Mobility Services for All Americans (MSAA): Planning to Overcome Challenges

Date

Presenter Name(s)
Presentation Outline

- Brief Review of Presentation #1
- Describe basic principles of structured design approach
- Identify needs
- Develop and value alternatives
- Develop Concept of Operations
  - Purpose
  - Definitions
  - Process
- Identify resources
Many Americans have difficulty accessing some of their basic needs, particularly seniors, persons with disabilities, and those economically disadvantaged, because they rely on human service transportation systems that are often:

- Fragmented
- Unreliable
- Inefficiently operated
- Segregated
The Challenge (continued)

• Disparate funding programs also contribute to the overall challenge
• The inefficiency also creates excessive cost to the government
• Lack of coordination is the leading obstacle to meeting the mobility needs of the people who depend on the services most
Currently over 80 Federal programs fund transportation services for transportation disadvantaged

- Coordinated Human Service Transportation (HST)
- Veterans Transportation and Community Living Initiative (VTCLI)
- Mobility Services for All Americans (MSAA)
- Mobility on Demand
- Rides to Wellness
- Others
The Opportunity (continued)

- Intelligent Transportation Systems (ITS) and other technologies instrumental in addressing many challenges
Basic Concepts of Structured Process

Know what the customer wants and how the system must perform (Requirements Analysis and Baselining)

Customer/ User Needs
External Influences

Program Requirements
Rules, Regulations, Standards
Technical Requirements

Plan and Integrate your work (Systems Engineering Planning and Analysis)
Baseline Management & Change Control
Decision Criteria Development
System Integration & Interface Control

Verify the preferred solution (System Verification)

Detailed Specifications
Design Review
Test Plan

- Product
- Process
- System
- Facility

Study various options and determine a preferred solution (Alternatives Analysis & System Synthesis)

Models & Parametric
Ranked Decision Criteria
Trade Studies
Physical System Architecture

Determine desired functionality to meet customer needs (Functional Analysis and Decomposition)

Functional Hierarchy
Functional System Architecture

Existing Technologies
Existing Designs
Existing Facilities

Source: Recreated by Battelle using an unknown source
## Why Use Structured Approach?

<table>
<thead>
<tr>
<th>Management of System Requirements</th>
<th>Stakeholders or users define what system should do (not how it should do it) and manage these “system requirements”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk Management</td>
<td>Need to identify and minimize risk</td>
</tr>
<tr>
<td>System Integration</td>
<td>Components of technology system have to be integrated from physical and organizational perspective</td>
</tr>
<tr>
<td>Management of Complexity</td>
<td>The process helps you manage complexity</td>
</tr>
<tr>
<td>Enhancement of Communications</td>
<td>The process enhances communication and system understanding</td>
</tr>
<tr>
<td>Verification of User Needs</td>
<td>Must verify that system meets users’ needs</td>
</tr>
</tbody>
</table>
• Common framework for ITS:
  – Documents what ITS should do from the user's perspective
  – Defines functions and information exchanges
  – Maintained by USDOT
• Website (http://www.iteris.com/itsarch/) can support alternatives development
• Search by goal or problem/solution pair within Service Package section
### Associated Planning Factors and Goals

<table>
<thead>
<tr>
<th>Planning Factor</th>
<th>Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>D. Increase the accessibility and mobility of people and for freight;</td>
<td>Achieve a significant reduction in congestion</td>
</tr>
<tr>
<td>G. Promote efficient system management and operation;</td>
<td>Improve the efficiency of the surface transportation system</td>
</tr>
</tbody>
</table>

### Associated Objective Categories

- Transit Operations and Management: Transit Signal Priority
- Traveler Information: Data Collection and Sharing on Travel Conditions

### Associated Objectives and Performance Measures

<table>
<thead>
<tr>
<th>Objective</th>
<th>Performance Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decrease delay by X percent per year by increasing the use of queue jumping and automated vehicle location.</td>
<td>Travel time delay on routes with queue jumping and automated vehicle location in use.</td>
</tr>
<tr>
<td>Increase the percent of modes in the region that share their traveler information with other modes in the region to 100 percent by Y year.</td>
<td>Percent of modes in the region that share their traveler information with other modes.</td>
</tr>
<tr>
<td>Increase the percent of the transportation system in which travel conditions can be detected remotely via CCTV, speed detectors, etc. to X percent by Y year.</td>
<td>Percent of the transportation system in which travel conditions can be detected remotely via CCTV, speed detectors, etc.</td>
</tr>
<tr>
<td>Increase the percent of transportation facilities whose owners share their traveler information with other agencies in the region to X percent by Y year.</td>
<td>Percent of transportation facilities whose owners share their traveler information with other agencies in the region.</td>
</tr>
</tbody>
</table>

Since the mapping between objectives and service packages is not always straight-forward and often situation-dependent, these mappings should only be used as a starting point. Users should do their own analysis to identify the best service packages for their region.

Source: ITERIS (http://www.iteris.com/itsarch/html/mp/mpapts01.htm#tab-4)
Structured Approach 101

Design approach that focuses on stakeholder needs

What needs to be done

Not on how it should be done or the latest available software
Structured Approach 101 (cont’d)

What the stakeholder needs

System that meets stakeholder needs efficiently and economically

What the technical and the operational environment can support
Structured Approach 101 (cont’d)

From Top: Needs become clearly defined goals and objectives for system design to achieve.

From Bottom: Existing operations and architectures form initial boundaries of design alternatives.
Structured Approach 101 (cont’d)

- What’s the problem?
- What are my alternatives?
- What’s the best alternative?
- How do I design the system to get what I want?
Structured Approach 101 (cont’d)

What’s the problem?

What are my alternatives?

What’s the best alternative?

How do I design the system to get what I want?

OBJECTIVE
RESULTS
Structured Approach 101 (cont’d)

Needs Identification

Definition and Decomposition

Concept of Operations
High-Level Requirements
High-Level Design
Detailed Requirements
Detailed Design
Implementation

Assessment

Operations & Maintenance
System Verification
Subsystem Verification
Integration & Testing

Integration, Verification, and Validation

Time

Source: Recreated by Battelle using FHWA Guidelines
Structured Approach 101 (concluded)

- Stakeholders Define Needs (problem & goals)
- Needs Determine Requirements of (what system must do)
- Iterative Process
  - Clear Audit Trail
  - Reflect Real World
Three Concepts in Structured Process

1. Use a combined top-down/bottom-up approach

2. Focus on stakeholders/users’ needs, **NOT** technology

3. Scale your process to the size and complexity of the project
“Systems engineering practitioners tailor their favorite processes to meet the needs of the specific project…”

*International Council on System Engineering (INCOSE)*
Identifying Needs

Needs
Requirements
Approach
“Defining the problem is the most difficult part of the … process”

*Systems Engineering and Analysis, Third Edition*
Identifying Needs (con’t)

• Needs can be one or more of the following:
  ✓ Problem to be solved
  ✓ Process to be improved
  ✓ New capability

• Critical that system users define the needs

• For example, users may describe needs that reflect how they envision interacting with system

Anyone could identify needs, but users can best articulate what is necessary for system to function
Identifying Needs (con’t)

- Identify User Groups
- Decompose Problem(s)
- Develop Goals and Objectives
- Develop Performance Measures
- Criteria for Evaluating Alternatives
- Criteria for Evaluating System Performance
Identifying Needs (con’t)

• Figure out the problem: Use problem tree or other method to clearly define

• Goal:
  – Desired product or outcome
  – Usually qualitative
  – “Destination”

• Objectives:
  – Activities or products used to achieve goal
  – Usually quantitative
  – “Paving stones that form path to the destination”
Identifying Needs: Define the Problem

Problem

Cause

Too few parking spaces

Construction staging in one section of parking area

Area adjacent to Info Center needed for construction staging

Too many visitors arriving at the same time

Climbers and hikers parking overnight

No alternative way for climbers to get to start area

Most popular programs held in 2 hour window

Trailheads adjacent to visitor center parking area

Cause

Area adjacent to Info Center needed for construction staging
Identify Needs (cont’d)

- Windshield Tourists
- Overnight campers
- Meadow walkers
- Technical climbers
- Half-day hikers
- In-park lodgers
- All-day hikers
- Nearby lodgers
Identify Needs (cont’d)

• User groups may represent distinct demographics that will affect how they interact with the system:
  – Technical climbers may be more likely to access using web-based approach
  – Windshield tourists may be more comfortable using the phone/may not have access to web
Identify Needs (concluded)

• Operators may be constrained by contract rules:
  – Example: Transit operators may be working under contracts with specific rules governing what they do – will your new system be covered under their work rules?

• Once problem identified, develop goals and objectives to address it
Developing Alternatives

• Do not be afraid to “Think Outside the Box”
• Majority of required FTA Policy elements clustered here:
  – ID relevant portions of regional ITS architecture
  – ID participating agencies roles/responsibilities
  – Initial requirements definitions
  – Analysis of alternative system configurations
• Iteration plays important role
• Does not occur in a vacuum – existing systems form an initial guideline
Developing Alternatives (con’t)

• Based on goals and objectives – various system approaches to achieve

• Develop scenario graphics/flow charts to help visualize how operators and users will interact with system
  – Stakeholders a critical element
  – “Use cases” as scenarios become more mature

• Use goals and issues that you are trying to address to search through National ITS Architecture
Developing Alternatives (concluded)

- Develop Scenarios for a “system” that will achieve the goals and objectives
- Use web-based National ITS Architecture
- Assess available infrastructure, ITS architecture and planned developments
- Identify Mandatory Requirements and Preferential Requirements – Understand the Difference
- Develop Alternatives
Value Ranking

• Supports:
  – Evaluation of alternatives
  – Selection of preferred alternative

• Captures organizational or social goals that may not lend themselves to quantification but can be key discriminator
  – Example: Providing worthwhile service vs. efficiency
Value Ranking (cont’d)

• May form the most critical design constraints
• Should be brought to the attention of ITS/design leads early in process
  – Example: Project Managers from National Park Service and State DOT are probably going to have different perspectives on cutting down some trees to clear a path for an inexpensive communications link
## Value Ranking - Example

### Values Ranking Matrix
*(All must receive ranking)*

<table>
<thead>
<tr>
<th>Values</th>
<th>Stakeholder Group 1</th>
<th>Stakeholder Group 2</th>
<th>Stakeholder Group 3</th>
<th>Stakeholder Group 4</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROTECT CULTURAL AND NATURAL RESOURCES</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FACTOR 1 - Prevent Loss of Resources</td>
<td>35</td>
<td>30</td>
<td>20</td>
<td>25</td>
<td>110</td>
</tr>
<tr>
<td>FACTOR 2 - Maintain and Improve Condition of Resources</td>
<td>15</td>
<td>5</td>
<td>10</td>
<td>15</td>
<td>45</td>
</tr>
<tr>
<td>PROVIDE FOR VISITOR ENJOYMENT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FACTOR 3 - Provide Visitor Services and Educational and Recreational Opportunities</td>
<td>10</td>
<td>25</td>
<td>30</td>
<td>20</td>
<td>85</td>
</tr>
<tr>
<td>FACTOR 4 - Protect Public Health, Safety and Welfare</td>
<td>15</td>
<td>15</td>
<td>5</td>
<td>5</td>
<td>40</td>
</tr>
<tr>
<td>IMPROVE EFFICIENCY OF PARK OPERATIONS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FACTOR 5 - Improve Operational Efficiency and Sustainability</td>
<td>5</td>
<td>5</td>
<td>10</td>
<td>10</td>
<td>30</td>
</tr>
<tr>
<td>FACTOR 6 - Protect Employee Health, Safety and Welfare</td>
<td>15</td>
<td>10</td>
<td>15</td>
<td>15</td>
<td>55</td>
</tr>
<tr>
<td>PROVIDE COST-EFFECTIVE, ENVIRONMENTALLY RESPONSIBLE, AND OTHERWISE BENEFICIAL DEVELOPMENT FOR THE NPS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FACTOR 7 - Provide Other Advantages to the National Park System</td>
<td>5</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>35</td>
</tr>
</tbody>
</table>

Source: Battelle
Continuing with the “V” Model

Source: Recreated by Battelle using FHWA Guidelines
A concept of operations (ConOps) is a document describing the characteristics of a proposed system from the viewpoint of an individual who will use that system. It is used to communicate the quantitative and qualitative system characteristics to all stakeholders.
Why a Concept of Operations?

• Ensures that all users and supporters have the same understanding of technologies. By providing description of components and operations:
  – Stakeholder misunderstandings can be reduced
  – Expectations can be managed

• Clearly defines conditions for use of technology. This should minimize risks associated with operating technologies
Why Concept of Operations? (cont’d)

• Should include:
  – Non-technical descriptions of all system users
  – Data and information needed to operate and use technologies
  – Conditions under which they use this data and information

• Documents operational needs of users without defining specific technical issues
Why Concept of Operations? (concluded)

- Provides operational needs and proposed characteristics for proposed system
- Describes high-level user expectations and functional requirements for system
- Describes information sharing across programs and operators
Key ConOps Sections

1. Scope
2. References
3. Use Cases
4. Operational Needs
5. System Design
6. Operational Scenarios
7. Operational and Support Environments
1. Scope

• Purpose of document:
  – To communicate an idea to multiple stakeholders
  – To convey business needs of the system

• Audience for ConOps:
  – Those who will build and implement system
  – Typically does not target all stakeholders
    • e.g. traveling public

Project benefits from a local ‘champion’ – i.e., one stakeholder (or stakeholder agency) who leads the others in the articulation of system goals, assignment of roles and responsibilities, and provides the project with the extra attention necessary for success.
1. Scope (con’t)

• Vision for system: High level “mission statement”
  – Example: To increase mobility and accessibility for the transportation disadvantaged and the general public, and achieve more efficient use of federal transportation funding resources through technology integration and service coordination
1. Scope (con’t)

- **Goals and Objectives:**
  - Enhance existing service elements
  - Improve efficiency of system’s operation (reporting, vehicle use, etc.)
  - Provide users (riders) a single point of access for trip planning, questions, etc.

- **System Needs: Identify specific needs that will be addressed by system**
  - Example: Need 1 – Reduce burden for travelers to schedule trips
1. Scope (concluded)

• System Functions: High-level overview of system functions
  – Example: Function 1 - Provide a single portal for travelers to schedule all trips

• System Scope Boundaries: Briefly identify scope of system
  – What is “in” and what is “out”
2. References

• Summary of inputs that influenced Con Ops
  – Previous reports, such as:
    • Existing mission statements
    • 5-year plans
    • Regional ITS architectures
  – Existing systems, including both internal systems and similar systems employed by others
  – Stakeholder input, including items like Meeting Minutes, etc.
3. Use Cases

- Identify System Users
  - Customers
  - State agencies which fund and administer human service transportation programs
  - Local transit agency
    - Operators
    - Dispatchers
    - Management

- Community/non-profit operators
  - Operators
  - Dispatchers
  - Management

- Privately-provided human transportation services
  - Operators
  - Dispatchers
  - Management

- USDOT
- State DOT
3. Use Cases (con’t)

• Identify functional requirements
  – What do you want the users to be able to do?
    • A single function may be required by multiple users
  – Example: Function 1: Check on vehicle location
    • Both customers and dispatchers will be able to check vehicle location in real-time through an internet website
4. Operational Needs

• Typically arise from stakeholder input
• First introduced in the scope
• What do you want to accomplish through deployment of the system?
  – Example: Need 1 – reduce burden for travelers to schedule trips?
4. Operational Needs (con’t)

• Other Needs:

- Minimize areas without service
- Reduce areas where service is not easy to access
- Ensure service is flexible for all users
- Make it easier for riders to plan a trip
- Allow riders to plan multi-destination or multi-mode trips
- Standardize reporting among all agencies
5. System Design

• Simple Design Schematic:
  – Outside: core system functions
  – Inside: store support data and information
5. System Design (con’t)
6. Operational Scenarios

For each function:
- Provide background on how the function occurs today (if at all)
- Present one or more scenarios that identify Who is involved, What they would do, and How they would interface with the TMCC?

