Dynamic Mobility Applications Open Source Application Development Portal

Task 3.3: Concept of Operations

www.its.dot.gov/index.htm
Final Report — October 12, 2016
FHWA-JPO-17-488

U.S. Department of Transportation

Produced under DTFH61-06-D-00005
Task Order: Dynamic Mobility Applications Open Source Application Development Portal

U.S. Department of Transportation

Office of the Assistant Secretary for Research and Technology

(List all USDOT agencies sponsoring this report; only list one agency on the report cover)

Notice

Technical Report Documentation Page

1. Report No. FHWA-JPO-17-488	**2. Government Accession No.**	**3. Recipient's Catalog No.**
4. Title and Subtitle Concept of Operations – Dynamic Mobility Applications Open Source Application Development ortal		**5. Report Date** October 12, 2016
		6. Performing Organization Code
7. Authors Steven Le, Al Hovde, Diane Newton, Ron Schaefer		**8. Performing Organization Report No.**
9. Performing Organization Name and Address Leidos 11251 Roger Bacon Drive Reston, VA 20190		**10. Work Unit No. (TRAIS)**
		11. Contract or Grant No. DTFH61-06-D-00005
12. Sponsoring Agency Name and Address U.S. Department of Transportation Federal Highway Administration, Office of Freight Management / Research and Innovative Technology Administration, ITS Joint Program Office 1200 New Jersey Avenue, S.E. Washington, DC 20590		**13. Type of Report and Period Covered**
		14. Sponsoring Agency Code ITS JPO

15. Supplementary Notes

This document is a project milestone and deliverable that will support development of System Requirement Specifications (SyRS) for the Dynamic Mobility Applications Open Source Application Development Portal

16. Abstract

The Dynamic Mobility Applications (DMA) program seeks to promote the highest level of collaboration and preservation of intellectual capital generated from application development and associated research activities funded by the program. The program hopes to achieve this by adopting an open source approach for all methods, algorithms, and source code developed under the sponsorship of the program. An open source approach will also serve to engage partners from academia and industry who may not be directly involved in funded applications development and testing. To this end, this Concept of Operations (ConOps) addresses the development of an open source application development portal.

The open source application development portal is a website for hosting developed open source applications and other assets for supporting dynamic mobility applications. This document presents the concept of operations for this new system.

The purpose of this ConOps is to communicate an understanding of user needs and to describe how the system will operate to fulfill those needs. This report takes into consideration results of the scan/assessment of open source development web resources and stakeholder engagement/feedback on user needs and operational scenarios with the System Requirement Specifications (SyRS)

Note: During the OSADP project the DMA program transitioned to the Connected Vehicle (CV) program. The goals to use the OSADP for the CV program are the same as the former DMA program. This document will continue to reference the DMA program since this project originated under that program.

17. Key Words Dynamic Mobility Applications, DMA, Concept of Operations		**18. Distribution Statement** No restrictions.	
19. Security Classif. (of this report)	**20. Security Classif. (of this page)**	**21. No of Pages**	**22. Price**

Unclassified	Unclassified	62	N/A

Preface

The US Department of Transportation (USDOT) Intelligent Transportation Systems (ITS) Joint Program Office (JPO) initiated the Dynamic Mobility Applications (DMA) program to expedite the development, testing, commercialization, and deployment of transformative mobility applications by fully leveraging new technologies and federal investment to maximize the productivity of the system and enhance the mobility of individuals within the system. Without such a program, the public and private sectors will bear higher costs for research, development and testing of mobility applications due to uncoordinated and possibly, duplicative efforts; and higher costs for the commercialization and integration of non-interoperable or proprietary technologies and control systems.

The DMA program seeks to promote the highest level of collaboration and preservation of intellectual capital generated from application development and associated research activities funded by the program. The program hopes to achieve this by adopting an open source approach for all methods, algorithms, and source code developed under the sponsorship of the program. An open source approach will also serve to engage partners from academia and industry who may not be directly involved in funded applications development and testing. To this end, this Concept of Operations (ConOps) document addresses the development of an open source application development portal.

