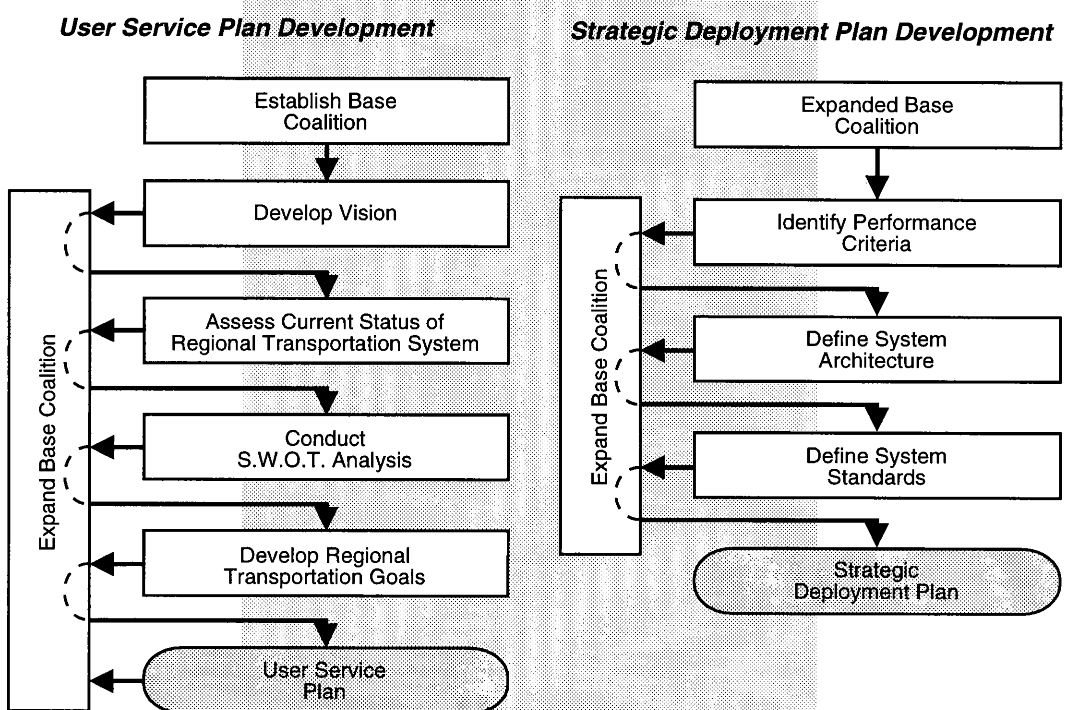
FINAL REPORT

EVALUATION OF THE ITS PLANNING PROCESS



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Technical Report Documentation Page

1. Report No. FHWA/VA-96-R-19	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle Evaluation of the ITS Planning Process		5. Report Date January 1996 6. Performing Organization Code
7. Author(s) Smith, B.L., Taylor, R.V., Pindur, W., and Yacus, G.		8. Performing Organization Report No. VTRC 96-R19
9. Performing Organization Name and Address Virginia Transportation Research Council 530 Edgemont Road Charlottesville, VA 22903-0817		10. Work Unit No. (TRAIS) 11. Contract or Grant No. IVH 9351 (602)
12. Sponsoring Agency Name and Address Virginia Department of Transportation 1401 E. Broad Street Richmond, VA 23219		13. Type of Report and Period Covered Final Report 14. Sponsoring Agency Code

15. Supplementary Notes

In cooperation with the U.S. Department of Transportation, Federal Highway Administration

16. Abstract

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The FHWA asked the Virginia Transportation Research Council (VTRC) to evaluate and revise Version 1.0 of the ITS Planning Process as part of the early deployment planning project, COMPARE, in Hampton Roads, Virginia. The study team, which included researchers from the VTRC and Old Dominion University, carried out four tasks: (1) a comparison of the ITS Planning Process with other large scale systems planning processes; (2) interviews of participants in other deployment planning projects in the United States; (3) participation in the COMPARE project; and (4) evaluation of the deliverables from COMPARE.

The researchers recommended several revisions to the ITS Planning Process. The revisions reflect the fact that ITS planning needs to be integrated into the traditional regional transportation planning framework. The main emphasis of the revised process, Version 2.0 is that planning result in implementation.

17. Key Words Intelligent transportation systems ITS Planning		18. Distribution Statement No restrictions. This document is available to the public Through NTIS, Springfield, VA 22161.	
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 61	22. Price

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

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(The opinions, findings, and conclusions expressed in this report are those of the authors and not necessarily those of the sponsoring agencies.)

Virginia Transportation Research Council
(A Cooperative Organization Sponsored Jointly by the
Virginia Department of Transportation and
The University of Virginia)

In Cooperation with the U.S. Department of Transportation
Federal Highway Administration

Charlottesville, Virginia

January 1996
VTRC 96-R19

ABSTRACT

Planning for the deployment of ITS in regions throughout the United States has been underway since the development of the Early Deployment Program by the Federal Highway Administration (FHWA) in 1992. In 1993, the FHWA released Version 1.0 of the *ITS Planning Process*, a systems planning process provided as a guide to those undertaking regional ITS planning efforts.

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The researchers recommended several revisions to the *ITS Planning Process*. The revisions reflect that fact that ITS planning needs to be integrated into the traditional regional transportation planning framework. The main emphasis of the revised process, Version 2.0, is that planning result in implementation. The major changes include the following:

- Replace the inventory with a "current assessment" element.
- Stress the need for a vision of the future regional transportation system.
- Insert steps to conduct an environmental scan and SWOT analysis.
- Emphasize the importance of beginning the process with a strong coalition that is constantly expanding.
- Add a step defining regional transportation goals.
- Map ITS user services into the regional transportation goals.
- Establish relatively simple measures for success for each prioritized user service.
- Stress the importance of defining system interface standards.
- Dedicate a large proportion of the work to the creation of the Strategic Deployment Plan, which should include alternative product packages based on various levels of funding and different partnership alternatives.

FINAL REPORT: EVALUATION OF THE *ITS PLANNING PROCESS*

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INTRODUCTION

Intelligent transportation systems (ITS) apply information technology to the surface transportation system to make travel safer and more efficient. Although technology serves as a foundation, the successful application of ITS is not dependent solely on the quality of the technical components. Rather, the ability of ITS to function effectively as an integrated system is fundamental to its successful application. Therefore, sound systems planning is essential to the successful deployment of ITS.

Recognizing the importance of systems planning for ITS, the Federal Highway Administration (FHWA) initiated the Early Deployment Program in 1992. This program provides funding for metropolitan areas and intercity corridors to conduct ITS planning studies. FHWA's goal is to complete these studies in the 75 largest metropolitan areas by the year 1997. As the program began, it became clear that planning for ITS was fundamentally different than planning for expansion of the traditional highway system. Therefore, the FHWA developed Version 1.0 of the *IVHS Planning and Project Deployment Process* to provide guidance to those involved in early deployment studies. (*Note:* ITS was referred to as intelligent vehicle-highway systems [IVHS] until 1994.)

Description of the Version 1.0 IVHS Planning and Project Deployment Process

Version 1.0 is actually a combination of two processes: the *IVHS Planning Process* (which will be referred to as the *ITS Planning Process* in the remainder of this report) and the *Project Deployment Process*. A complete description of both processes can be found in Appendix A.

The ITS Planning Process

The *ITS Planning Process* (Figure 1) provides a framework for the preliminary planning of the application of ITS in metropolitan areas and intercity corridors and is based on a systems planning approach.

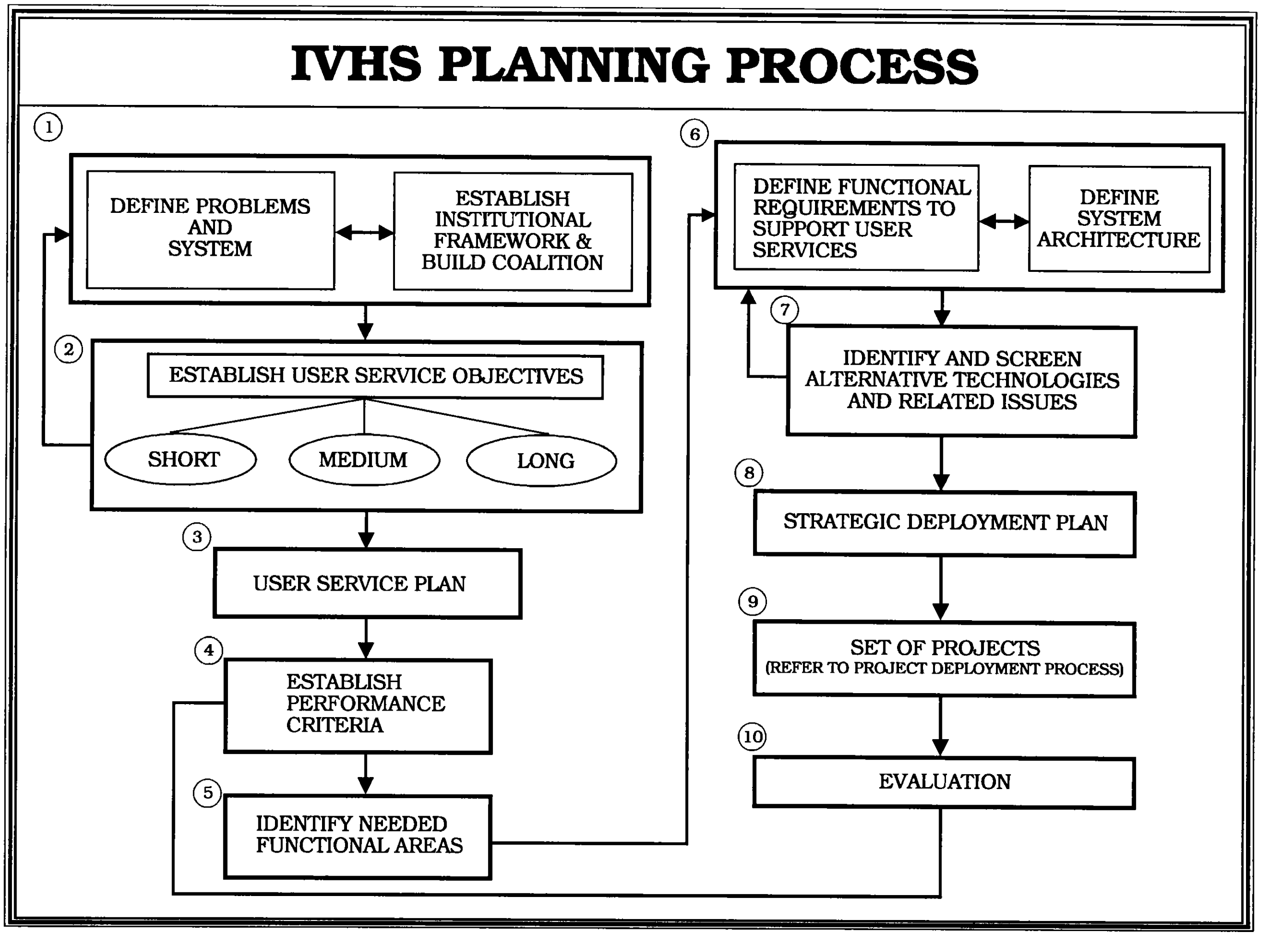

FIGURE 1. ITS PLANNING PROCESS, VERSION 1.0

The *ITS Planning Process* is composed of eight steps:

1. *Define Problems & System; Establish Institutional Framework and Build Coalition.* This step establishes both the technical and institutional framework for the planning effort. In defining the problems and system, the process calls on the planner to identify and quantify characteristics of the existing regional transportation system. In conjunction with this "technical" inventory, an inventory of regional transportation organizations is developed to serve as the basis for a coalition to support the deployment of ITS.

2. *Establish User Service Objectives.* The 29 elements that make up ITS are referred to as user services. User services are defined on a functional, technology-independent basis. For example, the pre-trip traveler information user service refers to the provision of real-time traffic and transit information (the service) to individual travelers and fleet managers (the users). This step involves selecting the user services best suited to addressing the regional transportation problems identified in Step 1.

3. *Develop the User Service Plan.* This step identifies the first product, or deliverable, of the *ITS Planning Process*, the User Service Plan. This deliverable documents the system characteristics, problems, and opportunities identified in Step 1 and describes the user service objectives developed in Step 2.

4. *Establish Performance Criteria.* In this step, specific criteria are identified to use in measuring the effectiveness of deployed ITS user services in addressing regional transportation problems.

5. *Identify Needed Functional Areas.* Functions that are necessary to support user services are identified in this step. For example, needed functional areas for the pre-trip traveler information user service may include communications, traveler interface, data processing, and surveillance. This step does not include the detailed technical design of user services.

