contracts will be required; one for the design consultant and a second for the low-bid implementation contractor.

- A systems manager contractor is, in effect a consultant. For this reason, major items of field construction and the furnishing of field equipment must be performed by contractors selected on a low-bid basis. This means two or more contracts will be required; one for the systems manager and additional contracts for construction, electrical contracting and equipment supply. These additional contracts will all be low-bid. All of this work (construction, electrical contracting and equipment supply) may be combined into a single contract for field device implementation.

- A design consultant must prepare a 30% design to be used for the selection and negotiations with a design-build contractor. So two contracts are required; one for the design consultant and a second for the design-build contractor. Note that some agencies with significant ITS expertise and design personnel on staff (Level 3) could prepare 30% design plans in-house.

Commodity procurements often require the services of a systems integrator, systems manager or design-build contractor to implement the COTS product being acquired.



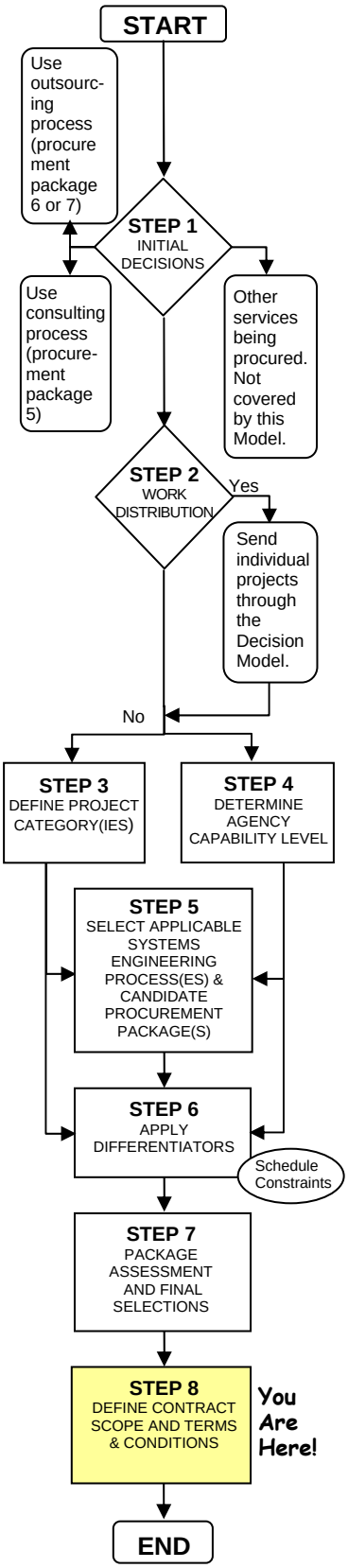
STEP 7 – PACKAGE ASSESSMENT AND FINAL SELECTIONS

It is important that Step 7 be performed for all procurements. *If you have not already done so, at this point it is imperative to discuss procurement package selection with agency procurement personnel.* You may also want to include legal personnel to discuss intellectual property rights, as well as contract terms and conditions of Step 8.

In the event that multiple procurement alternatives exist at the conclusion of Step 6, make the final selection of the preferred alternative cooperatively with your procurement staff. This decision must consider your agency policies, and should possibly give preference to alternatives with which your agency has had prior experience.

Take advantage of the expertise from your agency's IT department.

However, prior experience should not be limited to your agency's experience with highway construction. You may very well be able to take advantage of the expertise of information technology (IT) personnel that already exists either within or outside your procurement department. This expertise can take the form of technical expertise (e.g., hardware, software, communications) or even IT procurement expertise. While coordination with IT staff is encouraged, relinquishing authority for technology procurements (e.g., moving responsibility for procuring ITS related hardware, software, and communications from the DOT to another State department responsible for IT) is NOT recommended.