The open source application development portal is a virtual application development environment and is intended to support the research, analysis, application development, and testing of dynamic mobility applications. This document presents the concept of operations for this new system.

The purpose of this ConOps is to communicate an understanding of user needs and to describe how the system will operate to fulfill those needs. This report takes into consideration results of scan/assessment of open source development web resources and stakeholder engagement/feedback on user needs and operational scenarios with the System Requirement Specifications (SyRS). Specifically, the operational scenarios and system concepts described in this document will be leveraged to design and develop the SyRS for the open source application development portal.

Note: During the OSADP project the DMA program transitioned to the Connected Vehicle (CV) program. The goals to use the OSADP for the CV program are the same as the former DMA program. This document will continue to reference the DMA program since this project originated under that program.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

Important Revisions of Original Submission

Application Develop Environment

In the original OSDAP system concept, Application Development Environment (ADE) was envisioned to be a collaborative development workspace where multiple developers and collaborators can write source code and build executable applications directly online. Several system solutions were considered in earnest including CollabNet; however, this type of system was deemed to be not conducive to the type of development projects that OSADP would host. Also, the license per-seat license costs for CollabNet was prohibitive and not the most cost effective for USDOT application development model.

USDOT related development projects are contract based. Project code developers in such projects would design and build the code in their own development environment and test the applications with their external systems and data which would not be easily integrated with an online development environment. The application source code, after testing, is uploaded into a collaborative source code hosting such as GitHub or SourceForge, etc. USDOT approved a shift in the system concept for the discussed reasons. The deployed OSADP system has an open source staging environment for staging application source code where the uploaded code gets a peer review, issue tracked, and changes can be made collaboratively. The final application open source code is then released on the OSADP website.

Projects versus Applications

The term ‘application’ as in Dynamic Mobile Applications (DMA) context may have slightly different meaning and many times ‘application’ is not the same as ‘project’.

In USDOT contract-based development efforts, a development project may produce a single or multiple applications; and an application release on OSADP does may not necessarily have source code. For instance, an algorithm can be released as an open source; likewise, an Excel tool which has no code can also be released as an open source item on OSADP.

While project is often used for referring to a collaborative development effort, application is a discrete sharable release to the OSADP community where it can get downloaded and enhanced perpetually.

Chapter 1. Scope

Identification

This Concept of Operations (ConOps) describes the system characteristics of the Dynamic Mobility Applications (DMA) Open Source Application Development Portal, hereinafter referred to as the 'OSADP'.

Document Overview

The purpose of this ConOps is to communicate an understanding of user needs and to describe how the system will operate to fulfill those needs. The intended audience for this document includes:

1. USDOT DMA program stakeholders to determine whether their needs and desires have been adequately addressed for use by OSADP developer(s).
2. System developer(s) who will create and support the OSADP based on the user needs and systems concepts described in this document.
3. Analysts, researchers, and mobility application developers requiring access to data, algorithms and source code for application development.

The major sections of this document are:

- Section 1 - Scope and overview of this document, including an overview of the development of the application portal, system description, and associated definition of terms.
- Section 2 - Reference Documents.
- Section 3 - Current system or situation, including background, objectives and scope, operational policies and constraints, description, modes of operation, user classes, and support environment.
- Section 4 - Justification for and nature of changes, including description, priorities among changes, and changes considered but not included.
- Section 5 - Concept for the OSADP, including background, objectives and scope, vision for the DMA program, operational policies and constraints, description, modes of operation, user classes, and support environment.
- Section 6 - Operational scenarios, including basic scenarios and use cases.
- Section 7 - Summary of impacts, including operational and organizational impacts and impacts during development of the OSADP.
- Section 8 - Analysis of the proposed OSADP, including summary of improvements, disadvantages and limitations, and alternatives and trade-offs considered.

This document serves as the third major deliverable and one of the milestones for this project. It also serves to bridge the effort performed thus far with the effort that remains by tying together the scan/assessment of open source development web resources and stakeholder engagement/feedback on user needs and operational scenarios with the System Requirement Specifications (SyRS) and the follow-on acquisition or build, test, and deployment of the OSADP.

System Overview

The OSADP can host a collection of projects, where each project deals with the research, development, testing, and potential commercialization of a DMA-sponsored mobility application. A single application may have one or more associated projects within OSADP. In some cases this will be to assist in collaboration and in some cases because it makes sense to break a larger problem or issue down into sub-elements that look like multiple projects. These applications may be *federally-funded* or *federally-approved*. Federally-funded implies mobility applications developed through funding from the DMA program. Federally-approved implies mobility applications developed through non-federal funding and approved for inclusion in the portal by the DMA program. However, the DMA program may decide to support development of other transportation-related applications. For example, this could include support to the AERIS (Applications for the Environment: Real-Time Information Synthesis) research program, which is designed to conduct research on environmental issues and facilitate "green" transportation choices by transportation system users and operators.

The OSADP hosts core assets, most notably application code, and includes supporting meta-data, procedures for testing the applications, and the supporting documentation for the test procedures and data sets for benchmarking the applications. The OSADP includes secure, stable, scalable, and user-friendly features that allow:

- Creation of new application repository;
- Submission of new application, and corresponding benchmark data sets, test procedures and documentation for release;
- Configuration management of core assets;
- Collaboration among stakeholders interested in inter-related projects; and
- Recognition of Contributors of core assets.

Based on the understanding gained from preceding tasks of this project, in the following sections, an operational concept for the OSADP is described. At a high level, the OSADP has the following major characteristics:

- A web-based portal as the primary access for all Internet users.
- An application development environment that enables software developers and registered users to participate in building mobility applications.
- An open source community environment with collaboration tools that enable communication among the registered users. This community is protected and user registration is required to access it.
- A host for releasing application files including source code and associated documents and artifacts.
- Governance and license terms for all portal users.

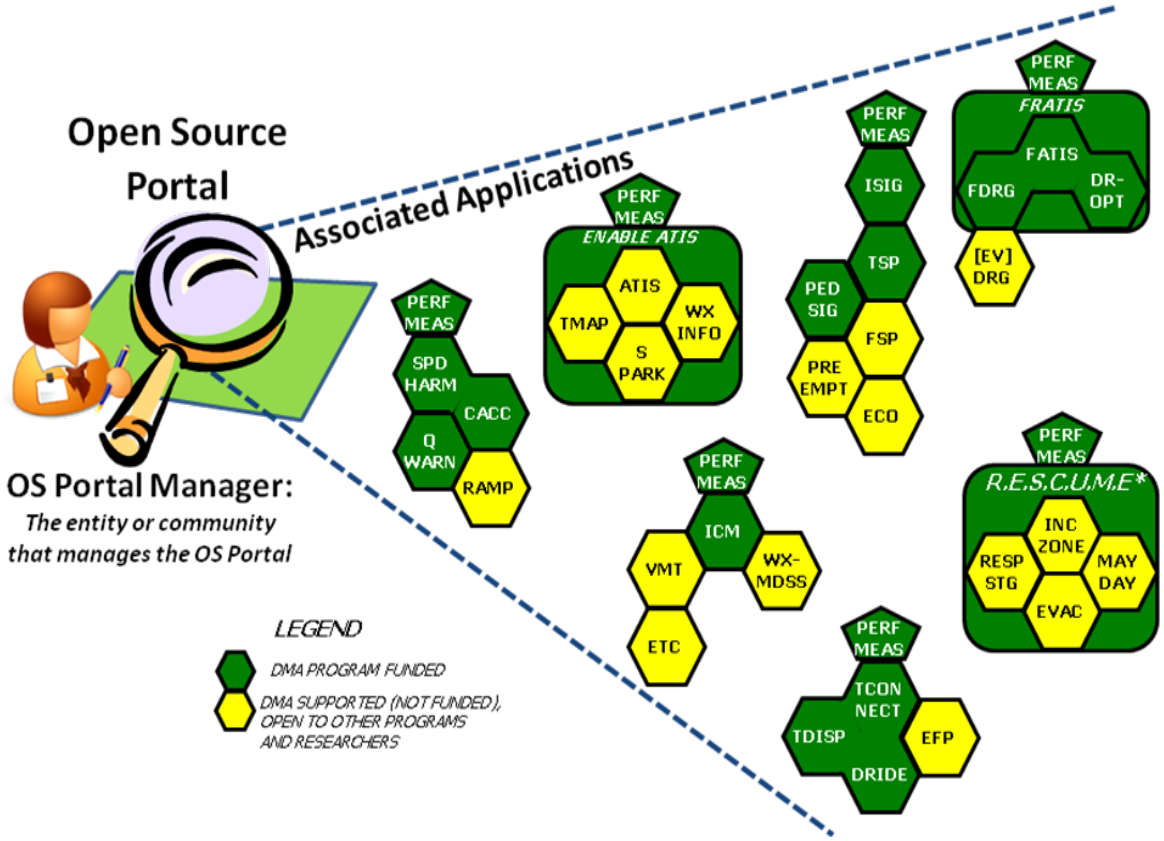
Outside of this project, under USDOT direction, an effort was conducted in parallel to examine the Intellectual Property (IP) rights, licensing agreements issues, governance issues, privacy issues, and federal regulations with respect to applications development, testing, and commercialization. The USDOT approved recommendations are incorporated into this effort.

System Description

The OSADP is a new portal system that hosts a virtual application development environment. Segregated by an access control mechanism, this portal system is compartmentalized into tiers accessible by user access rights and privileges. In the order of least to most anticipated user access, firstly, the publicly open tier contains DMA program information and is accessible by anyone with Internet

access. Secondly, a community tier is dedicated for Registered Users who have interest in the USDOT mobility applications. Thirdly, the most important tier of the system hosts the application development capabilities that enable virtual developers to work collaboratively. The fourth tier is the infrastructure support tier which has access to system administration and resources, but no operational privileges.

While the development portal can support any software application development projects that USDOT deems appropriate, in the next five years the OSADP will, at a minimum, host a series of DMA projects. Figure 1-1 shows groups or bundles of DMA program applications that may potentially be developed and hosted on this portal.



Source: Joint Program Office Intelligent Transportation Systems Website

Figure 1-1. USDOT DMA Program Application Bundles

The OSADP has a wide range of user participation from interested individuals, organizations and institutions inside and outside of USDOT. This environment is hosted in a secure network contained within a cloud computing infrastructure, where project Contributors can access it without imposing security risks to the USDOT network.

It is envisioned that the DMA program will not restrict the type of programming tools used for developing the applications to be made available via the OSADP, nor will it require that all applications that are available on the portal be related as long as these applications address improving surface transportation system productivity and/or individual traveler mobility, or goods movement. Furthermore, the algorithmic statements (or pseudo-code) describing these applications are a key element of the program in supporting and fostering collaboration among researchers and developers, in addition to source code.

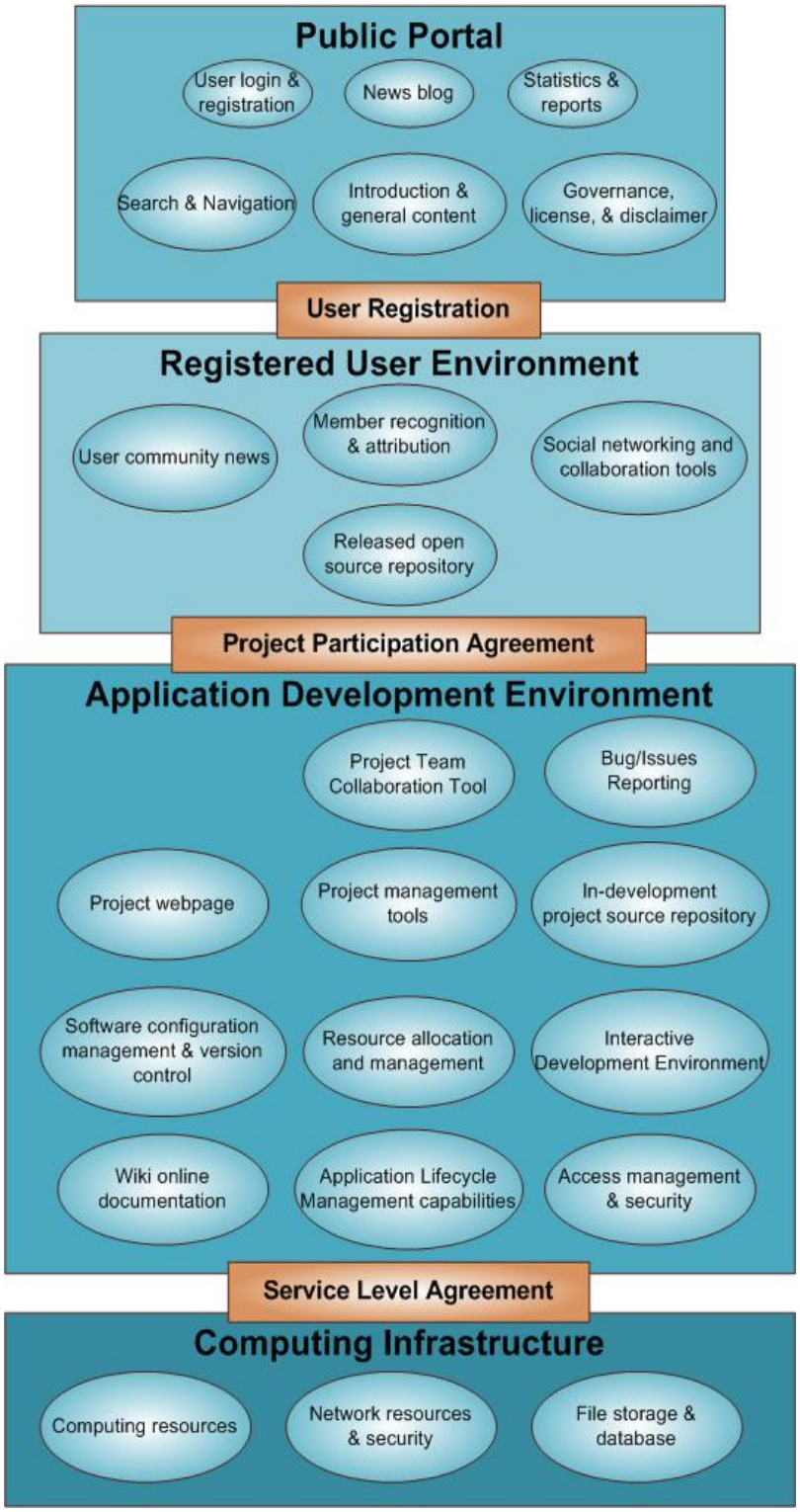


Figure 1-2. OSADP Multi-Tier Logical Architecture Source: Leidos Inc.

Figure 1-3 shows a multi-tier logical architecture of the OSADP. The top tier is the Public Portal accessible by anyone with Internet access. General DMA program information will be made available at this level. The Registered User Environment requires user registration and is a community-based setting with communication tools encouraging collaborative discussions and sharing for those who have common interest in USDOT mobility issues. Once the applications are developed, tested, and ready for sharing with the open source community, they are hosted in the Released Open Source Repository located on this tier. Accessible by project Contributors, the Application Development Environment provides software development capabilities and tools that enable the mobility application to be created. Detailed description of each tier will be discussed further in later sections of this document.

At a minimum, the multitier OSADP architecture serves the following functions:

1. A community for those who share common interest in embracing the open source initiative for USDOT applications.
2. A separate virtual application development environment enabling dispersed developers to collaborate.
3. A point of mobility application dissemination and sharing.
4. An environment that encourages collaborative work among professionals from cross-organizational boundaries and disciplines.

The OSADP supports a productive environment where DMA program goals can be realized by allowing synergistic efforts to take place.

Definition of Terms

The following terms are used in this document:

Completely Automated Public Turing test to tell Computers and Humans Apart (CAPTCHA) - is a type of challenge-response test used in computing as an attempt to ensure that the response is generated by a person. The process usually involves one computer asking a user to complete a simple test which the computer is able to generate and grade. Because other computers are supposedly unable to solve the CAPTCHA, any user entering a correct solution is presumed to be human. A common type of CAPTCHA requires the user to type letters or digits from a distorted image that appears on the screen.

Central Processing Unit (CPU) - is the portion of a computer system that carries out the instructions of a computer program, and is the primary element carrying out the functions of the computer, or other processing device. The central processing unit carries out each instruction of the program in sequence, to perform the basic arithmetical, logical, and input/output operations of the system.

Cloud computing - a general term for the computing environment that involves delivering hosted services over the Internet. These services are broadly divided into three categories: Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS), and Software-as-a-Service (SaaS). The name cloud computing was inspired by the cloud symbol that is often used to represent the Internet in diagrams.[1]

Directed Management Approach - (see Section 5.5.2) may be applied to a project that goes through the USDOT procurement process. This will be the most common project type during the initial phase

[1] Source: techtarget.com

of the DMA program; however, it is conceivable that this approach may be broadened to include certain projects procured by State DOTs or local agencies. For example, this could include a State DOT-procured or State DOT-led pooled fund procured project. During initial development phases, the project will operate in a directed management approach, analogous to typical USDOT funded projects today. The awarded contractor will hire and staff a development team with appropriate skill sets for performing the project deliverables. All engineering and system development takes place in the OSADP environment.

Dynamic Mobility Applications (DMA) - are part of a USDOT program that seeks to identify, develop, and deploy applications that leverage the full potential of connected vehicles, travelers and infrastructure to enhance current operational practices and transform future surface transportation systems management.

Federally-Approved Projects - are mobility projects and associated applications that are developed through non-federal funding and approved for inclusion in the OSADP by the DMA program.

Federally-Funded Projects - are mobility projects and associated applications that are funded through the DMA program.

Guided Management Approach - (see Section 5.5.2) may be applicable for a project that gets initiated from a challenge grant or seed funding from USDOT. Initial guidance and direction may be applied in this scenario. Project leadership will be assigned by the USDOT sponsoring organization while project team members will be recruited from the Registered User community, who has qualified skills and relevant knowledge of the project scope. Further funding for this project type may come from different sources including private firms and the commercial industry.

Infrastructure-as-a-Service (IaaS) - cloud infrastructure services, typically in a platform virtualization environment, that deliver computer infrastructure as a service. Rather than purchasing servers, software, data-center space or network equipment, clients instead buy those resources as a fully outsourced service. Suppliers typically bill such services on a utility computing basis; the amount of resources consumed (and therefore the cost) will typically reflect the level of activity.

Institute of Electrical and Electronics Engineers (IEEE) - is a non-profit professional association dedicated to advancing technological innovation related to electricity. It has more than 400,000 members in more than 160 countries.

International Standards Organization (ISO) - is an international standard-setting body composed of representatives from various national standards organizations. Founded in 1947, the organization promulgates worldwide proprietary industrial and commercial standards. It has its headquarters in Geneva, Switzerland. While ISO defines itself as a non-governmental organization, its ability to set standards that often become law, either through treaties or national standards, makes it more powerful than most non-governmental organizations.

Intelligent Transportation Systems (ITS)[2] - improve transportation safety and mobility and enhance American productivity through the integration of advanced communications technologies into the transportation infrastructure and in vehicles. ITS encompass a broad range of wireless and wire line communications-based information and electronics.

Meritocratic Management Approach - (see Section 5.5.2) may be appropriate for a project where the conceptual idea arises from within the community and it forms and gathers sufficient support. This type can become a meritocratic management project. Synergistic and innovative ideas will spur from the community and fresh initiative will take shape. The meritocratic management approach, as used in the Apache projects, delegates to the project organization the central decision making authority

[2] Source: ITS JPO website under About ITS List of FAQs.

over the development of its software and provides for a great deal of latitude in designing its own technical charter and governance. Within this context, meritocratic governance is a commonly found model in which project participants gain influence over the project through the recognition of their individual contributions. Funding may come from USDOT and other sources including support from private firms and the commercial industry. It is possible that a meritocratic management project can be forked out of a stable released directed management project.

Next Generation Simulation (NGSIM) - is a unique public-private partnership between FHWA and commercial micro-simulation software developers, the academic research community, and the traffic micro-simulation community. In undertaking this partnership, FHWA acted as a market facilitator and used focused public resources to influence and stimulate the commercial simulation market by fostering a cooperative environment of public-private coordination. NGSIM is designed to develop several driver behavioral algorithms, along with supporting documentation and validation data sets, which represent the fundamental logic within the microscopic traffic simulation model.

Open Source Application Development Portal (OSADP) - acronym used throughout this document to identify the portal that is the focus of this ConOps.

Open Source For America (OSFA) - consortium of various organizations established to advocate for and support the use of free and open source software in the Federal Government. It consists of various open source foundations, and companies, including GNOME, Mozilla, and Canonical. The organization consists of various committees and working groups.

Platform-as-a-Service (PaaS) - is the delivery of a computing platform and solution stack as a service. PaaS offerings facilitate deployment of applications without the cost and complexity of buying and managing the underlying hardware and software and provisioning hosting capabilities, providing all of the facilities required to support the complete life cycle of building and delivering web applications and services entirely available from the Internet.

RSS (Really Simple Syndication)- is a family of web feed formats used to publish frequently updated Internet content—such as blog entries, news headlines, audio, and video—in a standardized format. An RSS document (which is called a "feed", "web feed"; http://en.wikipedia.org/wiki/RSS - cite_note-GuardWF-2 or "channel") includes full or summarized text, plus meta-data such as publishing dates and authorship.

RSS reader - A program used to read an RSS feed. RSS readers allow user to aggregate multiple web RSS feeds and read them from a singular place on the web.[3]

Service Level Agreement (SLA) - a contract between a network service provider and a customer that specifies, usually in measurable terms, what services the network service provider will furnish. Many Internet service providers provide their customers with an SLA.

Software-as-a-Service (SaaS) - is a software delivery model in which software and its associated data are hosted centrally (typically in the Internet) and are typically accessed by users using a thin client, normally using a web browser over the Internet.

Source code - in computer science, source code is text written in a computer programming language. There are many forms of source code written in computer languages such as C++, C#, and Java. Such a language is specially designed to facilitate the work of computer programmers.

Smart Roadside Initiative (SRI) - is an approved mode-specific item in the USDOT ITS Strategic Research Plan, 2010-2014. SRI is an integrated system deployed at strategic points along commercial vehicle routes to improve safety, mobility and efficiency of truck movement and operations on the roadway.

[2] Source: about.com, Web 2.0 Glossary

System Requirements Specifications (SyRS) – is a System Engineering Management Plan (SEMP) document that includes the identification, organization, presentation, and modification of the system requirements. It discusses conditions for incorporating operational concepts, design constraints, and design configuration requirements into the system specification.

Transportation Analysis and Simulation System (TRANSIMS) - is an integrated set of tools developed to conduct regional transportation system analyses. With the goal of establishing TRANSIMS as an ongoing public resource available to the transportation community, TRANSIMS is made available under the NASA Open Source Agreement Version 1.3 and is supported by this online community.

Unified Modeling Language (UML) - is a standardized general-purpose modeling language in the field of object-oriented software engineering. UML is a set of graphic notation techniques to create visual models of object-oriented software-intensive systems.

Uniform Resource Locator (URL) - is an identifier that specifies where a known resource is available and the mechanism for retrieving it.

Chapter 2. Current System or Situation

Background, Objectives, and Scope

The OSADP is a new system that will not replace any of the current federally-funded or federally-approved open source systems. Since there are no current systems after which to completely model the OSADP, this section discusses the current environment including the procurement process and how the applications are developed. In addition, the current open source efforts by the U.S. Government will also be briefly discussed as a back drop to the open source movement.

USDOT objectives and scope for transportation technology research and development have not changed. In the meantime, the open source movement has proven its worth in the last decade, and USDOT believes collaborative efforts with the open source community will promote wider participation including academia, private sector and industry, which will encourage more rapid adoption of new technologies.

Operational Policies and Constraints

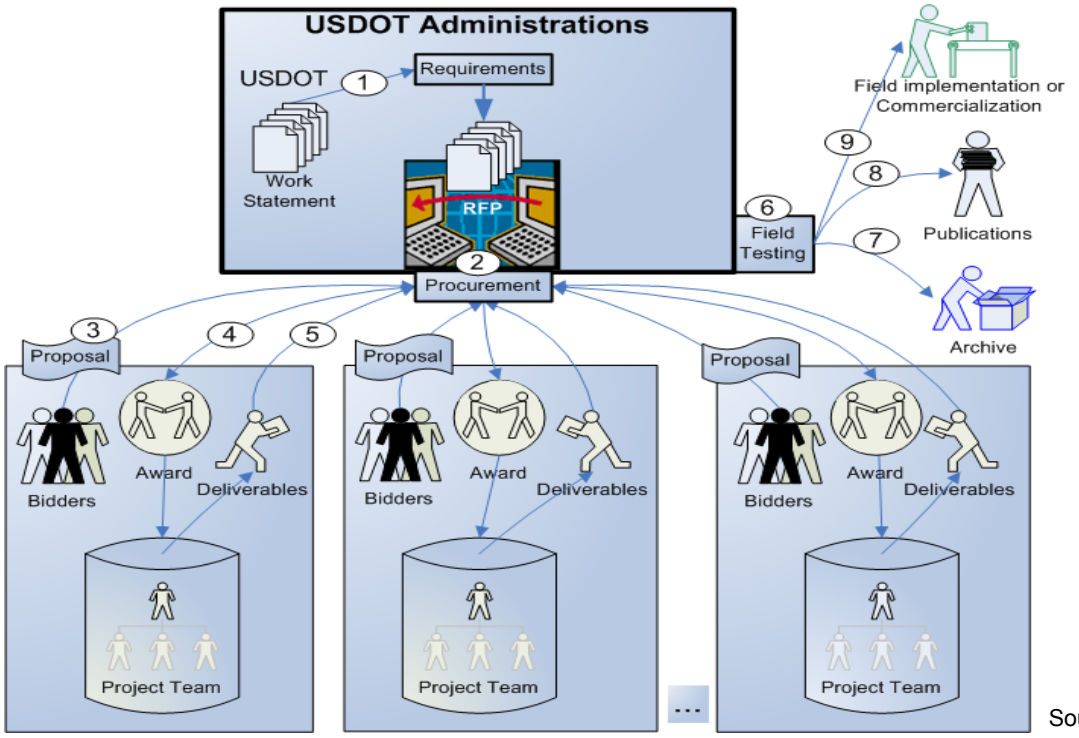
Current operational policies and constraints include:

- ***Copyright and licensing issues*** - Applications developed within USDOT are protected by copyrights and other legal terms and conditions. The clauses of IP prevent research work and applications to be shared widely with stakeholders and the public.
- ***Lack of transparency*** – Protected by legal means, access to USDOT commissioned applications has not been easy for the public.
- ***Limited collaboration*** – The current procurement process awards tasks through a bid and proposal mechanism. The work is performed in a closed setting within the awarded team. While there are advantages in this approach such as speed and control, application developments are performed in a stovepipe fashion and with limited or no collaboration.

Description of Current System or Situation

Current Procurement Process

Figure 3 shows the current acquisition process for application development services. Typically, the SOW is written in the form of requirements and issued in a Request for Proposal (RFP). The procurement is an open and competitive bidding process; however, the performance of the work occurs in a closed environment. The awarded contractor staffs a team with specific skill sets to work toward meeting the requirements. Deliverables in the form of software application(s) or in source code either goes to field testing with the possibility of operational implementation, or is archived. A majority of developed applications are archived indefinitely. