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**Federal Highway
Administration**



Developing and Using a Concept of Operations in Transportation Management Systems:

A Primer

September 2005

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Table of Contents

- 1. Introduction 1
 - Objective and Audience 1
- 2. The Concept of Operations Defined 2
 - Why Use a Concept of Operations? 3
 - What are the Elements of a Concept of Operations? 4
 - What are the Major Goals of the Concept of Operations? 8
 - Examples of Concepts of Operations for Different Types of Systems 9
- 3. Developing a Concept of Operations 9
 - Requirements for Technical Expertise 9
 - The Need for a Team Effort 9
 - A Purpose-Driven Scope 10
 - Resources Required for Concept of Operations Development 10
 - Stakeholder Identification and Involvement 11
 - Defining Performance Measures 12
- 4. The Concept of Operations and Systems Engineering 12
 - The Systems Engineering Life Cycle and the Systems Engineering "V" 12
- 5. Transition from a Concept of Operations to System Requirements 13
- 6. Additional Resources 14

1. Introduction

Objective and Audience

The objective of this document is to provide guidance to transportation professionals as they seek to develop and use the Concept of Operations throughout the life cycle of a Transportation Management System (TMS). For the purposes of this document, a *TMS is defined as any complex, integrated software/hardware project with a large number of inputs and outputs whose goal is to manage the large-scale movement of people and goods safely, efficiently, and effectively.*

This document is designed to provide the reader with insight into a TMS-focused Concept of Operations document. As such, it offers:

- *Guidance on developing the Concept of Operations*, including what information to include, how to begin the development process, stakeholder identification and involvement in the process, and identifying resources that will facilitate the development process.
- *Guidance on using Concepts of Operations*, including highlights of the entire systems engineering life cycle and presentation of a variety of stakeholder vantage points.
- *Specific examples of good practice from transportation agencies*, including testimonials, experiences and guidance from transportation professionals as well as from their Concept of Operations documents.
- *Guidance on tailoring the Concept of Operations to a specific system for successful development*, since there are no “cookbooks” (i.e., multi-step processes) for developing/using Concepts of Operations.

This primer is written for transportation professionals involved in the planning, development, design, operations, and maintenance of TMSs. However, the document is relevant to a wide audience with relatively little TMS experience since it is intended to communicate essential information about a TMS to a high-level audience.

The following common “classes” of TMS professional will find the guidance document useful for the following reasons:

- *Management* – Transportation managerial professionals operating either within or in conjunction with a TMS will find that this document reiterates the necessity of system stakeholder communication. A Concept of Operations is a critical foundation for such communication.
- *Technical staff* – Professionals working within a TMS that deal with all aspects of the system's operation, including but not limited to design engineers, integration and test engineers, operators of the various system functions, and maintenance staff, will find that this document demonstrates how a Concept of Operations helps to clarify agency goals and objectives.
- *Support engineering firms* – Any members of a contracted firm that work within or in conjunction with the TMS, performing work that includes repairs and maintenance, system support services, etc., will find that this document shows how a Concept of Operations assures that the ‘client’ has communicated, at the highest possible level, what they want the system to be – adding clarity and helping to avoid scope creep for all parties.

But this document is not just aimed at transportation professionals. It is also written for non-technical community leaders, local officials, and others who have an interest in transportation issues and who may influence resource allocation decisions. Such individuals may have as much input, if not more, in some cases, into transportation system development decisions as transportation professionals themselves.

This document will also present information on the development of Concept of Operations for TMSs with the understanding that not all of the individuals or groups reviewing this document will be at the same point operationally or developmentally. As such, consideration will be given to those organizations, agencies and individuals who:

- *Are new to a Concept of Operations.*
- *Have limited experience with a Concept of Operations.*
- *Are seeking to develop and use a Concept of Operations for an existing system.*

2. The Concept of Operations Defined

A *Concept of Operations* is defined as a high-level description of what the major system capabilities will be – it attempts to answer the *who, what, when, where, why, and how* questions for new systems in general terms. Figure 1 provides a conceptual representation of the overarching structure that, once fleshed out, becomes a Concept of Operations.