STEP 8 – DEFINE CONTRACT SCOPE AND TERMS & CONDITIONS

You've made it to the final step! This step in the decision model involves the selection of the terms and conditions to be included in the contract. As with step 6, you'll want to do this step in close collaboration with your agency's procurement personnel. While some terms and conditions are required for all types of contracts, others are only suitable for certain types of contracts (i.e., commodity supplier, low bid with design consultant, system manager, and design-build contractor). Table 5 lists the mandatory contract terms and conditions that should be considered regardless of procurement package used. Table 6 identifies terms and conditions that are most appropriate to a specific procurement package. The section following Table 6 provides definitions for all the terms and conditions in both Tables 5 and 6.

Table 5. List of Mandatory Contract Terms and Conditions

Parties to the Contract	Delays and Extensions of Time
Scope of the Contract	Modifications
Compensation and Method of Payment	Multiple Contract Awards
Extras	Liquidated Damages
Assignment of Claims	Variations in Estimated Quantities
Agency Furnished Property	Suspension of Work
Order of Precedence	Incorporation by Reference
Commercial Warranty	Specifications
Patent Rights	Delivery and Acceptance
Multiyear Contracts Contingent upon Appropriations	Intellectual Property
Termination for Default	Contractor's invoices
Termination for Convenience	Conflicting Terms
Execution and Commencement of Work	

ITS is not explicitly referenced in the FAR. Relevant information can be found in sections referencing Information Technology (IT).

Your agency is likely to have standard sets of terms and conditions that are to be incorporated in the request for proposals and resulting contract. In the unlikely event that standard terms and conditions are not available within your agency, or if you're looking for guidance on a specific term and condition not typically used by your agency, the Federal Acquisition Regulations (FAR) is a good source of information. The FAR, which govern the majority of Federal procurements, includes language for myriad terms and conditions including those appropriate to ITS projects.

Table 6. Procurement Packages and Their Associated Terms and Conditions

Commodity Supplier Terms and Conditions	Low-Bid Contractor with Design Consultant	Systems Manager	Design-Build Contractor with Design Consultant	Consultant	Outsourcing Agency Activity	Outsourcing Agency Function
Contractor Inspection Requirements	Design within Funding Limitation	Negotiation	Negotiation	Negotiation	Negotiation	Negotiation
Inspection of Supplies	Redesign Responsibility for Design Errors or Deficiencies	Commercial Computer Software Restricted	Design within Funding Limitations	Notice of Cost Comparison	Fixed Fee	Fixed Fee
Option for Increased Quantity	Deficiencies	Rights	Redesign Responsibility for Design Errors	Allowable Costs and Payment	Incentive Fee	Incentive Fee
Ordering	Fixed Price	Fixed Fee	Work Oversight	Fixed Fee	Work Oversight	Work Oversight
Definite Quantity	Incentive Fee	Incentive Fee	Suspension of Work	Incentive Fee	Execution and Commencement of Work	Execution and Commencement of Work
Indefinite Quantity	Performance/Payment Bond	Rights in Data	Fixed Fee	Performance Based Payments	Performance/Payment Bond	Performance/Payment Bond
Brand Name of Equal		Allowable Costs and Payment	Incentive Fee	Delivery Orders (Task Orders)	Allowable Costs and Payment	Allowable Costs
Performance/Payment Bond		Performance Based Payments	Execution and Commencement of Work	Specifications	Performance Based Payments	Modifications
		Delivery Orders (task orders)	Performance/Payment Bond	Delays and Extensions of Time	Modifications	Rights in Data
		Specifications	Specifications and Drawings	Modifications	Rights in Data	
		Delays and Extensions of Time	Performance/Payment Bond	Delivery and Acceptance		
		Modifications		Disputes		
		Delivery and Acceptance		Retention of Records		
		Conflicting Terms		Indemnification		
		Patent Infringement Indemnification				
		Federal Grant Flow down Provisions				
		Performance/Payment Bond				

CONTRACT TERMS AND CONDITIONS DEFINITIONS

The following are Contract Terms and Conditions Definitions for each of the Seven Types of Procurement Packages, which include:

1. Commodity Supplier
2. Low-Bid Contractor with Design Consultant
3. Systems Manager
4. Design-Build Contractor with Design Consultant
5. Consultant
6. Outsourcing Agency Activity
7. Outsourcing Agency Function

Agency-Furnished Property	Describes how Agency property will be delivered to a Contractor for use during the term of the contract.
Allowable Costs and Payment	Identifies all Contractor costs that will be allowable under the contract and the process of payment for those costs.
Anti-Bribery	Requires the Contractor to affirm that none of its officers, directors, partners or employees has been convicted of bribery under the laws of any state or the federal government.
Assignment of Claims	Allows the Contractor the right to assign its rights to be paid to a bank, trust company, or any other financing institution.
Bid Guarantee	Protects the Agency in the event Bidder's do not provide an acceptable bid guarantee as required at the time of bid submission.
Bid Samples (Sealed Bidding Only)	Insures the Contractor provides bid samples, in the quantities, sizes, etc., required for the items identified in the bid and must be submitted and received before or at the time for opening the bids.
Brand Name of Equal	Requires the Contractor to provide the brand name product or one that will be equal in all material respects.
Commercial Computer Software-Restricted Rights	Describes the specific restricted rights for contracts computer software of the Agency and Contractor.
Commercial Warranty	Insures the Contractor agrees to provide the most favorable commercial warranties the Contractor gives to any of its customers for supplies or services.
Compensation and Method of Payment	Identifies the terms of compensation and the method of payments the Agency will pay to the Contractor.
Compliance with Laws	Requires the Contractor to be in compliance with all laws (Federal, State, Local etc.) to qualify for award of a contract.
Conflicting Terms	Protects the Agency from any terms the Contractor may attempt to add to the contract with the Agency terms taking precedence.

Contingent Fee Prohibition	Allows the Agency to terminate a contract if the contractor is found to have employed or retained to solicit a contract from a bona fide employee of Agency.
Contingent Fees	Protects the agency from any commission, percentage, brokerage or other fee that is contingent on the success that a person or firm has in securing a contract with the Agency.
Contract Affidavit	Affirms that the Contractor is indeed a recognized business entity either domestic or foreign and the individual signing the contract is duly authorized to do so by the business.
Contractor Inspection Requirements	Requires the Contractor to be responsible for performing all inspections and tests necessary to insure conformance with contract requirements.
Contractor's Invoices	Describes what the Agency requires from the Contractor on all its invoices for payment purposes.
Cost and Price Certification	Requires the Contractor to certify that their cost or price information is accurate and complete.
Definite Quantity	Used when exact numbers of the requirements are known and can often protect the Agency from paying more for known quantities.
Delays and Extensions of Time	Describes the process and protects the Agency in the event delays and/or extensions of time are encountered or requested by the Contractor.
Delivery and Acceptance	Describes the delivery and acceptance process with which the Contractor must comply.
Delivery of Supplies F.O.B. Destination	Insures the Agency is free of expense and the Contractor will be responsible for all costs associated with delivery of supplies and or materials.
Delivery Orders (Task Orders)	Describes the process the Agency will use to order specific work under the contact.
Descriptive Literature (Sealed Bidding Only)	Requires the bidder to furnish literature that shows the item/s in the bid for which it pertains by the time specified in the bid for receipt.
Design within Funding Limitation	Requires the Contractor to design the requirement within a not to exceed amount of funding available for the project.
Discount for Prompt Payment	Provides for the Agency to receive a percentage discount for payments made to the contractor normally within a certain number of days from the submittal of an invoice to the Agency from the Contractor.
Disputes	Defines the parties to the contracts rights in the event of any disputes associated with the contract.
Equal Low-Bids	Provides for the Agency to award a contract when there is economic benefit that is in its best interest (in State vs., out of State Contractor).

Execution and Commencement of Work	Requires the Contractor to sign and return the contract document by a specific date and also to proceed with the performance of the work, including the purchase of necessary materials as required by the contract.
Extras	Prevents the Contractor from receiving payment for Extras unless such Extras are authorized in writing by the Agency Contracting Official.
Federal Grant Flow Down Provisions	Identifies the Federal contract terms and conditions (clauses) that must be used in Agency contracts when using federal grant funds.
Federal, State, Local Taxes	Assures the Contractor warrants that no Federal, State or Local Taxes have been included (EXCISE TAXES) in the amounts quoted in the bid or proposal.
Financial Disclosure	Requires the Contractor to file specific information to include disclosure of beneficial ownership of business interests.
Fixed Fee	Provides the Contractor with a predetermined amount of fee to be paid by the Agency assuming the Contractor satisfactorily completes the requirements under contract.
Fixed Price	Provides for the Agency to assume the least financial risk and places the most risk on the Contractor.
Gratuities	Insures the Agency's right to terminate a contract in the event the contractor offers or gives a gratuity to any Officer, Official or employee of the Agency.
Incentive Fee	Provides for the Contractor to receive additional compensation providing they exceed the Agency's requirements.
Incorporation by Reference	Protects the Agency by stating that all terms and conditions of the contract and any changes are made a part of the contract.
Indefinite Quantity	Used when the exact numbers of the requirements are not known and can cost the Agency more as more risk is placed on the Contractor.
Indemnification	Protects the Agency from any obligation to indemnify, hold harmless, or pay attorney's fees that result from the contract.
Independent Pricing	Insures the Contractor's offer has been arrived at independently without attempting to limit full and open competition.
Inspection of Supplies	Requires the Contractor to maintain an inspection system that is acceptable to the Agency.
Insurance	Defines the types and amounts of insurance coverage the Contractor shall provide to perform any work under a contractor.
Intellectual Property	Indemnifies the Agency with respect to any claim, cost or action for patent infringement or trademark or copyright violation as a result of the contract.
Late Bids, Modifications or Withdrawals of Bids	Describes the process by which late bids, modifications or withdrawals of bids from the Contractor will or will not be accepted by the Agency.

Liquidated Damages	Provides for the Agency to receive from the Contractor compensation in the event the Contractor fails to perform in accordance with the contract.
Modifications	Describes the process by and for which modifications will be executed under the contract.
Multiple Contract Awards	Allows the Agency to award more than one contract if multiple awards are in the best interests of the Agency.
Multi-Year Contracts Contingent Upon Appropriations	Protects the Agency for long-term contracts in the event that the funding authority does not make future-year fiscal appropriations.
Negotiation	Identifies the Agency's process for a negotiated procurement.
Nondiscrimination in Employment	Insures the contractor will not discriminate against any race when employing individuals to perform work under the contract.
Non-Hiring of Employees	Prevents the Contractor from hiring Agency employees during the contract term and sometimes vice versa.
Notice of Cost Comparison	Puts all contractors on notice of the Agency's intent to perform cost comparisons of proposals prior to award of a contract.
Officials Not to Benefit	Protects against Agency officials in sharing or benefiting in any way from a contract.
Option for Increased Quantity	Allows the Agency to increase the quantities of supplies called for in the contract at the contract bid price.
Order of Precedence	Describes the order in which each part of the contract will govern and generally protects the Agency more in the event of contract disputes.
Ordering	Describes how the Agency will order supplies or services from the Contractor under the contract.
Parties to the Contract	Identifies and defines all legal entities to the contract.
Patent Infringement Indemnification	Describes how the Contractor indemnifies the Agency for infringement of Agency patent.
Patent Rights	Protects the Agency against any claims made against them for any alleged infringements of patents by the Contractor or other third parties.
Payments Under Transportation Contracts	Describes how the Contractor will be paid by the Agency for transportation or transportation related services.
Performance Based Payments	Describes how the Agency will make payments to the Contractor based strictly on performance of specific requirements (normally specific deliverables) under the contract.
Performance/Payment Bond	Requires the Contractor to purchase a bond equal to 100% of the total contract value which insures the contractor will perform all the work and/or pay all their subcontractors, otherwise, the Agency can call in the bond to insure the work will be performed even if it is by other contractors.
Political Contribution Disclosure	Requires the contractor to file specific information for political

	contributions made for elective office in any primary general election.
Pre-Existing Regulations	Protects the Agency in the event there may be other regulations to consider that may take precedence over the specific terms and conditions within a contract.
Redesign Responsibility for Design Errors or Deficiencies	Requires the Contractor to redesign the requirement at no cost to the Agency in those cases where the Contractor has errors, deficiencies or inadequacies in the design.
Retention of Records	Requires the Contractor to maintain all records pertaining to a contract for a specific period of time.
Rights in Data	Describes the Agency's and Contractor's rights for data, including source code ownership and use, and identifies the specific types of data under the contract.
Scope of the Contract	Describes in as much detail as possible what the Agency is soliciting and expects to receive from the Contractor and becomes a part of the contract at time of contract award.
Specifications	Requires the Contractor to ensure that all materials, equipment, supplies or services conform to federal and State laws and regulations and to the specifications contained in the contract.
State Law Prevails	Protects the Agency in the event of contract disputes in that their own State laws will be used to litigate those disputes.
Suspension of Work	Allows the Agency to suspend the Contractor's work if it is in the best interests of the Agency.
Tax Exemption	Protects the Agency from paying any taxes borne by the Contractor under the contract.
Termination for Convenience	Allows the Agency to terminate a contract at any time for its convenience with minimal financial risk to the Agency.
Termination for Default	Protects the Agency in the event of contractor non-performance and results in early termination of a contract due to actions or inactions solely by the Contractor.
Truth-In-Negotiation Certification	Requires the Contractor to certify that their wage rates and other factual unit costs and current and accurate at the time of contract award.
Unnecessary Elaborate Contractor Proposals	Informs the Contractor's that elaborate proposals are not desired and may be an indication of the Contractor's lack of cost consciousness.
Variations in Estimated Quantities	Protects the Agency when it becomes necessary for the Agency to order more of less work under the contract.
Work Oversight	Allows for general oversight, supervision, direction and approval by the Agency over the Contractor for prosecution of the work under the contract.

APPENDIX A: STEP 3

WORKSHEET

Determining ITS Project Category (Complexity and Risk)

Prepared By: _____ Date: _____

Brief Project Description:

_____

_____

_____

_____

Which of the following best describes the ***Level of New Development*** for this project?

1. Little to no new software development / exclusively COTS software and hardware based or based on existing proven software and hardware.

2. Primarily COTS software / hardware or existing software / hardware based with some new software development or new functionality added to existing software - evolutionary development.

3. New software development for new system, replacement system, or major system expansion including use of COTS software. Implementation of new COTS hardware.

4. Revolutionary development - entirely new software development including integration with COTS or existing legacy system software. Implementation of new COTS hardware or even prototype hardware.

Answer Number: [ ]

Which of the following best describes the ***Scope and Breadth of Technologies*** for this project?

1. Application of proven, well-known, and commercially available technology. Small scope in terms of technology implementation (e.g., only CCTV or DMS system). Typically implemented under a single stand-alone project, which may or may not be part of a larger multi-phased implementation effort.

2. Primary application of proven, well-known, and commercially available technology. May include non-traditional use of existing technology(ies). Moderate scope in terms of technology implementation (e.g., multiple technologies implemented, but typically no more than 2 or 3). May be single stand-alone project, or may be part of multi-phased implementation effort.

3. Application of new software / hardware along with some implementation of cutting edge software, hardware, or communication technology. Wide scope in terms of technologies to be implemented. Projects are implemented in multiple phases (which may be category 1 or 2 projects).

4. New software development combined with new hardware configurations / components, use of cutting edge hardware and/or communications technology. Very broad scope of technologies to implement. Projects are implemented in multiple phases (phases may be category 1 or 2 projects).

Answer Number: [ ]

Which of the following best describes the need for *Interfaces to Other Systems* for this project?

1. Single system or small expansion of existing system deployment. No interfaces to external systems or system interfaces are well known (duplication of existing interfaces).

2. System implementation includes one or two major subsystems. May involve significant expansion of existing system. System interfaces are well known and based primarily on duplicating existing interfaces.

3. System implementation includes three or more major subsystems. System interfaces are largely well know but includes one or more interfaces to new existing systems / databases.

4. System implementation includes three or more major subsystems. System requires two or more interfaces to new and/or existing internal/external systems and plans for interfaces to "future" systems.

Answer Number: [ ]

Which of the following best describes the need to account for *Technology Evolution* during the expected life of this project?

1. Need to account for technology evolution perceived as minor. Example would be to deploy hardware and software that is entirely compatible with an existing COTS-based system. Ramifications of not paying particular attention to standards considered minor. System implemented expected to have moderate to long useful life.

2. Need to account for technology evolution perceived as an issue to address. Example includes desire for interoperable hardware from multiple vendors. Ramifications of not paying particular attention to standards may be an issue, as an agency may get "locked-in" to a proprietary solution. Field devices expected to have moderate to long useful life. Center hardware life expectancy is short to moderate. Control software is expected to have moderate to long life.

3. Need to account for technology evolution perceived as a significant issue. Examples might include implementation of software that can accommodate new hardware with minimal to no modification and interoperable hardware. Ramifications of not using standards based technology are considerable (costs for upgrades, new functions, etc.) Field devices expected to have moderate to long useful life. Center hardware life expectancy is short to moderate. Control software is expected to have an extendable useful life.

4. Need to account for technology evolution perceived as major issue. Examples include software that can easily accommodate new functionality and/or changes in hardware and hardware that can be easily expanded (e.g. add peripherals), maintained, and is interoperable. Ramifications of not using standards based technology are considerable (costs for upgrades, new functions, etc.) Field devices expected to have moderate to long useful life. Center hardware life expectancy is short to moderate. Control software is expected to have an extendable useful life.

Answer Number: [ ]

Which of the following best describes the need to account for *Requirements Fluidity* during development of this project?

1. System requirements are very well defined, understood, and unlikely to change over time. Formal requirements management a good idea, but not a necessity.

2. System requirements are largely well defined and understood. Addition of new system functionality may require more attention to requirements management.

3. New system functionality includes a mix of well defined, somewhat defined, and fuzzy requirements. System implementation requires adherence to formal requirements management processes.

4. System requirements not well defined, understood, and very likely to change over time. Requires strict adherence to formal requirements management processes.

Answer Number: [ ]

Which of the following best describes the potential impact of ***Institutional Issues*** on this project?

1. Minimal- project implementation involves one agency and is typically internal to a particular department within the agency.
2. Minor- may involve coordination between two agencies. Formal agreements not necessarily required, but if so, agreements are already in place.

3. Significant- involves coordination among multiple agencies and/or multiple departments within an agency or amongst agencies. Formal agreements for implementing project may be required.

4. Major- involves coordination among multiple agencies, departments, and disciplines. Requires new formal agreements. May require new multi-agency project oversight organization.

Answer Number: [ ]

ITS Project Category Score (Answer Number Total): [ ]

ITS Project Category Score	6 -12	12 - 18	18 - 24
Complexity	Straightforward to Moderately Complex	Moderately Complex to Complex	Complex to Extremely Complex
Risk	Low to Moderate	Moderate to High	High to Very High
Category	1 - 2	2 - 3	3 - 4

Determining Your ITS Project Category

Using the table above, determine which of the three (3) ranges your ITS Project Category score falls within. Use your judgment to select the appropriate Category number based on where your score falls within the range. If the score falls towards the lower end of the range, select the lower category in that range. If it falls towards the higher end of the range, select the higher category. If it falls somewhere in the middle, be conservative and select the higher category number. For example, suppose your ITS Project Category Score comes out to 15 which falls directly between 12-18. The suggestion is to be conservative and rank the project as a Category 3, one that is Complex with a High level of risk.

APPENDIX B: STEP 4

WORKSHEET

Determining Agency Capability Level

Prepared By:_____ Date: _____

Brief Project Description:

_____

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_____

_____

Which of the following best describes the ***Level of ITS Project Experience*** for your agency's personnel?

1. ITS assigned as part-time job to person with no staff and little to no specific ITS experience.

2. ITS assigned as full-time job with no staff or some part-time staff support. Person assigned has some specific ITS experience with Category 2 or 3 projects. Staff support (if it exists) has little to no ITS experience.

3. Full-time ITS Manager and staff with significant prior ITS experience. Staff support includes system administration, operations, and maintenance responsibilities.

Answer Number: [ ]

Which of the following best describes your agency's ITS *Organizational Experience*?

1. Little to no experience with the possible exception of Category 1 ITS project(s).

2. Experience with at least one Category 2 or greater project.

3. Experience with at least one Category 3 or greater project.

Answer Number: [ ]

Which of the following best describes your agency's *Organizational Structure* for handling ITS project responsibilities?

1. ITS responsibility is not defined. Responsibility housed within organization with other mission or primary responsibility. Responsibility may also be scattered amongst organizational entities with no clear lines of responsibility.

2. ITS responsibility somewhat defined, but not adequately defined. Individual organizational units have ITS responsibility and have their own budgets, management, and priorities; however, there is no definitive linkage between these units. An umbrella ITS organizational unit may exist, but may not have the budgetary authority to effectively manage sub-units.

3. Established organizational unit with budgetary authority and clear ITS responsibilities. Organizational unit ties all ITS responsibilities together and includes a procurement process that supports ITS acquisition (e.g., personnel, policies, and procedures).

Answer Number: [ ]

Which of the following best describes the level of *Resources* for ITS within your agency?

1. Little to none. No identifiable ITS budget categories or identification of specific ITS funding within existing organizational units.

2. Some budget resources (e.g., ITS earmark funding) assigned to one or more existing organizational unit(s). Support for personnel, equipment, office space, and training expected to come from organizational unit(s) existing budget.

3. Identifiable budget category set aside for ITS. Budget includes support for all required personnel, support equipment, office space, training, and (if necessary) consulting support.

Answer Number: [ ]

Which of the following best describes the level of *Management Support* for ITS and Operations within your agency?

1. Some mid-level management support for ITS/Operations, but little to no interest at top management levels. ITS/Operations not recognized as an agency priority.

2. Strong mid-level management support for ITS/Operations with some interest/involvement at top management levels.

3. Top level management support. ITS/Operations considered an agency priority within its overall mission.

Answer Number: [ ]

Which of the following best describes the level of management *Expectations* for ITS projects within your agency?

1. Not defined or limited to a lower category ITS project that's under consideration for deployment, expansion, or replacement.

2. Expectations exist for a few "special" ITS related projects. Expectations may or may not be realistic depending on if they've been managed properly.

3. ITS/Operations is part of both short and long range planning. Expectations are well defined within actual performance measures. ITS/Operations expectations focus on improvement and not on "status-quo".

Answer Number: [ ]

Agency Level Score (Answer Number Total): [ ]

Agency Level Score	6 -12	12 - 18
Agency Level	1 - 2	2 - 3

Determining Your Agency Capability Level

Using the table above, determine which of the two (2) ranges your Agency Level Score falls within. Use your judgment to select the appropriate Capability Level based on where your score falls within the range. If the score falls towards the lower end of the range, select the lower Capability Level in that range. If it falls towards the higher end of the range, select the higher level. If it falls somewhere in the middle, be conservative and select the higher Capability Level. For example, suppose your Agency Level Score comes out to 15, which falls directly between 12-18. The suggestion is to be conservative and rank your Capability Level as a 2 instead of 3.