6. *Define Functional Requirements & Define System Architecture.* In this step, functions identified in Step 5 are grouped into related subsystems to form the overall system architecture. The architecture defines how the various user services may be integrated to function as one coherent system.

7. *Identify and Screen Alternative Technologies and Related Issues.* In this step, the planner is called upon to consider possible technologies that will meet the functional requirements of the system architecture. However, this step does not call for a technical design. Rather, it is intended to provide a foundation for the design of various subsystems of the architecture once the project deployment phase is reached.

8. *Develop a Strategic Deployment Plan.* The final deliverable of the planning process, the Strategic Deployment Plan, is developed in this step. The purpose of the plan is to guide the implementation of ITS projects on an area-wide scale commensurate with the needs and objectives documented in the User Service Plan.

The Project Deployment Process

The *Project Deployment Process* is a generic methodology that is intended to guide the implementation of projects identified in the Strategic Deployment Plan. The process outlines the basic design, procurement, construction, and operations phase of project deployment. The

Project Deployment Process has not been used in studies conducted under the Early Deployment Program, which is focused on preliminary planning.

Request for Study

For the past 3 years, since the inception of the Early Deployment Program, the *ITS Planning Process* has been applied in areas throughout the nation. In Hampton Roads, Virginia, the process was applied in the regional ITS planning effort known as COMPARE (**CO**ngestion **M**anagement **P**lan, **A** **R**egional **E**ffort).

Given the importance of quality systems planning to the successful deployment of ITS, the FHWA is interested in providing the best possible *ITS Planning Process* to regions involved in the Early Deployment Program. In addition, as ITS evolves, it is certain that planning for new generations of systems will be necessary. Therefore, the FHWA asked the Virginia Transportation Research Council (VTRC) to evaluate Version 1.0 of the *ITS Planning Process* as part of the early deployment planning project in Hampton Roads, Virginia. The study team was composed of researchers from VTRC and Old Dominion University.

PURPOSE AND SCOPE

The purpose of this study was to identify specific modifications necessary to improve the *ITS Planning Process.* Since the Early Deployment Program focuses on ITS planning, and project deployment is dictated by diverse regional practices and partnership opportunities, an evaluation of the *Project Deployment Process* was considered to be beyond the scope of this research effort. Finally, since the study was focused on the process, the effort did not critique the performance of the participants in applying the process in Hampton Roads and other regions of the United States.

METHODS

The following four tasks were undertaken to identify needed modifications of the *ITS Planning Process*.

1. *Compare the ITS Planning Process with other systems planning processes.* Two frequently applied generic systems planning processes were compared with the *ITS Planning Process*: the systems analysis method and the classic strategic planning model. In addition, two similar planning processes developed for application to specific large scale, highly technical programs were compared with the *ITS Planning Process:* the National Aeronautics and Space

Administration's (NASA's) project cycle, and the Continuous Electron Beam Accelerator Facility (CEBAF) Project Management Plan.

2. *Interview participants in regional ITS planning studies.* Telephone interviews were conducted with participants in eight regional ITS planning studies (see Table 1). These studies represent a subset of the ITS regional planning efforts being conducted nationally. Further, many of the regions selected conducted their studies before the publication of the *ITS Planning Process.* This allowed for an interesting comparison of the effectiveness of different planning processes when applied to ITS. The interviews were structured around a number of open-ended questions designed to focus discussion in a number of key areas, which included the effectiveness of the process, the level of participation by the steering committee, and the deployment orientation of the study. The interview questionnaire is included in Appendix B.

3. *Participate in all COMPARE activities.* The study team participated in all aspects of the Hampton Roads, Virginia, regional ITS planning effort, known as COMPARE. Team members attended all meetings and workshops associated with the study and reviewed all intermediate materials delivered by the consultants.

In COMPARE, as in other regional ITS planning efforts, there were three major players. First, a steering committee was formed of representatives from major regional transportation organizations, such as federal, state, and local transportation departments, the metropolitan planning organization, and transit agencies. In general, the steering committee is chaired by a representative of the agency that is receiving and administering the federal funds from the Early Deployment Program. In the case of COMPARE, a representative of the Virginia Department of Transportation (VDOT) served as the committee chair.

TABLE 1. ITS PLANNING INTERVIEW PARTICIPANTS

Region	Planning Process Used
Boston, Massachusetts	*ITS Planning Process*
Cape Cod, Massachusetts	*ITS Planning Process*
Charlotte, North Carolina	Process similar to *ITS Planning Process*
Denver, Colorado	Strategic planning hybrid
New Jersey (statewide)	Process similar to *ITS Planning Process*
Orange County, California	Process similar to *ITS Planning Process*
Portland, Oregon	*Guidelines to ATMS Development*
St. Louis, Missouri	Strategic planning and *ITS Planning Process*

The second major player in ITS regional planning efforts is the technical consultant. Although the steering committee is ultimately responsible for the completion of the planning effort, in most cases a consultant is retained to conduct the analyses called for in the *ITS Planning Process.* In COMPARE, the consultant firm selected by the steering committee was I-95 Northeast Consultants.

Finally, the third major player in a regional ITS planning effort is the group of individuals and organizations that have a significant interest in the regional transportation system. This group is referred to as the "stakeholders." Stakeholders may include major regional employers, freight companies, and tourism agencies, among others. It is the job of the steering committee and the consultant to actively seek the involvement of stakeholders in the regional ITS planning effort to ensure the Strategic Deployment Plan will guide the region to a transportation system that meets the stakeholders' needs.

While participating in COMPARE, the study team worked directly with the consultants and the steering committee to learn from their experience. In addition to frequent informal discussions, quarterly review meetings were held with the consultants to gather insights gained from applying the *ITS Planning Process.* For example, the consultants were asked which tasks were particularly helpful, which tasks were not cost-effective, and whether or not additional steps were necessary. In addition, the active members of the steering committee were surveyed to gain their insights into the *ITS Planning Process* and its application in Hampton Roads. This survey was conducted at the completion of the planning effort, immediately after the committee had received a copy of the draft Strategic Deployment Plan. The survey questions were designed to determine whether or not the *ITS Planning Process* would produce a product that would meet the region's needs.

4. *Examine the products of COMPARE.* The two key products of the *ITS Planning Process,* the User Service Plan and the Strategic Deployment Plan, were examined to determine the impact the process had on them. The examination was based on the following three criteria:

- *Distribution of effort.* Does the document reflect a balanced distribution of effort in the steps of the *ITS Planning Process*? Are there apparent biases in the distribution of effort?
- *Clarity of recommendations.* Are the recommendations in the deliverables clear and well documented?
- *Ability to implement.* Do the documents provide a solid foundation on which the region can proceed to deploy ITS?

RESULTS AND DISCUSSION

Comparison with Other Planning Processes

Systems Planning Processes

A *system* is defined simply as a set of elements so interconnected as to aid in driving toward a defined goal (Gibson, 1989). A system can be described by its elements, also known as objects, the relationship between objects, and the attributes of the objects (Chadwick, 1978). A large scale system has the added characteristic of a policy component. In other words, the success or failure of a large scale system is dependent not only on the quality of the engineering design but also on the public policy that affects the system. Based on this definition, ITS can be classified as a large scale system.

When one analyzes a large scale system, it is important to start "at the top" with the identification of goals and objectives before getting into the details of system components. Otherwise, the following difficulties may be encountered:

- Unless the goal is known precisely, the traditional "bottom-up" approach may waste effort in developing task segments that turn out to be unneeded.
- Without a set end point for each subtask, the subtasks may be elaborated upon to an unnecessary degree, thus wasting resources.
- Without a known end point, the specification of a vital subtask may be under-estimated, thus setting up a performance deficiency (Gibson, 1989).

The discipline of systems analysis has led to the creation of a number of processes that guide the analysis of large scale systems. Most of the processes are similar in structure. For simplicity's sake, only two are discussed here: the systems analysis method and the strategic planning model.

Systems Analysis Method

According to Gibson (1989), there are six major phases of systems analysis:

1. *Determine the goals of the system.* This phase encourages planners to consider the "big picture" before delving into details. The *ITS Planning Process* does not include an explicit goals determination step.

2. *Establish criteria for ranking alternative candidates.* This phase, which is identical with Step 4 of the *ITS Planning Process*, involves the selection of performance criteria that will be used to select objectively from the various alternatives proposed for the system. This step is important because the selection of system components or objects and their attributes creates the backbone of the system. Without unbiased measures to evaluate and compare alternatives, the selection of components would be purely subjective.

3. *Develop alternative solutions.* Alternative means of achieving the system objectives are developed in this phase. Gibson emphasized that it is important to consider all options and not limit ideas at this point. The *ITS Planning Process* calls for the candidate alternative solutions to be limited to ITS user services.

4. *Rank alternative candidates.* In this phase, the alternatives are ranked based on the performance criteria identified in Phase 2. The criteria, which could range from cost factors to physical size limitations, should lead to an objective selection of the appropriate system components. The *ITS Planning Process* calls for the performance criteria to be used in evaluating the project deployment stage. Therefore, it does not provide guidance for the selection of alternative candidates in the planning stage.

5. *Iterate.* This seemingly simple phase is actually significant. One cannot expect to complete the other phases in a simple, sequential order. It is expected that an analyst will move through the phases rapidly a number of times, narrowing down toward an appropriate solution. This approach is often referred to as a "spiral" methodology. The *ITS Planning Process* is presented as a sequential methodology, and iteration is not included.

6. *Action.* This phase illustrates the fact that a successful systems analysis effort leads to action, not a report. In other words, at the conclusion of a study, a detailed "road map" to implementation should be produced. In the *ITS Planning Process*, this road map is the Strategic Deployment Plan.

Strategic Planning Model

There are five components of the strategic planning model (Johnson, 1987; Pindur, 1992).

1. *Mission and Vision.* The development of a vision as the first step is an important characteristic of strategic planning. This step requires that the planning effort focus on the "big picture," the desired outcome. Although the *ITS Planning Process* calls for the development of a vision, it does not receive the same level of emphasis as it does in strategic planning.

2. *Goals and Objectives.* This is a fundamental part of any systems planning process. This step does not exist in the *ITS Planning Process*.

3. *Environmental Scanning.* Environmental scanning involves determining what other relevant work is being conducted in other communities, what new findings are available, and what strategies are being pursued. Benchmarking with other similar communities provides planners with concrete examples of successes, failures, and potential solutions. This scanning adds to the initial steps of a generic systems analysis method. It provides an early "reality check" on the planning process, encouraging planners to build on the experiences of other, similar initiatives. The *ITS Planning Process* does not incorporate such a step.

4. *SWOT Analysis (Strengths, Weaknesses, Opportunities, and Threats).* The SWOT analysis examines external factors (regulatory/legislative, economic, social/political, technological, demographic, and others) and factors internal to the community or organization. These factors can be categorized as organizational *strengths* that can be built upon, *weaknesses* that need to be considered during planning or implementation, *opportunities* that can be exploited for a better product, and *threats* to success. Careful attention to this phase will greatly improve the successful implementation of the plan. In some ways, the first step of the *ITS Planning Process* is similar to SWOT analysis. In building a coalition, the SWOT factors must be taken into account. However, this element of planning is not emphasized in the *ITS Planning Process.*

5. *Development of Alternatives.* This step is found in all systems planning processes. The alternatives in the *ITS Planning Process* are constrained to ITS user services.

6. *Select and Implement Strategy.* The strategic planning process concludes with the typical development and selection of alternatives. Implementation is the final step. The main point in strategic planning is to create a plan that will take into account all factors that affect a system and plan for it to work well within those constraints and opportunities. The focus on implementation may be of benefit to the final product of the *ITS Planning Process:* the Strategic Deployment Plan.

Application-Specific Planning Processes

Although examining generic planning processes is valuable in evaluating the *ITS Planning Process*, it should be remembered that the process is not generic. Rather, it was developed specifically to guide the planning of regional ITS. Therefore, two application-specific planning processes were compared with the *ITS Planning Process*. These processes were chosen because both guide the planning of highly technical, public-private, large scale systems in the Hampton Roads region of Virginia.

The first process is NASA's project cycle, used extensively at NASA's Langley Research Center in Hampton, Virginia (NASA Center for Systems Management, 1991). This process guides the design, procurement, construction, launch, and evaluation of aerospace efforts. The second process is the project management plan of CEBAF, located in Newport News, Virginia

(CEBAF, 1990). CEBAF is a basic nuclear physics research facility managed by a consortium of 41 universities and colleges in the southeast United States. The overall structures of both are similar to the generic planning process discussed earlier. Therefore, rather than examine them step by step, a number of general observations are discussed here.

Both processes are derivatives of major generic planning approaches, as is the case with the *ITS Planning Process*. Like the *ITS Planning Process*, CEBAF's process is based on systems analysis. On the other hand, the foundation of NASA's planning process is strategic planning. It is interesting to note, however, that the CEBAF process more closely follows the classic systems analysis method than the *ITS Planning Process* does. Although the *ITS Planning Process* does not include a specific goal development step, the CEBAF planning process has a comprehensive technical objectives section at the beginning. The objectives are defined on both the program and project levels.

A major difference between the NASA and CEBAF processes and the *ITS Planning Process* is the use of milestones. The only two milestones in the *ITS Planning Process* are the final deliverables, the User Service Plan and the Strategic Deployment Plan. However, they are loosely defined, with no time frame provided. On the other hand, the NASA process incorporates a number of strictly defined control gates that define major review points and the corresponding products in the planning process. The gates play an important role in ensuring that the process proceeds on schedule. The CEBAF process also has well-defined milestones.

Finally, an integral component of the NASA planning process is the budget cycle. The process recognizes that NASA's programs are fiscally constrained and directly incorporates the constraints. ITS, like NASA, will certainly be subject to government budget cycles, but the *ITS Planning Process* does not include this component. It is likely that the budget cycle in NASA's process is important in developing programs and projects that are realistic and that can be implemented.

Interviews with ITS Regional Planning Participants

The interviews with ITS planning participants revealed general satisfaction with the *ITS Planning Process*. The significant difference between ITS planning and traditional transportation planning was stressed by a number of the interview participants. There were also a number of elements in the *ITS Planning Process* that caused confusion. The results of the interviews were grouped into four categories: envisioning, selection of alternative solutions, education and communication, and implementation.

Envisioning

The initial step of the *ITS Planning Process* calls for consensus building and system inventory. It also requires that a vision for the "ideal" transportation system be developed at this stage.

Most of the studies represented in the interviews spent the majority of the time on the system inventory aspect of the first step. Envisioning the ideal was often neglected because of the time required to gather inventory data. A number of participants commented that because of the size and complexity of regional transportation systems, one could easily spend the entire planning budget on inventory data collection alone.

The Charlotte ITS planning study is an example of how to avoid spending too much time on system inventory. The North Carolina Department of Transportation did this study in house and was able to have the necessary data gathered and placed into a GIS data base before the start of the ITS planning study. This exemplifies the importance of using existing data sources. The St. Louis study also spent little time on gathering data and defining the system because of a subcontractor's extensive knowledge of the area. Reliance on local knowledge of system problems appears key in saving time for envisioning the ideal results and the later steps in the planning process.

The most successful ITS planning studies were the ones that established a clear vision of how a region could use ITS. The Charlotte study was clearly defined as a precursor to an operational test. This fact allowed for a relatively smooth process and successful implementation of the plan's recommendations. By knowing where the process was heading, those involved in the study were able to clarify their system goals and ensure that the planning team focused on the big picture.

Selection of Alternative Solutions

As described earlier, an important element of systems planning processes is a rigorous evaluation of alternative solutions. In fact, some processes go so far as to call for the use of simulation in selecting alternatives (Catenese & Steiss, 1970). However, the results of the interviews suggested that few of the ITS regional planning efforts included a formal process for the selection of alternative solutions.

In most cases, those involved in planning processes claimed they would have preferred to include a formal alternative evaluation step but that a lack of planning resources and/or a lack of data precluded this. In addition, they noted that the alternatives for consideration in the process are constrained to ITS user services. Since user services, by design, are defined in a general, functional manner, an assessment of their specific benefits in a region proved to be quite difficult.

In order to assess the effectiveness of user services, a number of those interviewed expressed a desire for analysis tools developed specifically for ITS user services. Traditional transportation analysis methods are designed primarily to estimate the effect of capacity or geometric changes. However, the study team uncovered a number of efforts dedicated to developing the tools the planning participants wanted. First, the TASC corporation has developed a regional ITS deployment model named *PlanITS* (TASC, 1995). This model allows for on-line evaluation of alternative ITS architectures, effectively providing planners with a tool in selecting user services. In addition, the Volpe National Transportation Systems Center is developing a benefits framework that can assess the congestion, emissions, fuel consumption, and safety impacts of ITS user services (Ricci & Gazda, 1994). Although this framework is designed to analyze ITS in more detail than is probably needed for regional planning efforts, it is still a potential resource.

Finally, a number of the regional ITS planning studies developed their own evaluation methodologies. For example, in Boston, user services were prioritized based on steering committee feedback on effectiveness using the following criteria: operational efficiency, output, safety, environment and energy, and implementation. In St. Louis, services were evaluated on the basis of cost/benefit analyses, although rudimentary models were used because of the time-consuming nature of more complex models. In both cases, the use of a formal evaluation method provided a stronger justification for the resulting User Service Plan.

Education and Communication

Participants in ITS planning efforts found that educating the regional planning steering committee is of utmost importance. This does not merely entail the general introduction to ITS that is usually needed to create a level playing field at the beginning of the study. Education, in this sense, also means continued formal and informal communication among the consultants, participants, and decision makers to keep everyone involved and up to date while the project is underway.

Nearly every study noted the importance of continuing education throughout the planning process. In the St. Louis study, the consultants provided steering committee members with a three-ring binder and gave them a series of technical memos on a variety of ITS topics, keeping everyone informed on various issues. This proved very popular. The Charlotte study extended the education element all the way to high-level political representatives in the U.S. Congress. The level of communication and education in this study had a direct, positive effect on securing federal funding to implement study recommendations.

Implementation

Implementing recommendations from an ITS Strategic Deployment Plan has not been easy for a number of ITS planning projects across the nation. Achieving the required funding was cited as the major impediment. To counteract this, the interview participants felt that ITS deployment needs to be presented to the public and decision makers as a beneficial investment. Unfortunately, these benefits are often not thoroughly described and documented in the Strategic Deployment Plan.

A significant missing ingredient in the implementation process is the lack of a true cost/benefit analysis to back up proposed public (and private) investments. Without known benefits, it is difficult to sell ideas in the political realm. This fact was mentioned by a number of participants. Most felt there should at least be a "back-of-the-envelope" or rudimentary model used to assess cost benefits. This analysis would also allow the development of alternative implementation schemes depending on funding levels, so that a fully functional system could still be created even if funding was less than optimal.

However, there are examples of successful implementation of ITS plans. Portland, Oregon, achieved implementation through their study's fact-based foundation. The study included simple benchmarks to provide a comparison between pre- and post-implementation conditions. The benchmarks were based solely on travel time and volume. Although these were not highly complex benchmarks, they did allow performance to be measured and evaluated, which is an integral part of achieving funding. Another example is Boston. There, the education of the steering committee and decision makers allowed those involved to act on the recommendations and secure funding for implementation.

Implementation is the most challenging aspect of planning for ITS deployment because it is not strictly a part of the ITS planning study. It is what happens after a study is completed. Continuing education, a strong initial system vision carried throughout the planning process, and a solidly argued and fact-based presentation in the Strategic Deployment Plan have been shown to be important elements in moving toward successful implementation.

Participation in COMPARE

The results of this task are presented in two sections. The first describes lessons learned from interactions with the COMPARE steering committee, and the second describes those learned from I-95 Northeast Consultants, the firm selected to conduct the planning study.

Steering Committee

Survey

Only 17 of the 29 members of the steering committee participated actively in COMPARE. This group of active participants was composed largely of traffic engineering representatives from state and local government. Therefore, the results of the survey probably do not represent the range of views of the entire committee. However, they do represent the insights of those who played the most significant role in shaping the COMPARE effort.

The survey statements and the average score for each are presented in Table 2. The statement scores were based on a Likert scale of 5, with 5 = strongly agree, 4 = agree somewhat, 3 = neutral, 2 = disagree somewhat, and 1 = strongly disagree. The scores are an average of the 17 responses received.

The following three questions were also asked to solicit open-ended answers. Appendix C contains the full set of responses to these questions.

1. What did you like best about COMPARE?

2. What did you like the least about COMPARE?

3. What would you do differently?

Trends

A number of trends became clear upon examination of the survey results.

A High Value Placed on Regional ITS Planning. Roughly 80% of those interviewed asserted that they liked either the "interaction between jurisdictions and agencies" or "regional cooperation" best about the COMPARE effort. Clearly, this majority of responses provides significant evidence that the steering committee felt strongly that planning for ITS must take place on the regional level.

The steering committee attributed at least a portion of the regional perspective of COMPARE to the *ITS Planning Process*. The members agreed that "the *process* has encouraged a regional perspective." They also agreed that "this *process* has provided a new mechanism for solving regional transportation issues." Judging from the scores for these two statements, one can conclude that the steering committee valued the systems foundation of the *ITS Planning Process*.

TABLE 2. STEERING COMMITTEE SURVEY

Statement	Average Score
I understand the COMPARE vision.	4.71
The COMPARE committee members have shared information well.	3.94
The COMPARE consultants presented information well.	3.41
All stakeholders have had an opportunity for input.	3.41
Inter-governmental levels have been a major barrier to success in the process.	2.65
The process has remained on schedule.	3.18
The time I spent in general COMPARE meetings was useful.	3.12
The time I spent in COMPARE task force meetings was useful.	3.35
The overall time I devoted to COMPARE was well spent.	3.53
The final plan relates well to ultimate ITS goals (safety, traveler convenience, level of service, energy conservation, and environmental concerns).	3.65
Proposed user services will greatly improve most problems.	3.53
System architecture should work well when implemented.	3.65
The final plan will support regional economic growth.	3.41
Planning was sensitive to my community's/agency's needs.	3.41
The planning process was sensitive to customer focus.	3.71
This process has encouraged a regional perspective.	4.24
Public-private partnerships will be a major funding source.	3.35
The government will ultimately pay the cost of the regional system.	3.59
This process has provided a new mechanism for solving regional transportation issues.	3.76
The consultants did a good job in meeting their charter.	3.29
This process has been instrumental in breaking down barriers to transportation planning in Hampton Roads.	2.76
I know how my agency should proceed next.	3.12
There is a good mechanism to form public-private partnerships.	2.41
The process will continue after consultants have completed their work.	3.24
Overall, I'm satisfied with the COMPARE process.	3.53
Overall, I'm satisfied with the COMPARE product.	3.53

Too Slow a Beginning. Two of the responses to the question "What did you like the least about COMPARE?" were that the initial stages of the process were too slow. This response mirrored a number of informal comments by steering committee members. At the beginning of the study, the committee was excited and ready to dive into ITS planning. However, they felt that many of the early steps, particularly the lengthy inventory process, took too long. This probably led to the most prevalent "least like" response of the survey: "too much detail; irrelevant/repetitive information." Finally, it is likely that the slow beginning led to the steering committee's dissatisfaction with the study's schedule, as seen in the score of 3.18 for the statement "The process has remained on schedule."

Lack of a Mechanism to Form Public-Private Partnerships. It is generally agreed within the ITS community that public-private partnerships will be necessary to achieve wide-scale implementation of ITS. However, the results of the survey showed that the *ITS Planning Process* did little to help the Hampton Roads region prepare to develop such partnerships. The survey respondents tended to disagree with the statement "There is a good mechanism to form public-private partnerships," as seen in the average score of 2.41. In fact, even if there were such a mechanism, the steering committee did not see such partnerships playing a significant role in funding ITS as shown by the score of 3.35 for the statement "Public-private partnerships will be a major funding source."

Lack of an Implementation Orientation. The major weakness of the *ITS Planning Process* evident in the survey was its lack of an implementation orientation. The steering committee did not hold much hope for the implementation of the Strategic Deployment Plan produced by COMPARE. This was particularly evident in the neutral feelings to the statement "I know how my agency should proceed next," which received a score of 3.12. In fact, there was little agreement that planning for ITS would even continue, as seen in the score of 3.24 for the statement "The process will continue after the consultants have completed their work."

It is likely that this lack of an implementation orientation was a result of a lack of a foundation for further action. The steering committee saw a need to involve individuals more directly with funding authority. When asked what they would do differently, nearly 25% of the respondents answered: "more interaction with policy/political figures." Finally, links with important regional goals were not clearly made. For example, the statement "The final plan will support regional economic growth" received an average score of 3.41. These results show that the application of the *ITS Planning Process* did not result in a product that could be directly implemented in the Hampton Roads region.

Consultants

The consultants felt that the overall structure of the *ITS Planning Process* provided a solid foundation on which to conduct the COMPARE effort. However, they also felt strongly that one cannot follow the process word for word and expect it to work in all applications. They felt that the process is a framework that should be adapted to meet the particular needs of the region in which it is being used. Beyond this general observation, the consultants shared a number of thoughts on specific features of the process and its application.

Need for Coalition Building. The consultants stated that an active, well-rounded steering committee of stakeholders is critical for the successful application of the process.. In fact, it was recommended that the term "steering committee" be changed to "task force" in order to reflect the fact that the stakeholders need to play a very active role. It should be noted that when a number of permanent task forces were developed toward the end of the COMPARE study, participation increased. The concept that an ITS planning effort can be successfully completed by hiring a consultant and reviewing deliverables every several months simply is not valid. The COMPARE consultants recognized this and initiated the task forces with regional representatives to work toward the implementation of the plan once they were no longer involved.

The composition of the steering committee is also important. This refers to the need to involve not only individuals from different organizations but also those with different responsibilities within the same organization. In COMPARE, the majority of the steering committee members were traffic engineering/operations personnel from local and state government. Because of this, the committee naturally was more interested in such things as the technical details of traffic surveillance and communications. However, given the nature of ITS planning, it would have been advantageous to balance the committee with individuals responsible for regional transportation planning and other modes of transportation.

Conflict Between ITS and Traditional Transportation Improvements. The fact that the *ITS Planning Process* is intended solely for identifying ITS initiatives was problematic in the COMPARE effort. Isolating ITS from other transportation improvements makes identifying ways to implement recommendations particularly difficult. Given that there are no exclusive ITS deployment funds, any ITS initiative must compete with traditional improvements. However, since the ITS initiatives do not compete with traditional improvements in the *ITS Planning Process*, it is difficult to create justifications for use in future funding "battles." Beyond the specific funding challenges, the nature of the process tends to make participants feel they are participating in a "special" endeavor that is not very tightly connected with normal transportation improvements. Therefore, ITS was often viewed as an interesting program, but not as a viable alternative for transportation improvement.

Importance of System Inventory Data Collection. The consultants felt that data collection is an important element of the process. These data gave the study a solid, objective foundation on which to proceed. However, they also felt that too much time was devoted to the inventory. A complete inventory of a regional transportation system is a monumental task. It quickly became clear as more and more detail was sought that the activity was associated with diminishing returns for the resources expended. This points out the fine line that must be walked at this stage of the study.

Reliance on User Services. The complete reliance of the *ITS Planning Process* on ITS user services was problematic. First, restricting the potential "solution set" to the ITS user services defined by FHWA unnecessarily constrains the available options. An important need identified in COMPARE was to provide a clearinghouse for the use of local and state agencies in sharing transportation information. Unfortunately, no user service directly provides this capability. The consultants created a new service for this study. However, it is possible that other potential solutions were not adequately considered because they did not fall within the established ITS user services.

There is little detail in the *ITS Planning Process* to assist in the prioritization of user services. As the consultants worked to develop the user service objectives, it seemed that all of the services were desirable. Further, it was difficult to gain input from the steering committee because the concept of user services is so broad and functional that the committee had trouble making informed recommendations.

Lack of Early Products. After the coalition of stakeholders is built in Step 1 and their interest is gained, the structure of the *ITS Planning Process* does not produce tangible deliverables to maintain their involvement. Again, user services are not defined in sufficient detail to be real to those who are not deeply involved in ITS. In the early phases of the process, steering committee members often questioned when detail would be provided for them to consider in making decisions. This made it difficult to maintain the momentum established at the beginning of the project.

Unclear Performance Criteria. This step of the process created quite a bit of confusion for the consultants. They were unclear about the objective of this step. Is the objective to identify criteria that can be used to conclude whether or not the regional ITS is effective once implemented? Or alternatively, are the criteria to be used in selecting specific components of the overall ITS program to be implemented? The decision made in the COMPARE study was to consider criteria to measure implementation success.

Based on this decision, the consultants felt the step is misplaced. For the COMPARE effort, it was moved to follow the development of the User Service Plan. It was argued that defining criteria that were sufficiently broad to measure the success of a regional ITS was futile. Such criteria would be so broad that they would not be meaningful. Further, it would be nearly impossible to conclude that changes in such broad measures could be directly attributed to ITS initiatives. Rather, the consultants identified performance criteria for specific user services as defined in the User Service Plan. This allowed the identification of more specific criteria that would better show the effectiveness of a particular user service.

Lack of Utility of Technology Screening. The consultants conducted a technology screening as called for in Step 7 of the *ITS Planning Process*. However, they did not find it to be of much utility in developing the Strategic Deployment Plan. Although such a screening may be of use in system design, the planning study was not conducted at that level of detail. The consultants felt they could have used the resources dedicated to this activity better in other areas of the planning study.

Lack of Recognition of the Changing ITS Planning Environment. The *ITS Planning Process* is presented as a linear set of activities. However, throughout the course of COMPARE, the environment in which the study was proceeding changed considerably. For example, VDOT policies on public-private partnerships were changing, designs for regional traffic control projects were being modified, and personnel availability was also changing. This forced the consultants to use a "spiral" approach, revisiting a number of the earlier ITS planning steps after they had been "completed." The consultants stressed that ITS planning can be expected to take place in a very dynamic environment and that any planning process must allow for continual refinement as new events occur.

Examination of COMPARE Products

The two major deliverables produced in the COMPARE project were the User Services Plan and the Strategic Deployment Plan.

User Services Plan

The User Services Plan met the requirements for the document set forth in the *ITS Planning Process.* In particular, the descriptions of the priority user services were excellent. However, many of the conclusions and recommendations in the report did not seem to be well supported. The assessment of the plan using the criteria specified in "Methods" follows.

Distribution of Effort

The system inventory consisted of a thorough review of existing information on the transportation system in Hampton Roads. The information was presented through a comprehensive series of maps. Because of time constraints, no new data were collected. By examining the amount of information on each transportation mode, one can detect a clear bias toward highways. Finally, it should be noted that a significant amount of the necessary revisions of the draft User Service Plan consisted of relatively minor errors on the inventory maps.

Although called for in Step 1 of the *ITS Planning Process*, the plan did not present a vision for the use of ITS in the Hampton Roads region. This provides further evidence that the effort was skewed toward the collection of inventory data.

Clarity of Recommendations

In COMPARE, a two-step prioritization process was created to select the user services:

> [F]irst, User Services were matched and ranked for their potential to have an impact—at the regional level—on improving mobility, safety, air quality, vehicle efficiency and economic impact within the principal problem areas;

second, the resulting User Services were assessed for their ease of implementation and multipurpose potential (pp. 2-6).

A missing element in this prioritization process was relating the selected user services to the opinions shared by the stakeholders and steering committee members. A more rigorous prioritization process might have shown these links more clearly.

Ability to Implement

The User Services Plan describes the active stakeholder process conducted during the early stages of the COMPARE study. This process was intended to help identify problems in the region and initiate coalition building. An excellent representation of transportation stakeholders in the region was achieved, with the process involving policy makers, large employers, commuters, freight movers, and tourism officials. However, it was mainly a one-way process, as opposed to a true involvement process. The stakeholders were queried, but very little information about COMPARE or the potential benefits of ITS was shared with them. As a result, it appeared as though very little coalition building was actually accomplished. This can be expected to reduce significantly the ability to quickly form the kind of partnerships necessary to implement the recommendations for ITS deployment.

Strategic Deployment Plan

The Strategic Deployment Plan developed in COMPARE provides a detailed action plan for developing ITS in the Hampton Roads region. The operations plan is particularly strong, providing information on estimated costs, potential funding sources, added personnel and equipment requirements, and other items. It is likely that it can be used to program for improvements in the regional transportation system. The assessment of the plan using the three criteria specified in "Methods" follows.

Distribution of Effort

The Strategic Deployment Plan has a very strong traffic operations/public sector orientation. There is very little discussion or planning for transit, emergency operations, or freight. Most likely, this is due to the makeup of the steering committee. Although representatives from other areas were on the committee, they did not participate actively. Therefore, the plan was written to serve the study's clients, who, by default, were traffic operations personnel from state and local agencies.

Clarity of Recommendations

A significant limitation of the plan is the lack of a clear connection between the ITS recommendations and regional transportation goals. The document does not link the ITS recommendations with the problems that must be addressed in the region. In the future, the plan may not stand alone as it moves from technical personnel to the arena of policy makers. Although the recommendations are sound and well described, the support for the recommendations is lacking.

Ability to Implement

Finally, although a significant portion of the document is devoted to the discussion of public-private partnerships, specific recommendations in this area were not well defined. In the funding source category of the operations plan, these partnerships were identified as potential sources for projects varying from ramp metering to traveler information systems. Given the important role that such partnerships are expected to play in Hampton Roads, one would have expected to see specific projects identified as being ideally suited to partnerships.

CONCLUSIONS

Version 1.0 of the *ITS Planning Process* and the FHWA's Early Deployment Program have played an important role in the development of ITS in the United States. By encouraging regions to examine closely the use of ITS to solve transportation problems, the process has helped to change ITS deployment in the United States from a somewhat uncoordinated set of stand-alone projects to a more integrated set of ITS user service deployments. Based on the analysis conducted in this research effort, the following conclusions were reached.

- The Early Deployment Program is a first step in the necessary planning for a well-integrated regional ITS. However, it is clear from COMPARE and other regional studies that planning for ITS must be an ongoing activity. It is also clear that planning for ITS as a stand-alone effort is of limited effectiveness. ITS planning should be integrated within the traditional regional transportation planning framework. The ongoing work in this area by JHK and Associates and the Volpe National Transportation Systems Center is important.

- Without the active, strong involvement of regional stakeholders, an ITS planning effort is of little use. In addition, the involvement of a wide range of stakeholders from all modes and the private sector is of critical importance. The *ITS Planning Process* alone will not produce valuable results. In those studies with active, well-rounded steering groups, strong strategic deployment plans were developed that led to implementation.

- The systems analysis foundation of the *ITS Planning Process* is sound and should be retained.

RECOMMENDATIONS

Specific improvements to the process should be incorporated into a new version (Version 2.0) of the process. Here, the recommended modifications are organized within the framework of Version 1.0. A flowchart describing the recommended Version 2.0 is shown in Figure 2.

Changes in Steps in the Process

The steps in the process should be changed as follows.

Step 1. Define Problems & System; Establish Institutional Framework and Build Coalition

The purpose of the first element of this step is to develop an understanding of the current state of the regional transportation system. Much of what is needed to carry this out takes place within the framework of traditional transportation activities, such as planning and maintenance management. Therefore, the statement "An inventory of the existing system to establish its composition and available resources is an important early activity" is unnecessarily repetitive for a region. Further, a complete inventory is a costly, time-consuming task that does not add sufficient value to the end product, as seen in COMPARE and other early deployment efforts. The inventory element should be replaced with a current assessment element that would focus on developing a general scenario of the current state of the regional transportation system.

A very important element of this step is the development of a vision of the future regional transportation system. This serves a number of purposes. First, it provides an early product of the process that can be used as a focus for the attention of the steering committee. It allows for meaningful dialogue to establish ITS goals and objectives. It also serves as an important benchmark for the remainder of the project. In other words, all other activities in the planning process should be predicated on the fact that they help to achieve the vision. Finally, the vision serves as a significant aid in attracting additional members of the coalition. By demonstrating how ITS is envisioned to work within the regional transportation system, stakeholders will clearly be able to see how their activities may be affected by ITS. The development of a vision should precede the current assessment element in the planning process to ensure that the effort begins with an orientation toward future innovation.

Two elements of the classic strategic planning model should be added to this step after the regional assessment. The first, the environmental scan, calls on the planners to identify similar regions and examine the effectiveness of their ITS initiatives. This provides an early

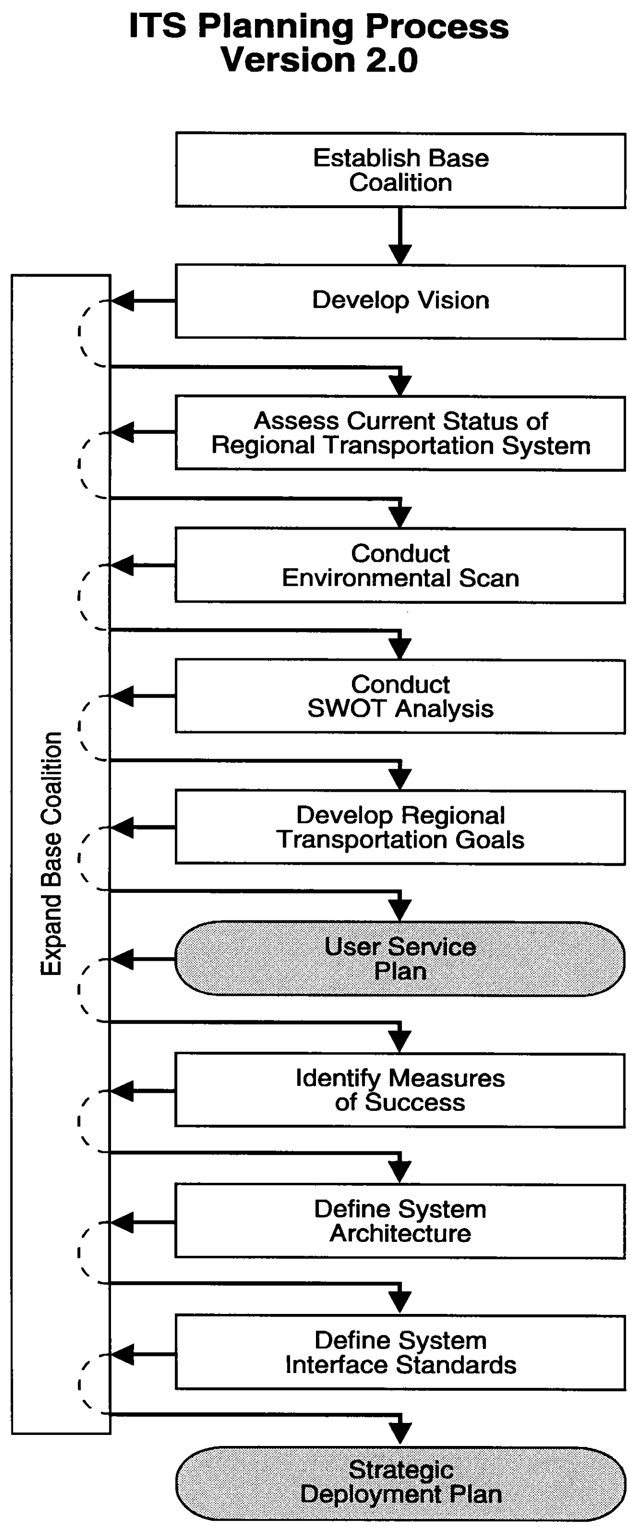

FIGURE 2. VERSION 2.0 OF THE ITS PLANNING PROCESS

reality check in the process and provides the steering committee with tangible examples of how ITS may be of use in their region. Following the environmental scan, a SWOT analysis should take place. This analysis adds an additional early reality check to the planning process, forcing the planners and steering committee to fully consider the challenges and opportunities for ITS implementation in the region. The addition of these two steps should result in a much stronger implementation orientation in the *ITS Planning Process.*

Finally, the second component of this step, *Establish Institutional Framework and Build Coalition*, is misplaced. In fact, if a strong coalition is not in place at the beginning of the study, there is a real danger of following the process simply for the sake of conducting a planning study. Therefore, the initial step should be to establish a base coalition. However, as the process proceeds, products such as the vision should be used to pull in other stakeholders. In other words, expanding beyond the base coalition is an ongoing element of the planning process, and this should be reflected in Version 2.0.

The ongoing coalition building element of the revised process will play a significant role in integrating ITS planning with other regional transportation planning efforts. By actively involving stakeholders from all modes of transportation, it can be expected that elements of the Strategic Deployment Plan will begin to find their way into the transportation improvement programs of transit, freight, highway, and the other transportation modes.

Step 2. Establish User Service Objectives

A significant problem with this step is that it requires planners to select functional alternative *solutions*, user services, before any *goals* have been developed. Those who used the process felt constrained to pick user services without having a sound basis to justify their selection. This step should be changed to *Develop Regional Transportation Goals*. Such a change would be consistent with the practice of other large scale system planning processes.

Therefore, the fundamental purpose of this modified step is to identify goals for the regional transportation system that must be achieved in order to move from the current scenario to the vision identified in Step 1. The goals should not be restricted to ITS. Later in the process, the planners can narrow down the solutions to those that are ITS related. The goals of other regional planning efforts (transportation or otherwise) should be considered and used in the ITS planning process. Such a broad consideration of regional transportation is essential to developing an ITS Strategic Deployment Plan that meshes well with the region's transportation improvement strategy.

Finally, the discussion of phasing in Step 2 should be eliminated. At this stage, it is too early to look at the phasing of alternative functional solutions. In fact, looking at phasing during this step will likely begin to bias the structure of the User Service Plan before any analysis of the alternatives is conducted.

Step 3. Develop the User Service Plan

Originally, this step simply documented the analyses conducted in Steps 1 and 2. However, based on the recommended changes in Step 2, the development of the User Service Plan takes on a different role. In this step, planners should "map" ITS user services into the goals identified in Step 2. In other words, this step identifies user services, which can be thought of as functional alternative solutions, that will help to achieve the regional transportation goals.

Such a mapping would take place as follows. First, the analyst will estimate the level to which each user service helps to achieve each goal. It can be expected that some of the user services will play a significant role in achieving some of the goals, although other goals may not be achieved by any of the user services. Based on this mapping exercise, user services will emerge that hold a high potential for helping to meet regional goals, and other services will likely be shown to have a low potential. Based on this range, the User Service Plan will prioritize ITS user services for implementation in the region.

The User Service Plan will serve as an important steering document for the remainder of the planning study by linking regional transportation goals, which are of significant interest to decision makers, to ITS user services. It is expected that such a linkage will be of considerable assistance when policy makers make decisions to fund ITS implementation.

Step 4. Establish Performance Criteria

This is an important step that has often been overlooked in regional ITS planning efforts. The statement "Performance criteria initially will be developed by the coalition for the potential area-wide system" should be removed. Such a wide-scale measure is difficult, if not impossible, to identify. In addition, it will not be possible to determine if measurable changes in the criteria are a result of ITS user services or other changes in the regional transportation system. Instead, this step should focus on establishing relatively simple criteria for *each* of the priority user services identified in Step 3. Finally, the name of this step should be changed to *Identify Measures of Success*. These measures should be easily understood by the general public and policy makers, as opposed to highly technical performance criteria that may be meaningful only to transportation engineers. The name change is recommended to illustrate this subtle, yet significant difference.

Step 5. Identify Needed Functional Areas
Step 6. Define Functional Requirements & Define System Architecture

These two steps should be combined into one: *Define System Architecture*. As it currently stands, the two steps describe how to develop the architecture. The planning process would be simplified by combining them. Otherwise, the content of the steps should remain unchanged.

Step 7. Identify and Screen Alternative Technologies and Related Issues

In examining the application of the *ITS Planning Process* in regions around the nation, it became clear that this step does not benefit the ultimate Strategic Deployment Plan enough to justify the resources required to execute it. Information technology, the backbone of ITS, is changing at a tremendous pace. Given the fact that the Strategic Deployment Plan identifies possible projects, many of which must be initiated under the normal transportation improvement process, it is reasonable to expect a significant lag between this step and project design and construction. During this lag time, it is expected that the majority of the technology screening methods will become obsolete.

However, it cannot be denied that an understanding of ITS technology is important to those who will implement the Strategic Deployment Plan. Therefore, ITS technology should be a key aspect of the education "curriculum" in the coalition building activities of the planning process.

The aspect of this step that is important and should be retained is identifying applicable standards for the system architecture. Different elements of the architecture must interface effectively in order to function as an integrated system. It is likely that many elements of the architecture will be developed by different organizations at different times. Therefore, an identification of interface standards will ensure that the elements fit together. The scope of this step should be reduced, and the step should be renamed *Define System Interface Standards.*

Step 8. Strategic Deployment Plan

This is the most important step of the process. The Strategic Deployment Plan serves as a transition map, guiding the region from its current transportation system status to the vision established early in the planning process. Because of its importance, a significant portion of the resources dedicated to an ITS planning effort should be used for this step.

The statement "The plan should possess a short, medium, and long term component" should be removed. This should be a regional decision. For example, a region may wish to concentrate its plan on items in the near term. In addition, it should be emphasized in this section that the plan is not merely a list of projects: it should also address operations, maintenance, and personnel issues associated with the projects.

Finally, the Strategic Deployment Plan should include alternative product packages based on various levels of funding and differing partnership alternatives. Until this point in the process, the planning is, by design, relatively unconstrained. However, the plan's main objective is to take the results and provide a realistic road map to implementation. Given the highly variable nature of public and private funding for ITS, a high-quality plan will provide alternative project packages that can be tailored to the funding scenario.

Project Deployment Process

The Project Deployment Process should be deleted from the "packet." The deployment process will vary significantly by region and type of project, and a generic process will be of limited use.

ITS Planning Process Version 2.0

The original publication of the *ITS Planning Process* (Version 1.0, April 1, 1993) is the only complete version of the process available. Version 2.0, which would incorporate the recommended changes, should be published.

In Version 2.0, all references to transportation operations systems (TOS) should be eliminated. These references may bias regions toward developing a TOS before the planning analyses are conducted. In addition, the narrative of the publication should be reduced. There are numerous examples included in Version 1.0, most of which refer specifically to a TOS. Again, although they are informative, they are likely to bias those conducting the effort. Such examples should be developed on a case-by-case basis for the purpose of educating stakeholders.

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APPENDIX A

IVHS Planning and Project Deployment Process, Version 1.0

U.S. Department
of Transportation
Federal Highway
Administration

IVHS PLANNING AND PROJECT DEPLOYMENT PROCESS

April 1, 1993

Developed By
FEDERAL HIGHWAY ADMINISTRATION

Version 1.0

INTRODUCTION TO THE IVHS PLANNING AND PROJECT DEPLOYMENT PROCESS

Intelligent Vehicle Highway System (IVHS) technologies promise to help increase the safety and efficiency of the nation's transportation system. However, unless there is a process for which IVHS technologies can be systematically implemented, and evaluated as part of integrated transportation systems, the promise of IVHS may never be fully realized. There is a need to help the agencies and organizations responsible for the nation's transportation system guard against inefficient allocation of limited resources. Hence, the IVHS Planning and Project Deployment Process has been created to serve as a tool for organizations to systematically plan for, and implement, IVHS technologies as part of an integrated transportation system.

The IVHS Planning and Project Deployment Process actually encompasses two distinct processes - (1) the IVHS Planning Process and (2) the Project Deployment Process. The objective of the IVHS Planning Process is the development of a Strategic Deployment Plan. This plan essentially provides an agency or agencies with a "road map" for incorporating IVHS technologies into transportation improvement projects in a small local area or throughout an entire Region. Among other things, the plan will identify various projects incorporating IVHS applications, their phasing, priorities, costs, and how they help meet previously set goals and objectives. Once the Strategic Deployment Plan has been developed, the Project Deployment Process serves as the means for actual implementation of IVHS technologies into transportation projects.

The premise of the IVHS Planning and Project Deployment Process and the description that follows is based on the concept of the "user services" approach to IVHS technology deployment. The provision of a set of services to users of the transportation system are the reason for the deployment of IVHS technologies. The term "users" may refer to travelers, drivers, transit operators, commercial fleet operators and regulators, or traffic management personnel. Examples of "services" might include traveler advisory, trip planning, traffic network monitoring, traffic control, vehicle and cargo monitoring, and dynamic ride sharing to name just a few. These user services fall under the following five broad user service areas: traveler information, traffic management, freight and fleet management, public transport and emergency vehicle management, and additional services, which may be considered a "catch-all" category. This concept is explained further in the description of the process that follows.

In addition, more details pertaining to the concept of "user services" are provided in the document - Working Paper on IVHS User Services and Functions included as an appendix to this paper. Since the IVHS Planning and Project Deployment often refers to this document, the reader may wish to become familiar with this background material first.

A comment is warranted on integrating the IVHS Planning and Project Deployment Process within the overall context of Statewide and metropolitan planning. It is critical to recognize that planning for deployment of IVHS services cannot take place independently of Statewide and metropolitan planning activities for the entire transportation system. The concept of Statewide and metropolitan planning and the use of management systems (pavement, bridge, intermodal, congestion, public transportation, safety, and traffic monitoring) relies on an integrated framework for transportation decision-making. The management systems serve as a mechanism for monitoring the performance of the existing transportation system, and provide a vehicle for identifying strategies for improving system performance. These strategies may include capital and non-capital options and serve as input to the broader planning effort.

Within this context, IVHS services designed to improve performance of the existing transportation system or serve as a component of planned improvements are a valuable tool that should be evaluated within the statewide and metropolitan planning processes. The IVHS Planning Process is a subset of broader planning activities and outlines steps that should be followed by metropolitan areas for identifying possible applications of IVHS services and technologies. However, even though the title contains "IVHS", the process described here does not solely apply to complex transportation projects incorporating IVHS technologies. While the process is encouraged to be used as a tool for this type of complex planning, it can serve equally as well for planning and developing a single, relatively simple, traffic or transit management project. Essentially, organizations are encouraged to use the process for any transportation system deployment project no matter how large or how small.

BOX #1: • DEFINE PROBLEMS & SYSTEM
• ESTABLISH INSTITUTIONAL FRAMEWORK & BUILD COALITION

Box #1 of the flow-chart shows the initial steps of the IVHS Planning Process. While the process is usually initiated with problem formulation, this is not always the case. Defining system problems and establishing an institutional framework are, in fact, highly interdependent activities. These activities will likely be carried out in an iterative fashion with either one as a starting point.

Define Problems & System

The initiative to improve a transportation system usually results from the recognition of problems with its current operation. Safety and congestion-related problems degrade the performance of the transportation system and have a resulting effect on such things as industrial productivity, air quality, and the safety and mobility of individuals. These problems can be diagnosed and quantified through a variety of traffic studies. Institutional problems can also affect the performance of the transportation system. For example, non-uniformity of commercial vehicle regulatory and registration procedures among states reduces the efficiency of goods movement. Institutional problems are often the most difficult to resolve, but their solutions often result in the most significant system improvements. Even where problems do not exist, opportunities will exist for the system to perform new functions or to perform current functions more effectively.

An inventory of the existing system to establish its composition and available resources is an important early activity. Properly defining the characteristics of the system is vital to identifying problems and opportunities and to formulating possible action plans. A system's definition should include all possible information pertaining to the available resources and the environment within which it operates. This would include such information as the system's purpose, physical components and structure (e.g., roads, travelers, buses, rail, control centers, etc.), and organizational components and structure (e.g., operating agencies, funding sources, political and agency jurisdictions, etc.). It should be noted which existing characteristics must necessarily remain fixed throughout the life of the system and which could change.

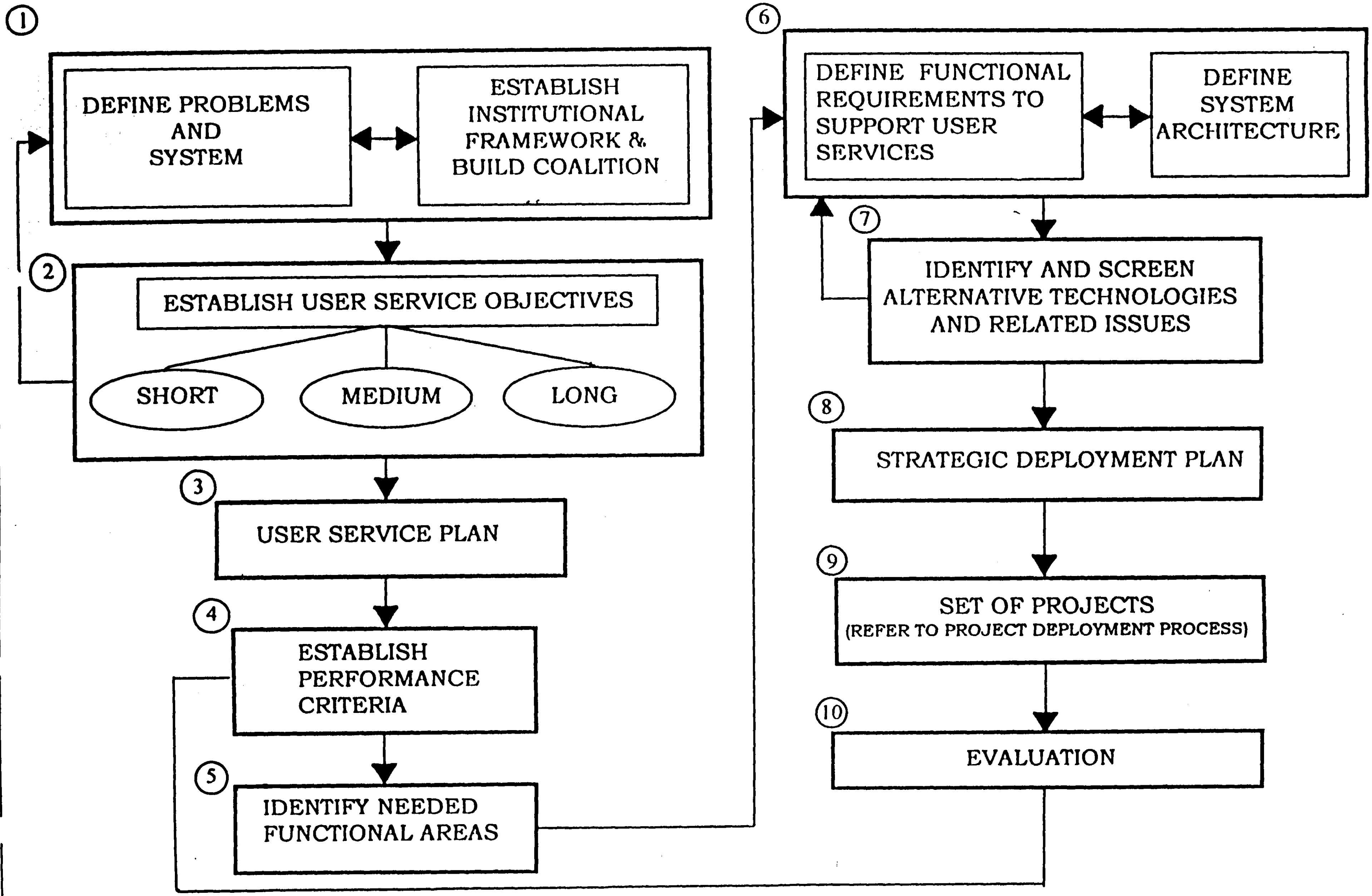
By identifying problems with the current system and opportunities to operate more effectively, a vision of the ultimate desired system begins to take shape. The end products of this step in the IVHS planning process are an inventory of the current transportation system, the vision of the ultimate system, and a list of the system needs that must be fulfilled to implement that desired system. This is not a simple step. When evaluating something as complex as a transportation system involving multiple jurisdictions and modes, it is important to obtain several viewpoints. Problems and opportunities that are not perceived or are not considered important by one group may be extremely important to other groups. For this reason, efforts should be made to obtain the views of a wide variety of groups, including public and private, system user and non-user. Initial system definitions and needs should not be considered final and should be revisited throughout the system planning process, as new coalition members are identified.

Establish Institutional Framework & Build Coalition

To perform an area-wide study, or implement system wide programs, it is necessary to involve numerous organizations and multiple levels of government working together as a coalition. Agencies within the coalition will obviously possess differing agendas, priorities and policies, and some compromises will have to be made. However, while instilling the need for close cooperation and coordination during the planning process, the coalition structure should allow each agency as much autonomy as possible in carrying out its own objectives. A well organized coalition will permit the various agencies to develop a better understanding of the system alternatives and the recommended system's features and functions, to comprehend and appreciate overlapping responsibilities, and to work harmoniously so that each agency can better fulfill its role. Developing a good working relationship with each involved organization during the early stages of the planning phase, and then maintaining this cooperation throughout the system process, will help ensure that the system effectively meets the needs and expectations of each agency and the public[2]. Coordination must remain an important concern even after specific projects have been implemented and are operating.

There is also a need for the coalition to interact with the public and other stakeholders in the transportation system, such as politicians and large employers. Public acceptance and benefit are critical to the successful implementation of an IVHS. The desired methods, extent, and timing of public input should be determined very early in the system planning process.

IVHS PLANNING PROCESS



BOX #2: • ESTABLISH USER SERVICE OBJECTIVES

When developing an area-wide system for managing transportation operations it is critical to think in terms of what services need to be provided to the users of the system - not what new technologies can be incorporated into the system. The term "users" could refer to travelers, drivers, transit operators, commercial and emergency vehicle operators, or transportation system management agencies. User services provided by an area-wide Transportation Operations System (TOS) should be the guiding force in developing the overall system concept. They will be used to help fulfill the needs that were identified earlier in the process. The services identified in the Mitre paper will fall into one of the following six areas:

- Traveler Information Services
- Freight and Fleet Management Services
- Emergency Vehicle Management Services
- Traffic Management Services
- Public Transport Services
- Additional Services

When deciding what user services to provide, it is useful to consider the short, medium, and long-term system needs, keeping in mind the desire to show early "first user" benefits. Operation of a partial system cannot be put on hold until a significant infrastructure investment is completed (for example, would the interstate highway system have been successful if motorists were not allowed to drive on it until the entire network had been constructed?). While the full functionality of an IVHS may be achieved only over a long time period, the system should be phased in so as to offer benefits throughout the stages of its development. As an example, consider the possible evolution of traveler information and traffic management user services in a system. In the short term it might be desirable to provide some level of traffic network monitoring coupled with a limited level of traveler advisory. In the medium and longer terms, as network monitoring improves through improved or increased surveillance, it may prove desirable (depending on the circumstances) to provide route selection and route guidance.

The goals of the various agencies involved in the area-wide system should be evaluated early so that overlapping agency goals can be identified and considered in the planning and design of the overall system. Overlapping agency goals may indicate user service objectives and system functions that can be coordinated or integrated. This subject of integration is discussed further in the section on defining functional requirements.

BOX #3: • USER SERVICE PLAN

This box identifies a product referred to as the User Service Plan. This plan will document the system characteristics, problems, and opportunities as discussed under box #1 above. The plan will also discuss the user service objectives which have been established to meet the needs of the areawide system in the short, medium, and long term as discussed in box #2. The User Service Plan will be the basis for further planning and design of the IVHS deployment. The plan will constantly be referenced to determine whether the IVHS Planning Process is addressing the identified system needs and user service objectives.

BOX #4: • ESTABLISH PERFORMANCE CRITERIA

In order to determine how successful the TOS will be in meeting the identified user service objectives, it is necessary to establish criteria against which the performance of the system can be measured. These criteria may be either quantitative or qualitative. Specific quantitative criteria will depend on the particular user service but might be based on such performance measures as changes in travel time, fuel consumption, vehicle occupancy, accidents, or transit schedule reliability. However, evaluations considering only qualitative measures may not fully gauge the success of a system. A qualitative assessment like a survey of the attitude of the people who interact with the system (e.g., operations and maintenance personnel, management, the general public, decision makers, etc.) may also be a good indicator of system success. If these people have faith in the system and its capabilities, then the system could be considered successful. Good performance criteria often involve both quantitative and qualitative measurements.

It is important that performance criteria be developed for individual projects as well as for the area-wide transportation system as a whole. Performance criteria initially will be developed by the coalition for the potential area-wide system. Later, as individual projects are developed, the agencies responsible for implementation will be required to develop project specific performance criteria. These project-specific performance criteria should be included in the Strategic Deployment Plan. The evaluation associated with box #10 will determine whether these performance criteria are being met by the operating system.

BOX #5: • *IDENTIFY NEEDED FUNCTIONAL AREAS*

Each user service offered by a transportation management system is achieved through the application of various technologies which perform one or more of the following system functions:

- Surveillance
- Communications
- Traveler Interface
- Control Strategies
- Navigation/Guidance
- Data Processing
- In-vehicle Sensors

A set of matrices in the Mitre User Services document serves as a tool to identify which functions are necessary to support each service and what current technologies are available to perform these functions. [see appendix A, page 6-2] For example, it might be desirable for a system to offer the following eight user services: traffic network monitoring, adaptive traffic control, traveler advisory, incident management, commercial vehicle regulatory support, commercial vehicle cargo monitoring, dynamic ride sharing, and automatic transit payment (flex-fares). By referring to the matrix, it is found that the surveillance and communications functions are necessary for all except the dynamic ride sharing service, the data processing function is necessary for all but the regulatory support and automatic transit payment, and so on.

Member agencies of the coalition should work together to determine what functions the area-wide traffic management system is going to need. It is not only important to determine what functions will be needed to support the system, however, but also where and when they will be needed.

BOX #6: • DEFINE FUNCTIONAL REQUIREMENTS TO SUPPORT USER SERVICES
• DEFINE SYSTEM ARCHITECTURE

Box # 6 contains two very closely related activities that should be performed simultaneously. The objective of this step is to define the specific functions that will be performed by the system as well as the information flow and processing, staff support, and other requirements necessary to support those functions. Definition of the interaction between subsystems and systems is also performed, and a preliminary architecture is developed. This step is performed before identifying specific technologies. There is a close relationship between the functional requirements of a system and the best architecture for that system. These two analyses are therefore highly iterative. Opportunities for integration should be examined during this iteration, taking into account commonalities in functional requirements.

Define Requirements to Support Functions

The purpose of this analysis is to determine what system attributes are required to achieve the specific activities and desired level of operation for each system function identified in Box #5. Some important determinations in defining a communications subsystem, for example, include what information needs to be transmitted, what the origins and destinations of the transmissions are, how often and how fast information must be sent, and how important specific pieces of information are to the operation of the system.

Define System Architecture

At this stage, enough information is available to begin a preliminary architecture definition. Grouping of resources and required activities and resources to various subsystems will take place. The required interaction among the subsystems and with other systems will be defined. What is developed is a high-level flow-chart upon which technology selection and more detailed system design is based. The system architecture provides the framework around which detailed functions, technologies, and interfaces are defined.

The key is to define an architecture from the start which meets the functional requirements of the system and can provide for inevitable change, evolution, and growth. A well developed architecture will provide the area-wide traffic management system with the flexibility necessary for future upgrades and compatibility facilitating system expansion. It is also important that an architecture be "open" to allow specific components to be supplied by several manufacturers. As previously stated, this preliminary architecture will be further refined as various alternative are considered and as information from the next step - Identify and Screen Alternative Technologies and Related Issues - is fed back into this step of the process.

When examining the user services and associated functions that have been identified in previous steps, it is extremely important to identify opportunities for integration. As was noted previously, the various agencies participating in the operation of an area-wide system will have differing goals and objectives. However, the possibility exists that the functional requirements necessary to achieve these objectives may be very similar. Integration can decrease costs and redundancy in the system and/or improve its overall operating effectiveness. The user services identified above should not be considered apart from each other. When considering an area-wide system, the entire array of user services should be considered together. For example, a State department of transportation might want to consider traffic management activities, and the State police might like to improve its commercial vehicle operations enforcement. Some of the functions and technologies (e.g., communications) may be similar in support of these two user services and therefore, could potentially be integrated.

The potential for integration within an agency should not be overlooked either. For example, within a State DOT, the office responsible for obtaining vehicle counts for use in planning studies or in the Highway Performance Monitoring System is often separate from the office that operates a traffic control system using traffic surveillance. These offices, within the same agency, may not be aware of the traffic count data being collected by each other, which leads to duplication of effort and inefficient use of resources.

By considering integration of functions and user services at the beginning stages of the planning process, there is an opportunity for an area-wide system to integrate various project specific sub-systems which shares all or some of the same data or common hardware element(s). By eliminating redundancies between systems and using common equipment and staff to perform multiple functions, the integrated system can offer significant cost savings. For example, increasing the size, storage, and speed of computers does not appreciably increase procurement nor operating and maintenance costs. Similarly, many communications media have a large bandwidth that may be substantially under utilized if used solely for a traffic control system[2].

BOX #7: • IDENTIFY AND SCREEN ALTERNATIVE TECHNOLOGIES AND RELATED ISSUES

The activities involved with this step are closely related to those identified in box #6. Close attention should be paid to determining whether the identified alternative technologies support the functional areas, requirements, and user services. How these technologies affect the preliminary architecture definition developed in the previous step must also be considered. "Related Issues" refers to those items indirectly related to technology considerations such as procurement, standards, operations and maintenance, etc. Note that this step conveys the intent of **identifying** and **screening** alternative technologies. The culmination of this and preceding steps in the planning process is an area-wide strategic deployment plan (Box #8) and not a preliminary design (Box #3 of the Project Deployment process). This step therefore does not require a rigorous detailed evaluation of alternative technologies. However, the review should be at a level of detail sufficient to allow refinement of potential architectures (as preliminarily defined in Box #7) and identification of possible procurement methods, operations and maintenance strategies, and funding arrangements. The remainder of this section discusses some of the issues to be considered during this step in the process.

The **performance** and **reliability** of various technologies should be evaluated against the functional requirements of the system. This would include hardware (e.g., computers; surveillance equipment - loop detectors, video equipment, etc.; traffic control devices - ramp meters, computerized signals, etc.; traveler information equipment - HAR, CMS, etc.; and communications lines -twisted pair, fiber optic, etc.), software, personnel, etc.

The **cost** of alternatives are evaluated against each other through economic analysis studies. An economic analysis should take into account the total cost of the system over its assumed life cycle. Initial construction costs usually captures the most attention; however, costs relating to operations and maintenance, replacing system components during the life-cycle of the system, system expansion, and other costs should also be included with the initial expenses.

One comment worth mentioning pertaining to total life-cycle system cost: While the costs of system planning and design, as compared to total system cost are quite small, the decisions made and engineering performed during this phase will have the greatest impact on total system cost. Accordingly, it is unwise to cut back on the early phases of system development. Investment in the cost and time spent on the planning and design phase will generate significant savings during the construction and the operations and maintenance phases such that total life-cycle costs are reduced[2].

Incorporation of **Standards**, where feasible, allows the option of using different vendors for the same service, helps to ensure compatibility with new products and services in the future, and can provide compatibility between neighboring traffic operations systems. When planning and designing an area-wide system, there needs to be an awareness of current standards and developing standards, especially those evolving from non-transportation industries. Examples of general standards frameworks are Open Systems Interconnection (OSI) and Portable Operating System Interface (POSIX). An example communications standard is SONET (Synchronous Optical Network), which is an optical transport standard providing interconnectivity between fiber-optic cable vendors.

Existing system components should be examined to determine how or if they should be incorporated into the future area-wide system. Incorporating existing components (i.e., computers, controllers, communications cable, changeable message signs, etc.) can save significant amounts of money. However, if the existing components are not suitable for the intended purpose, the system may end up costing more or functioning less effectively than if new components had originally been provided. There may be an instance where a traffic management system of some type already exists. An attempt should be made to incorporate it into the new system while allowing for enhancement of the existing system and keeping the concept of an open architecture in mind.

Procurement Alternatives should be identified for the system and/or sub-systems chosen to be used where applicable. Perhaps different projects selected for deployment within the system will use different methods of procurement. Traditional low-bid procurements that work well for simple construction projects do not work well for implementing a system composed of computers, software, communication devices, electronic sensors, and other similar equipment. A system procurement strategy could involve several different contracts and use various combinations of the following (or other) alternatives:

- Low Bid
- Two-Step
- Design/Build
- Sole Source
- System Manager
- Design/Build/Operate

The **operations and maintenance** requirements of the alternative technologies must be in balance with the availability of personnel and budget resources. Identification of the maintenance and operations requirements might include an assessment of the existing operations and maintenance capabilities in terms of personnel, skills, and equipment; determining the necessary skills and work load impact of each alternative; comparing the existing conditions with what is required for the various alternatives; analyzing the deficiencies; and establishing the feasibility of providing the additional operational and maintenance capabilities (personnel, skills, equipment, etc.) required for each system alternative.

An important related issue are considerations of the **environmental impacts** associated with various technologies as well as the potential effects of implementing integrated systems on an area-wide level. For example, are the operating frequencies of a particular Automatic Vehicle Identification (AVI) transceiver safe for human beings that may be exposed? On an area-wide level in ozone non-attainment areas, are the applications being considered for the transportation system conducive to attaining air quality improvement, or is there a potential that what is being considered may actually contribute to non-attainment? These types of environmental issues must be addressed.

A particular area-wide system can also incorporate IVHS technologies as they become proven in field operational tests as part of the **Operational Test Program** and are available for wide scale implementation. In addition, monitoring of the USDOT's effort to develop a **national IVHS architecture** will be beneficial even though the implications of this effort may not be felt for a few years.

BOX #8: • STRATEGIC DEPLOYMENT PLAN

The culmination of the activities associated with the previous 7 flow-chart boxes is the development of an area-wide Strategic Deployment Plan. The purpose of the plan is to guide the implementation of transportation system operation projects on an area-wide scale commensurate with the needs and objectives of the system (as documented in the User Service Plan). Preparation for, and application of, IVHS technologies will be an integral part of the plan. The plan should possess a short, medium, and long term component. However, due to the rapid advances in technology, the plan will have to be a "living" document that will evolve with changes in technology and as other National developments (e.g., National architecture development process) and results of the Operational Test Program become available. Projects should be identified for deployment and as part of the short, medium, and long range components of the plan. After developing an array of potential projects and the systems to be implemented (including incorporation of existing systems), all of which will be integrated into an area-wide traffic operations system, consideration of project phasing can begin. In an area-wide system, it is important that the initial "foundation" be deployed in preparation for the implementation of IVHS technologies. Different areas of the country will phase in projects depending upon their current transportation operation activities and will therefore be at different levels of preparedness for implementing IVHS technologies. Some areas may be beginning at "ground-zero". Projects in the initial phases for these areas might begin building a foundation by deploying computerized signal systems, incident management, traffic network data collection and processing systems etc. Subsequent phases will include many different types of projects which include many modes of transportation, all of which will build upon previous projects, until a fully integrated, area-wide multi-modal system incorporating state-of-the-art IVHS technologies is implemented. This does not imply that IVHS technologies will not be implemented until the very last phases of a Strategic Deployment Plan. Some projects may be field operational tests designed to research IVHS technologies. The plan should identify institutional arrangements, document the personnel and budget resources required, and provide a time table for area-wide system implementation. As explained earlier, the plan should also identify the procurement approach for each project.

The system concept will be an important component of the Strategic Deployment Plan. The system concept loosely identifies a framework under which specific projects will be deployed. The system concept also should delineate the geographic limits of the system area along with locations of components of the area-wide architecture.

While the Strategic Deployment Plan could be considered an area-wide operations plan, each individual project will also require an operations plan specific to that project. Like the Strategic Deployment Plan, and individual project operations plan would consider items associated with construction management, system start-up, and operations. Additionally, it would identify the integration of the project with other projects in the system. It is imperative that a commitment be made by the involved agencies to dedicate the necessary resources for system operations and maintenance and be documented in the operations plan. An operations plan is required for Federal-Aid funded projects per 23 CFR part 655, subpart D.

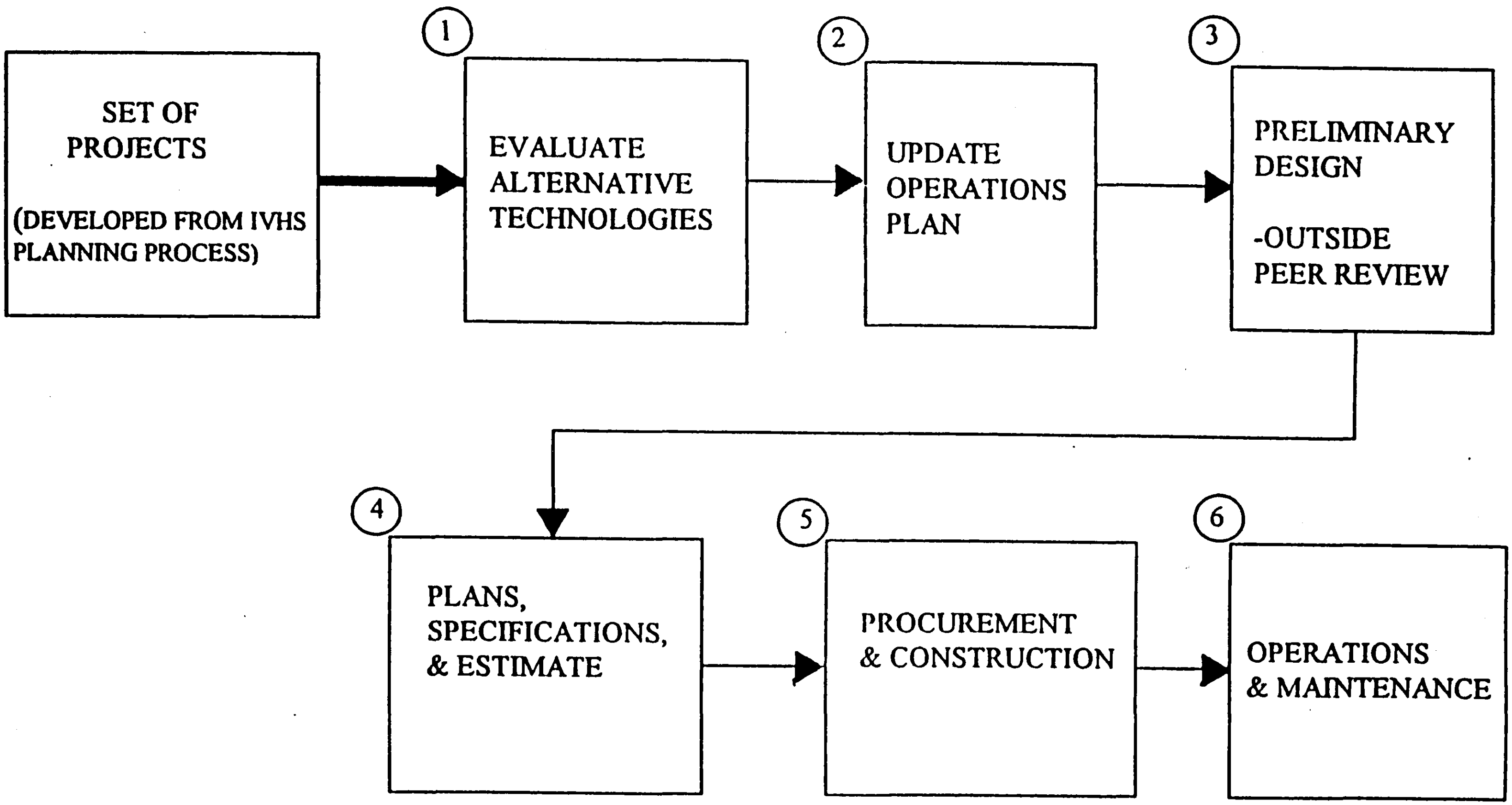
Remember that performance criteria have been established in box #4 for the area-wide system. It is imperative not to forget to establish performance criteria for each project identified in the Strategic Deployment Plan. The evaluation associated with box #10 will determine if these performance criteria are being met.

Upon completion of the Strategic Deployment Plan, it may prove beneficial to invite an outside peer review of the Plan. The purpose of the review would be to determine if the most appropriate technologies have been considered, whether standards have been incorporated wherever feasible, the "openness" of the architecture, etc.

BOX #9:	• *SET OF PROJECTS*

This box does not contain specific activities to be performed as part of the process; however, it is included to show what results from the Strategic Deployment Plan - a set of individual projects identified for deployment within a particular system. The projects may utilize off-the-shelf technology or they may apply advanced IVHS technologies in real world test bed type scenarios. In the latter case, this might be an Operational Test project. Operational Tests can be initiated through participation in the IVHS Operational Test Program. The projects will be phased in over time as indicated in the Strategic Deployment Plan. The projects will be phased in over time as indicated in the Strategic Deployment Plan. Projects which are intended for implementation within three to five years should be included in either or both the Transportation Improvement Program (TIP) for the metropolitan area and the State TIP.

PROJECT DEPLOYMENT PROCESS



PROJECT DEPLOYMENT

With projects identified for deployment in the Strategic Deployment Plan, the process of project implementation can begin.

BOX #1: • EVALUATE ALTERNATIVE TECHNOLOGIES

Here, under a specific project focus, alternative technologies will be evaluated in detail. This will result in a preliminary design for the project. During the IVHS Planning process, alternative technologies were identified and screened for possible incorporation into an area-wide Strategic Deployment Plan. At this stage, the identified alternatives are rigorously evaluated based on performance, life-cycle cost, operations and maintenance, and any other criteria that have been identified.

• BOX #2: UPDATE OPERATIONS PLAN

Once the technologies to be used in a specific project have been selected, the specific activities needed to implement and operate the project can be defined in much greater detail. Consequently, the operations plan developed for the project in Box #8 (Strategic Deployment Plan) of the IVHS Planning Process should be updated at this point. The project operations plan should discuss in detail how and when the project design, procurement, installation, start-up, operations and maintenance will take place. It should also discuss project evaluation and expansion, as well as the legal and institutional considerations in implementing the project.

BOX #3: • PRELIMINARY DESIGN

A preliminary design is developed so that each sub-system (e.g., traffic control, traveler information, transit management, etc.) performs its necessary functions. Alternative technologies that were evaluated highly will be incorporated into the design. The interaction between sub-systems should be defined by the preliminary architecture. The architecture for the project should fit into the overall area-wide system concept architecture. Where applicable, existing traffic systems or components should be incorporated into the system design.

At this point, an outside peer review for the project may be beneficial to review the technologies proposed to be utilized by the system to ensure the most appropriate technology is applied. The peer review should examine the architecture to determine whether or not an open architecture has been maintained, to what level standards have been employed, and to what extent customized software has been applied (software should be commercial off-the-shelf wherever possible).

BOX #4: • PLANS, SPECIFICATIONS, & ESTIMATE

Final plans should be developed which incorporate comments from the outside peer review. The design should be reviewed for compliance with system requirements - modifications to the design are performed as necessary. Specifications should include standards incorporated in the design. Specifications should include all system hardware:

- Computers (e.g., processing speed, memory, storage, video display, number and type of units, etc.)
- Surveillance Equipment (e.g., number and quality of loops, number and type of surveillance cameras, etc.)
- Traffic Control Devices (e.g., number and type of ramp meters)
- Traveler Information Equipment (e.g., number and type of HAR transmitters, CMS, etc.)

Specifications should include software required for the operating system(s), software needs (commercial off-the-shelf software packages), and software programming needs (traffic operations system specific). Specifications should also include personnel required for the development stage (engineers, laborers, computer programmers, communications experts, technicians, architects, etc.) as well as personnel required for the operations and maintenance stage (engineers, computer programmers, technicians, communications specialists, etc.). Initial funding and ongoing funding should be considered. Documentation should be identified which is necessary for development plans, implementation plans, evaluation plans, and operation and maintenance plans. A time line for the development of the project system should also be prepared.

BOX #5: • PROCUREMENT AND CONSTRUCTION

Hardware is acquired which incorporates the engineering requirements and maintains an open architecture. The procurement method has already been identified under the IVHS Planning process and was included as part of the Strategic Deployment Plan. Trained personnel should be inspecting the construction and integration of the system. As part of system start-up, tests and evaluations should be conducted throughout development of the system. Test plans and procedures should be developed to test design concepts. Software testing should also be performed. Based on these test results, design modifications may by necessary. Ongoing testing during the entire system development phase should make design modifications more feasible (both technically and monetarily). Only after system start-up, and the system is operating according to the requirements, should the system be accepted.

BOX #6: • OPERATIONS AND MAINTENANCE

Providing adequate technical staff and budget resources for system operations and maintenance is critical for a successful system. A commitment to providing the necessary personnel must be made, followed by the hiring of the additional staff and staff training. Coordination with all involved agencies and organizations is also very important for successful operations and maintenance. Documentation must be provided in sufficient detail to fully describe the maintenance requirements, methods of operation, and the expansion/modification procedures. Maintenance personnel should be consulted throughout the design phase as to their needs and concerns. It is important to design with maintenance in mind. The successful performance of any system is dependent on an effective maintenance management program. Lack of maintenance can drastically reduce equipment service life. Contract maintenance may be beneficial for agencies which have a problem with recruiting, training, and retaining personnel who posses the skills necessary to maintain sophisticated systems[2].

BOX #10: • *EVALUATION*

Box #10 is the last box in the IVHS Planning Process as well as the Project Deployment Process. It comes directly after the set of projects developed during the IVHS Planning Process. The point being made is that there are basically two evaluations taking place. One is an evaluation to determine if all projects integrated in the area wide system are meeting the performance criteria established by the coalition in box #4. The other evaluation is specific to the performance criteria for each individual project as identified in the Strategic Deployment Plan.

Evaluation should be an on-going process which continues for the life of the system. Depending upon the results and information obtained from evaluations, enhancements to the system can be considered. These enhancements might be performed to: correct problems, expand geographical coverage, incorporate improved technologies, or expand the system functionality. Enhancements will be technically feasible through the use of open architectures and existing standards. Ultimately, however, enhancements will only be possible through continued funding and system effectiveness and acceptability.

REFERENCES

1. The majority of this document is based on work done by the Mitre Corporation as part of its contract with the Federal Highway Administration. The two Mitre documents referenced were:

   i) Yablonski, A., Working Paper on IVHS User Services and Functions, work under contract #DTFH61-91-C-00027 for Federal Highway Administration, Washington, D.C, September 1992.

   ii) Mitre Presentation, Deployment for IVHS, prepared for Federal Highway Administration, Washington, D.C., 1992

2. Neudorff, L.G., Guidelines For Successful Traffic Control Systems, Report No. FHWA-RD-88-014, Federal Highway Administration, Washington, D.C., 1988.

APPENDIX B

Questionnaire For Early Deployment Project Participants

The Virginia Transportation Research Council is conducting, with assistance from Old Dominion University, an evaluation of the Federal Highway Administration's *ITS Planning and Project Deployment Process*. As a part of this study, we are interviewing participants in other ITS Early Deployment planning projects nationwide to solicit their experiences, views, and results from their planning work.

Process.

1. a.) Did you use any version of the Federal Highway Administration's *ITS Planning and Project Deployment Process* in your early deployment project?

   b.) If you did not use the federal process, please briefly outline the process you did use, including the goal(s) of the overall process. Did the process you used have the following steps/features?
   - Define Problems and System.
     Establish Institutional Framework & Build Coalition
   - Establish User Service Objectives.
     Short. Medium. Long.
   - User Service Plan.
   - Establish Performance Criteria.
   - Identify Needed Functional Areas.
   - Define System Architecture. (*Define Functional Requirements to Support User Services.*)
   - Identify System Component Options. (*Identify and Screen Alternative Technologies and Related Issues.*)
   - Define Implementation and Operational Strategies (Phasing, Partnerships, etc.).
   - Strategic Deployment Plan. (*Set of Projects.*)
   - Evaluation.
     (Source: FHWA's *ITS Planning and Project Deployment Process*)

2. a) What was the time frame for carrying out the process (start, completion dates)? Were these dates met?

   b) What parts would you have spent more (or less) time on?

   c) Did the time frame negatively impact results?

3. What was the time frame for implementation, or "planning horizon," for your early deployment project?

4. a.) Please describe the data gathered as part of the inventory of the region's transportation system.

   b.) How was your transportation system defined (i.e., interstate and primary highways, rail lines, intermodal facilities, etc.)?

   c.) What was the level of ITS deployment in your metropolitan area prior to the start of this early deployment project?

5. Did the process you used result in the development of a strategic plan for deploying ITS technologies in your region?

Participation.

1. Steering Committee.

   a.) Please indicate the agencies represented on the "steering" committee which guided the early deployment project in your region and the number of committee members.

   b.) What was the frequency of committee meetings?

   c.) Were there representatives which had decision-making powers on your committee?

   d.) How effective was the committee?

   e.) Was the committee very active?

   f.) What changes would you have made to the committee?

2. Stakeholder Input.

   a.) How were the views, opinions, needs, etc. gathered from the transportation stakeholders in your region?

   b.) Was this process successful?

3. Institutional Issues.

   a.) Were institutional barriers to successful implementation of ITS technologies identified and addressed in your region's early deployment planning project?

b.) If so, what were some of the barriers identified, and what solutions (if any) were offered?

Implementation.

1. a.) Did the ITS Strategic Deployment Plan include elements which addressed safety concerns, air pollution, and intermodal issues?

   b.) Were any of these issues stressed more than the others?

2. Were there any public/private partnerships or collaborations identified in the Strategic Deployment Plan?

3. Have projects outlined in the Strategic Deployment Plan been funded, implemented, and/or completed?

Final Question.

1. Is there any documentation that you can send us (i.e., final reports, other information)?

Please share any other comments regarding the early deployment planning process.

APPENDIX C

General Question Answers -- Steering Committee Survey

1. What did you like best about COMPARE?
   - Interaction between jurisdictions and agencies (9)
   - Regional cooperation (5)
   - Higher awareness of transportation issues (3)
   - The fact that there is a plan/focus on future (3)
   - Presentation/integration of information technology (2)
   - Good system architecture developed
   - Public-private workshop was good
   - Task forces and final products were good

2. What did you like the least about COMPARE?
   - Too much detail; irrelevant/repetitive information (6)
   - Lack of focus on specific systems/actions/costs (4)
   - Meetings too long (3)
   - Initial stages were too slow (2)
   - Skipped important agenda items due to no time (2)
   - Poor scheduling of meetings
   - Not enough public sector awareness
   - Performance of the consultants
   - Hidden agendas
   - Too many meetings
   - Failed to discuss issues and reach consensus
   - Too much focus on highways. Limited vision
   - Areas were too diverse and scope was too large

3. What would you do differently?
   - Change structure of meetings; lower level of detail (6)
   - More interaction with policy/political figures (4)
   - More team action/consensus building (3)
   - More input and direction into consultant's contract (3)
   - Keep focused on regional-specific issues (2)
   - Hold a workshop at the beginning to educate (2)
   - Break down into smaller groups with a common factor (2)
   - Devise mechanism for post-process/steady-state ops (2)
   - Find innovative solutions (2)
   - Start the process sooner
   - More focus on transit issues
   - More interaction with the private sector

- Thoroughly explain acronyms
- Expose newer technologies to group
- Have state take leadership on specific teams
- Have state give presentation to local councils
- Improve scheduling of meetings
- Hold fewer meetings
- Start the meeting with a review. More admin/consensus.
- Shorten length of project
- Increase length of project. One year too short
- Obtain an initial funding commitment from state/region