Potential scenarios:
- Normal Operations
- Changes in service providers
- Changes in participating Human Service Programs

Scenario elements:
- What modes are affected?
- How does each scenario affect customers’ interaction with the system?
- Anticipated impacts
- Potential disadvantages or limitations
7. Operational and Support Environments

- Describes environment in which system will operate:
  - Facilities
  - Hardware
  - Software
  - Personnel
  - Communications Needs
## Benefits of Structured Approach

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduced Time</td>
<td>Reduces time required to move from concept to deployed systems</td>
</tr>
<tr>
<td>User Needs are met</td>
<td>Ensures that system meets users’ needs</td>
</tr>
<tr>
<td>Reduced Deployment Cost</td>
<td>Reduces cost of deploying systems</td>
</tr>
<tr>
<td>Change Orders are controlled</td>
<td>Ensures that number of “change orders” is minimized (change orders result in vendors performing more work than expected)</td>
</tr>
</tbody>
</table>
Benefits of Structured Approach (cont’d)

- **Reduced Risk**: Reduces risks associated with system development
- **Improved System Quality**: Improves system quality, reliability, and performance
- **Improved Communications**: Improves communications among team members and vendor during design and development
- **Sustainable System**: Improves ability to sustain and upgrade systems in the future
1. Requirements Analysis and Baselining:
   Know what users want and how system must perform

2. Functional Analysis and Decomposition:
   Determine desired functionality of system to meet users’ needs

3. Alternatives Analysis:
   Study various system options and determine preferred solution

4. System Validation and Verification:
   Verify preferred solution
Needs -> System Requirements

• System requirements: what the system must do or deliver (after ConOps)

• Once system requirements are developed, project team keeps track of each requirement – called “traceability”

- User Needs: Need to be able to confirm that all requirements derived directly from user needs
- Flexibility: Requirements may change over life of project
- Documentation: Need way of documenting changes, reasons for change and status of each requirement throughout testing process
Procurement

• System built consisting of functions identified after ConOps
• Most likely, system will be developed by a vendor, meaning that you will need to procure a vendor’s services
• Key elements of procurement and resulting vendor contract on following slides
Procurement Key Elements

• Provide potential vendors with system requirements
• Ensure that vendors can meet those requirements
• Define process that vendor must use throughout project to ensure:

1. They are delivering system that meets users’ needs
2. Project is on-time and within budget
Implementation Process

- **System Requirements Matrix**: Maintain system requirements matrix noting status of each requirement throughout project (for traceability, as described earlier).

- **Bi-weekly Conference Calls**: Conduct bi-weekly conference calls or meetings with vendor to discuss project status and action items.

- **Iterative Testing**: Define and execute iterative testing to ensure:
  - System components work as they were intended
  - All components work together as a system
  - All requirements are met and can be accepted by your organization
## Intended Outcomes of MSAA

<table>
<thead>
<tr>
<th>Category</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enhanced Experience</td>
<td>Enhance customer experience</td>
</tr>
<tr>
<td>Improved Effectiveness and Efficiency</td>
<td>Improve effectiveness and efficiency of services being provided by different transportation providers</td>
</tr>
<tr>
<td>Sustainable Institutional Model</td>
<td>Produce <strong>sustainable institutional model(s)</strong> enhanced by information technology</td>
</tr>
<tr>
<td>Data Sharing</td>
<td>Data sharing by addressing institutional barriers</td>
</tr>
<tr>
<td>Intelligent Transportation Systems</td>
<td>Utilization of Intelligent Transportation Systems</td>
</tr>
</tbody>
</table>
Intended Outcomes of MSAA (cont’d)

- **State-of-the-art**
  - Advance the state-of-the-art in:
    - Comprehensive traveler support
    - **Interoperable** and **coordinated** transportation service operations and management
    - Streamlined program management requirements

- **Data Exchange**
  - **Data sharing and exchange** within HST

- **System Interoperability**
  - **System interoperability** by leveraging existing proprietary solutions
Overall Human Service Benefits

**Personal Mobility**
- Provides choice in personal mobility:
  - Access to healthcare and jobs
  - Access to social welfare programs
  - Better transportation connectivity

**Inclusiveness**
- Encourages inclusiveness

**Equity**
- Provides equity of service access and delivery
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