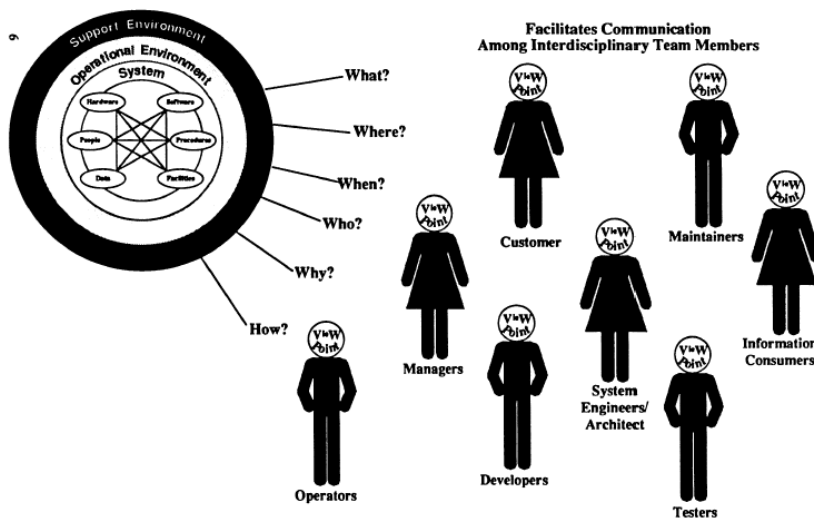


Figure 1. – The Concept of Operations must answer who, what, when, where, why, and how about the system to satisfy each of the system stakeholder perspectives. Graphic reproduced with permission by ANSI/AIAA from “Guide for the Preparation of Operational Concept Documents,” ANSI/AIAA G-043-1992

- What – What are the known elements and the high-level capabilities of the system?
- Where – What are the geographical and physical extents of the system?
- When – What is the time-sequence of activities that will be performed?
- How – What resources do we need to design, build, or retrofit the system?
- Who – Who are the stakeholders involved with the system?
- Why – What does your organization lack that the system will provide?

The Concept of Operations is the key transition point leading to development of Requirements, a document which the Concept of Operations informs and shapes.

The Concept of Operations should be a document that is available and relevant to all stakeholders in the system, no matter what their background or role within the system. In the context of a TMS, it should be as readable and relevant to high-level decision makers and community leaders as it is to the TMS manager, the TMS operator, and other transportation professionals.

The Concept of Operations is not a requirements document that lists the thousands of low-level capabilities of the system. It should not contain information on the specifics of systems design that will make this functionality possible, but rather lay out all the things the system should be able to do. The ideal case is that all those people who have any stake in the system (including end users, all organizations who are sharing information, system developers, management, etc.) are able to understand the basic idea of the system and be able to discuss the system in terms of what it does.

A Concept of Operations may not be called by this name. In many cases, the elements of a Concept of Operations are scattered through various related documents – such as a system’s Business Plan, Requirements, etc. However, if the core elements of a Concept of Operations, as outlined within this document, are found within a document such as the Business Plan, then it can be considered to be a Concept of Operations. Nonetheless, it is often the case that existing systems do not have one document containing all of the core elements that will be outlined.

Why Use a Concept of Operations?

There are a variety of benefits that can accrue to an organization or group of organizations from developing a Concept of Operations. The primary motivations for moving forward with the development of such a document include the following:

- The identification of system stakeholders and the assurance that they will communicate in a common forum.
- The formulation and documentation of a high-level system definition.
- The foundation for all lower-level sub-system descriptions.
- The definition of all major user groups and activities.
- The identification of the environment in which the system will function.

An overwhelming majority of transportation professionals interviewed for *Developing and Using a Concept of Operations in Transportation Management Systems*, the companion report for this primer,¹ mentioned *stakeholder agreement* on interrelationships, information sharing, and roles and responsibilities for the system as the most important benefit of the Concept of Operations development process. A testimonial

“The biggest benefit from developing a Concept of Operations is getting all the stakeholders to agree on what they all do and what they need from each other.” – *Excerpt from a survey of transportation professionals*

¹ Federal Highway Administration, *Developing and Using a Concept of Operations in Transportation Management Systems*, FHWA-HOP-07-001 (Washington, DC; September 2005).

from one transportation professional identified the principal benefits as being creation of a consensus on the priority of needs for the organization, a bridging of the gap between the technical and operational sides of the organization, and establishment of continuity throughout the ebb and flow of economic and political fluctuations.

An additional benefit that accrues from stakeholder consensus is a *decreased risk of project failure*. The experiences of transportation professionals have shown that developing a Concept of Operations significantly increases the chance for success on the project. The stakeholder consensus integral to the Concept of Operations development process not only builds a unified vision and understanding of a new system, but also contributes to reductions in cost overruns, a more accurate definition of the system earlier in the development stage, and a decrease in the likelihood that stakeholder dissatisfaction will terminate the project. One transportation professional said of the Concept of Operations for a Transportation Management System that it is “not a silver bullet [i.e., not a cure-all to the problems of developing and maintaining a TMS], but it does decrease the likelihood of failure for a project.”

What are the Elements of a Concept of Operations?

The ANSI Concept of Operations standard (ANSI/AIAA G-043-1992) provides an excellent format for developing a Concept of Operations Document for any highly complex system. In essence, ANSI recommends that a Concept of Operations Document “...describes system characteristics from an operational perspective,” and, for each stakeholder, answers the question “What does it [the system] look like from my point of view?” The standard is summarized in the diagram in Figure 2, and its elements are addressed below.

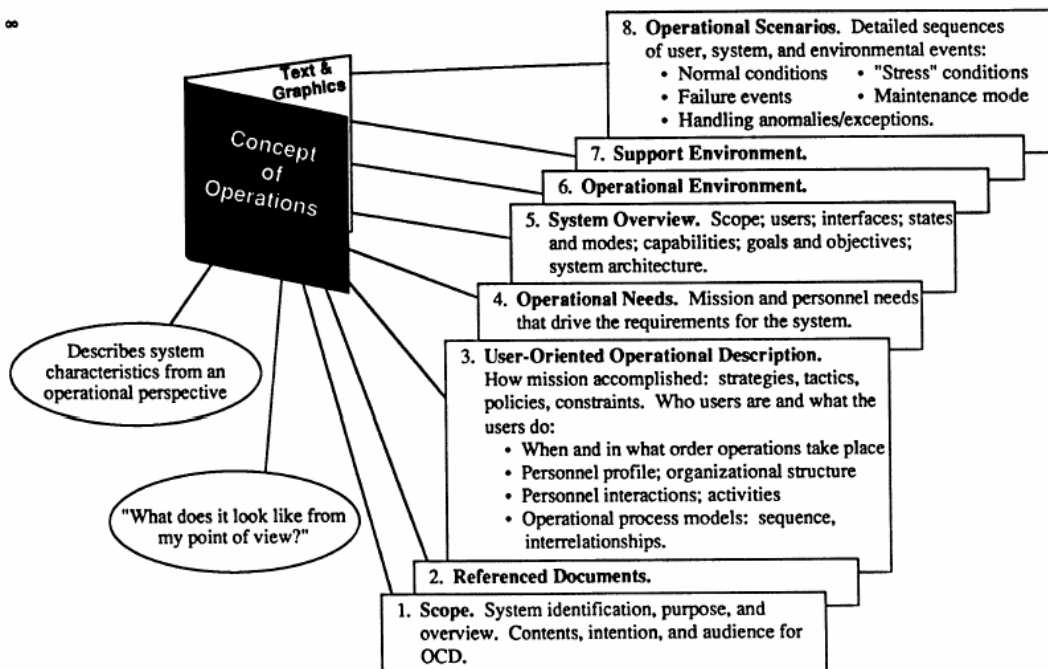


Figure 2: The Core Elements of a Concept of Operations - Graphic reproduced with permission by ANSI/AIAA from “Guide for the Preparation of Operational Concept Documents,” ANSI/AIAA G-043-1992

It is important to note that all Concept of Operations documents will not be the same since they are all tailored to support the development and use of a specific system or set of services. The critical function of the Concept of Operations is to encourage careful consideration of the system by multiple stakeholders at the outset of a system development process and to document agreed-upon descriptions. The formality of the section titles is not necessary, and it is apparent when looking at the current state-of-the-practice for Concept of Operations development that each organization will arrange information in a way that best fits its individual system.

1. **Scope** – This section presents an overview of the entire Concept of Operations, including the following elements:
 - Outline of the Contents of the Document.
 - Purpose for Implementing the System.
 - Highlight Major Objectives and Goals.
 - Identify the Intended Audience.
 - Set Boundaries on the Scope of the System.
 - Describe an Overarching Vision for the System.

Example² — *Fontana/Ontario, a joint TMC project for the I-10 corridor between Fontana and Ontario in Southern California, includes in its Concept of Operations an introduction section, which, among other details, lists the major organizations that will be included in the integrated operation. This introduction clearly sets the boundary of the system and states high-level goals for the project:*

2 Introduction

2.1 Document Organization

This document sets forth the Concept of Operations for the Fontana/Ontario Advanced Traffic Management and Information System (ATMIS). The document will provide the reader the following information:

- Identification of the issues and problems to be resolved.
- The agency needs to operate and manage the proposed solution.
- Operational and use perspectives to define the use and intent of the ATMIS.

This document flows from the Inventory / Needs Document and forms the basis for the System Requirements Document...

3 Fontana / Ontario ATMIS...

3.2 System Overview / Purpose of Project

Funded by a Federal ITS grant and local resources, the Fontana/Ontario ATMIS will be one of several ITS projects in the Southern California ITS Priority Corridor. The project is being implemented as a joint venture between Caltrans District 8 (D8) and the cities of Fontana and Ontario. ...[T]he system encompasses several major event generators - among them, Ontario Mills Mall, Ontario Convention Center, Ontario Airport, California Speedway, and commercial transportation from manufacturing facilities adjacent to the California Speedway.

The ATMIS will provide for integration of freeway and surface street operations, and will become the foundation of a "Smart Corridor" along the I-10. With multiple parallel alternatives (both freeway and arterial), ATMIS will facilitate the coordination of traffic management activities on both the freeway network and the local arterials.

² City of Fontana, California, *Fontana/Ontario Advanced Traffic Management Information System (ATMIS), Phase 1C: Concept of Operations Document*, (Fontana, CA; December 13, 2000).

2. **Referenced Documents** – In this section, authors of the Concept of Operations list the resources used when developing the document. This both clarifies the sources of information that went into the document and provides the reader with guidance to find additional information. Types of reference documents that are typically listed include:
 - Business Planning Documents.
 - Concept of Operations for related systems.
 - Requirements for related systems.
 - Studies to Identify Operational Needs.
 - System Development Meeting Minutes.
3. **User-Oriented Operational Description** – This section of the document describes the system from a user vantage point. It identifies how organization/system-specific goals and objectives are accomplished, including strategies, tactics, policies, and constraints. This portion of the Concept of Operations should be the main focus for the entire document. Its purpose is to outline the system and provide a clear working image of how each party should expect to integrate itself within the overall system. Information that should be highlighted in this section includes:
 - User Activities.
 - Order of User Operations.
 - Operational Process Procedures.
 - Organizational/Personnel Structures.
4. **Operational Needs** – This section details agency- and region-specific goals and objectives that will drive the requirements for the system. In other words, the section addresses the question of what is necessary to the agency or region that the current system or set of services does not provide.
5. **System Overview** – This section provides a high-level description of the interrelationships of key system components. (Figure 3) The areas this section should address include:
 - Scope.
 - Interfaces.
 - System Capabilities (Functions).
 - Goals and Objectives
6. **The Operational and Support Environments** – Although the ANSI/AIAA standard describes two sections, there is considerable overlap between them. Therefore, it is recommended that the sections be combined to provide information about the general operational environment for operation of the new system (or created by the change in the current system). This section includes the following environmental characteristics:
 - Facilities.
 - Equipment.
 - Hardware.
 - Software.
 - Personnel.

Example —The St. Louis Gateway Guide System, an effort to integrate multiple regional operations and control centers/ systems, uses the graphic below to illustrate information flows among partners at a very high-level.

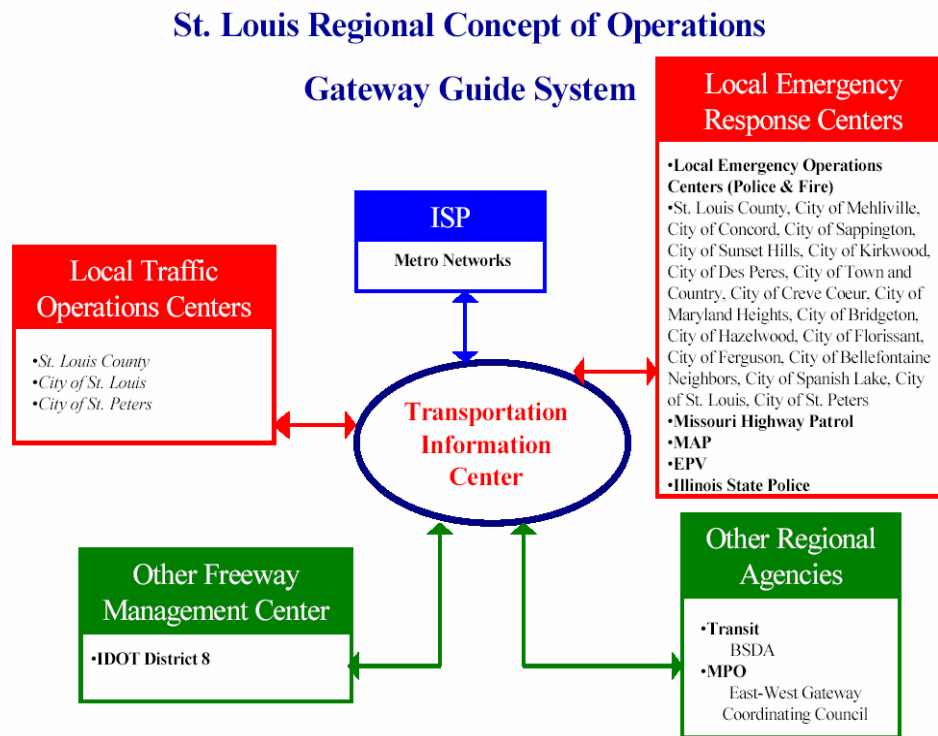


Figure 3. The St. Louis Bi-State Regional Intelligent Transportation Systems (ITS) Concept of Operations provides a high-level relational diagram demonstrating how the overall system relates to all system stakeholders.

- Operational Procedures.
- Support Necessary to Operate the Deployed System.

Ideally, a description of the operational and supporting environment should make a clear connection between functional, physical, and logical viewpoints.

7. **Operational Scenarios** – In this section of the Concept of Operations, the authors place themselves in the users' position and detail how the new system would impact their activities under various conditions ranging from normal to stress and failure conditions. There are four basic elements to consider in operational scenario development:

- Included Users' Perspectives.
- Variety of User Classes.
- Stress/Failure Scenarios.
- Multiple Circumstances.

Example — *Fontana/Ontario Concept of Operations*³ gives different user perspectives for several different scenarios, which are listed below:

- Fontana TMC Operator
- Fontana Maintenance Operator
- Fontana Engineering
- Police Department: Caltrans District 8 Operator
- Caltrans District 8 Signal Engineer
- Major Event Generator
- Traveling Public
- Ontario International Airport

The following is an excerpt from the Fontana TMC Operator Perspective which concerns operator "Joe":

Alerted by the sudden decrease in vehicle speeds along Sierra, Joe selects the video images from Sierra and Randall. Joe notices that the north bound lanes on Sierra are backing up due to a stalled car on the outside lane. The problem is exacerbated by the fact that there is a construction crew working next to the car on the inside lane. Upon further review he notices the construction crew assisting the driver out of his car and onto the street. He switches the image to the large screen display – it looks like a medical emergency.

Joe logs the incident using the ATMIS 'Incident Management Dialogue' window. He enters information about the incident - reporting agency, contact name, phone, incident location, phone number, lanes affected, place on map, description, notification list, traffic management plan and alternate routes. The incident report is immediately transmitted to the Fontana PD CAD system alerting operators who can react by dispatching police and emergency services. Additionally, Joe updates local dynamic message signs (already in use for the construction activity) to warn oncoming traffic of the incident and provide alternate routes.

What are the Major Goals of the Concept of Operations?

In order to understand a concept of operations, it is essential to comprehend its goals. Key goals of a concept of operations are as follows:

- *Stakeholder Identification and Communication.* A major goal of the document is to facilitate discussion and eventually find common ground among the relevant groups associated with system design, development, and operation.
- *High-level System Definition.* All stakeholders should be able to understand, what the system is being designed to do, including the flows of information among major system entities, the information flow to external entities, high-level capabilities, and the main daily operational occurrences..
- *Foundation for Lower-level System Description.* Although the Concept of Operations is not a requirements document itself, a well-formed Concept of Operations will be a source of information that can be decomposed into a first cut of high-level functional requirements.
- *Definition of Major User Classes and User Activities.* All stakeholders should be aware of the different types of users of the system and activities those users will perform, allowing everyone who uses the document to get an idea of who is performing what activity, and which high-level capability that activity is supporting.

³ Ibid.

Examples of Concepts of Operations for Different Types of Systems

A Concept of Operations should be developed for any system-level initiative in a TMS. These initiatives may be developing a new traffic control center/system, integrating multiple systems in a region, adding a service to an existing system, etc. This section briefly discusses expected differences in Concepts of Operation for different classes of TMS initiatives.

Stand-Alone Centers — Transportation Management Centers that have a contained scope of one agency/jurisdiction can approach the Concept of Operations straightforwardly. The Texas DOT TMC Advanced Traffic Management System ATMS for Austin is an example of a 'stand-alone' center whose Concept, while focused on one activity/ system, relates very well to the core elements.

Integration Programs — iFlorida represents a statewide transportation integration effort, and the Concept of Operations document is adjusted to fit that level of operation. The iFlorida Concept of Operations is divided into various sections from which the statewide integration project will be built. Each "Procurement" of the project describes all the elements listed for each section of the integration, thereby conveying all the information for the core elements of a Concept of Operations on a section-by-section basis.

Existing Systems — There are several reasons for developing a Concept of Operations after systems development has already begun - including adding functionality to an existing system or addressing groups of stakeholders with jurisdictional concerns. The Virginia Department of Transportation's Hampton Roads Smart Traffic Center, a regional TMC, is such an example. The Center has existed for several years with little change in overall mission, stakeholders, users, etc. However, with the addition of new functionality to the TMC's capabilities, an entirely new group of stakeholders, system connections, and information analysis capabilities have been integrated, resulting in the need for a thorough review of the TMC's original concept. The Center is now in the process of developing an entirely new Concept of Operations.

3. Developing a Concept of Operations

Requirements for Technical Expertise

The Concept of Operations document is intended to have a wide audience. As such, its writing must balance generality with specificity: it must be general enough for individuals or stakeholders with limited system knowledge to understand the overall system, yet detailed enough that in-system technical stakeholders are able to glean a depth of understanding that will enable them to transition from step-to-step within the systems engineering process to build or refine the system.

This writing balance is often best assured by creating a writing team that contains members with a broad set of backgrounds and that encompasses the core of the stakeholder group. The leaders of this group should be the individuals who will be responsible for operating the system. So, while technical expertise is necessary for the development of the Concept of Operations, it is not a required qualification for those who will actually write a Concept of Operations document.

The Need for a Team Effort

An effective concept of operations depends on a solid team compiled to create and use the document. The following guidance may be useful in this effort:

- *Begin compiling the team immediately* –The process to build the Concept of Operations document is iterative. It involves the core group whose goal is to define an idea, bring in additional

stakeholders for their review and consideration, and then refine the idea further. The core stakeholders and the core idea will come into balance in time, and finding individuals who have the time and interest in developing the concept is critical in the earliest stages.

- *Focus on those who will be responsible for using the system* – The expansive, reiterative process involved in idea/concept development should involve all stakeholders, but the writing should involve only a core group containing the immediate users rather than peripheral stakeholders, who may attempt to redirect the effort toward their more critical, but less pertinent, needs.

A Purpose-Driven Scope

A Concept of Operations may be developed for many different classes of systems initiatives.

- *New center* – Although it may be perceived that a new TMS without the influence of any existing system will be easier to develop, this is not always true. The challenge lies in the preparatory phases: identifying system boundaries, identifying stakeholders, determining what the system should do, etc.
- *Regional integration program* – Such TMSs must integrate systems representing both similar and different technologies, organizations, and missions. Here, the Concept of Operations generates a new, overarching mission demonstrating how a regional, systemic need can only be met by integrating some or all aspects of existing regional TMSs.
- *Adding/modifying functionality to an existing system* – It is generally considered a good idea to rewrite a Concept of Operations document when substantial new functionality is added to the system resulting from a change to the nature of the mission, when significant new capabilities are added, or when new stakeholder groups arise whose needs require integration.

Resources Required for Concept of Operations Development

The resources necessary to develop a Concept of Operations will vary greatly from system to system depending on institutional issues and the size and scope of the system in question. However, there are a few issues to consider:

- *Owning agency leadership* – First and foremost, it will be well understood that without leadership from the owning agency, moving forward with a Concept of Operations, or with any system, would substantially increase the likelihood of project failure.
- *Logistics of a major development* – Undertaking a new system involves a tremendous logistical effort; therefore, the owning organization should seek out experienced professionals, such as consultants, to take on the associated tasks.
- *Appropriate Concept of Operations drivers* – Technical system operators should not be selected to lead the Concept of Operations development. Such individuals' perspectives may be too narrow to facilitate good overall system design.
- *Staffing, duration, and funding* – Information gathered from surveys and interviews suggests that the average development team for a Concept of Operations consists of 2 to 4 people who typically do not work exclusively on the Concept of Operations effort. The development processes experienced ranged from 2 months to 6 months, and project budgets varied from \$10,000 to \$400,000, depending on the size, scope, and number of participants in the effort.

Stakeholder Identification and Involvement

The ANSI/AIAA standard explains the purpose of a Concept of Operations as being to afford better understanding of the system at hand for a wide variety of key players. Many stakeholder groups are readily apparent in the early stages of system development, but others are identified later in the process as system definition and scope become more detailed. It is advisable to separate stakeholders into internal groups and external groups. Attributes of each class are described in Table 1.

Table 1: Highlights of the Different Attributes of Internal and External Stakeholders

Internal Stakeholders	External Stakeholders
<ul style="list-style-type: none"> • Within in the primary organization(s) that is developing or operates the system • Play a significant role in system function • Are significantly affected by changes in system design and function 	<ul style="list-style-type: none"> • Interact with the system but are outside the scope of the system • Play a secondary role in system function or are only affected by system function

It is impossible to create a list that will include every possible stakeholder for every TMS, but there are key classes of stakeholders that will be present in most, if not all, TMSs. The categories of stakeholders listed in the ANSI standard include:

- *Users*—any individual, organization, or system that interacts with the system.
- *Operators*— staff members who actively manage the system.
- *Maintainers*—staff who deal with system upkeep including software, hardware, sources for collecting information, and data storage.
- *System Engineers and Architects*—staff who design the system from the Concept of Operations stage through the system’s lifecycle.
- *System Implementers*—those who perform software coding, implementation of data collection sources, integration among various sub systems, and other technical development roles.
- *Customers and Buyers*—any group that is purchasing some aspect of the system from organizations or contractors who exist outside the scope of the system
- *Testers*—staff who test all aspects of the system from the component level of software development to testing the completed, working system for user acceptance.
- *Customer and Developer Organization Management*— managerial-level members of the organizations involved in the development or operation of the system.

Active participation among stakeholders is essential for successfully developing a concept of operations. Advice obtained from transportation professionals overwhelmingly concludes that stakeholder involvement is necessary, and that the sooner stakeholders become involved, the better.

Interview information suggests that it is essential for each stakeholder to hold meetings internally to come to a consensus as to that organization’s needs and goals before joining in discussions with all other stakeholders. If this process is overlooked, stakeholder agreement can become more difficult than it already is since certain organizations in the process have not yet identified their own vision, goals, and desired function for the system.

Research also suggests that problems occur during the development phase of a project if all stakeholders do not feel that their mission/goals are being met. Agreement on every aspect of the system is not necessary, but one TMS professional recalls that the Concept of Operations “would not have been successful without each organization feeling like it could meet its goals and objectives.”

Defining Performance Measures

Goals and objectives drive requirements development for the operation of a system, but measuring how close or how far one is from those goals and objectives once the system is operational requires some sense of system performance. By generating initial performance measures in the Concept of Operations, a foundation for the System Acceptance and System Validation plans is formed. While the system will be modified and expectations for the system will change over time, the performance measures outlined in the Concept of Operations should be both on a high enough level and flexible enough to allow for some re-interpretation and new application.

Generally, in TMS, the Concept of Operations developers will need to consider at least these performance measure focus areas:

- *Applied System* – The finished system is intended to improve some characteristic of the transportation system, so some quantitative method must be used to explain the before and after system states of a transportation characteristic, e.g., travel time or travel cost.
- *Inter/Intra* – The system will have unique features that may be useful in measuring the efficiency of its own operation. An example would include system reliability.
- *Peripheral* – The system may have associations with other systems, technically or organizationally, whose measures may address both applied system performance and inter/intra system performance. An example may be traveler level of satisfaction with transportation services.

4. The Concept of Operations and Systems Engineering

Systems engineering is a method to facilitate the development, maintenance, refinement, and retirement of dynamic, large-scale systems of systems comprising both technological components (machines, information systems, etc.) and human components (users, stakeholders, etc.). Despite the apparent simplicity of the definition of systems engineering, the methods it utilizes are rich enough to manage the most sophisticated system application.

The Systems Engineering Life Cycle and the Systems Engineering “V”

The series of iterative steps identified above is captured in what is referred to as the Systems Engineering “V.” This form places the relevant procedures in a step-wise, temporally relevant (with time moving left to right) shape (Figure 5). Developing a Concept of Operations is a critical first step, setting the stage for the remainder of the system development process and assisting in continuous validation of the system once it has become operational.

The Systems Engineering “V” diagram succinctly captures the relationship that the Concept of Operations maintains with the systems engineering process. It is clear that the best development practice, one that assures all goals are achieved, would be to incorporate the Concept of Operations at every phase of development, keeping both process goals and stakeholders’ needs at the forefront in each step.

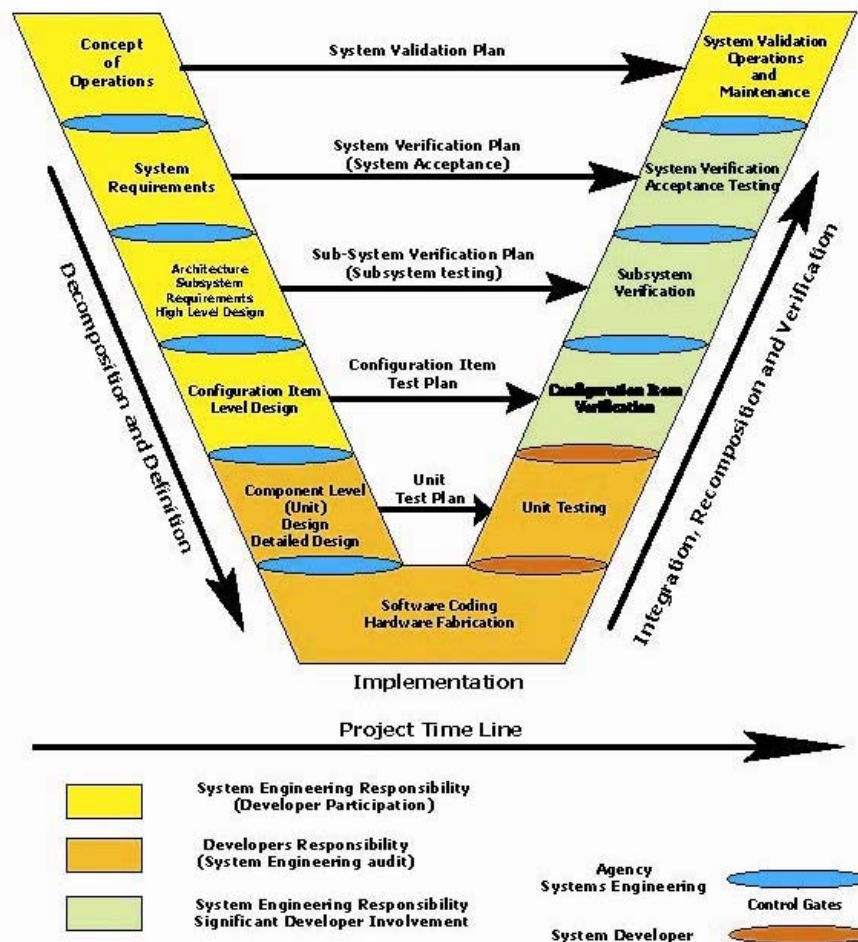


Figure 5 – The Systems Engineering "V" (Graphic provided by ASE Consulting LLC)

5. Transition from a Concept of Operations to System Requirements

All of the effort to create a Concept of Operations now gives way to stating, in detail, what the system must have in order to achieve those features and characteristics detailed in the Concept of Operations. This is the job of the System Requirements development team. Figure 6, below, summarizes the activities that are part of the Concept of Operations development process and shows the segue into the requirements development phase.

Generally, any Concept of Operations should have addressed, and included in some fashion, the integration of the concept, the systems' diagram, and the commonly accepted stakeholder system objectives, referenced above as an Objectives Hierarchy. These are the features that will be of greatest value for the Requirements development team as they commence their efforts in the next step of the system engineering process.

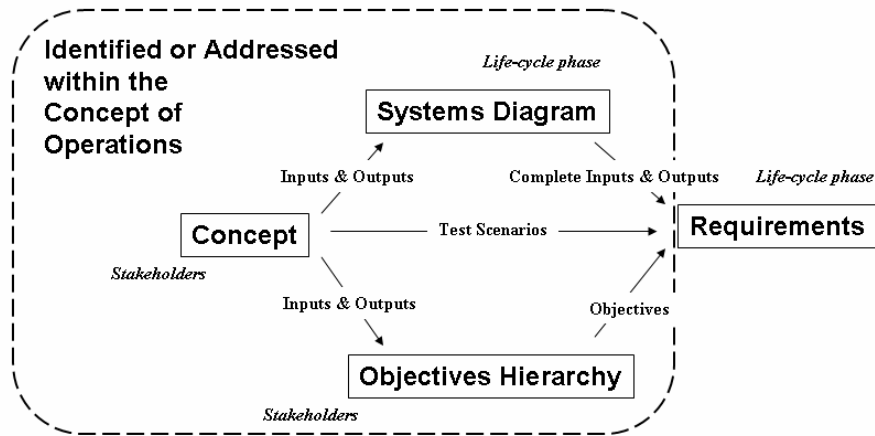


Figure 6. Concept of Operations and Requirements Relationship

6. Additional Resources

The handbook entitled *Developing and Using a Concept of Operations in Transportation Management Systems* is intended to provide guidance for transportation professionals as they seek to develop and use a Concept of Operations throughout the life cycle of a TMS. It is written for transportation professionals involved in the planning, development, design, operation, and maintenance of TMSs.

The documents listed below are available on the TMC Pooled-Fund Study website at <http://tmcpfs.ops.fhwa.dot.gov/>.

- *Developing and Using a Concept of Operations in Transportation Management Systems*, FHWA-HOP-07-001 (Washington, DC: September 2005).
- *Developing and Using a Concept of Operations in Transportation Management Systems – Fact Sheet*, FHWA-HOP-07-002 (Washington, DC: August 2006).

**Developing and Using a Concept of Operations
in Transportation Management Systems:
A Primer**



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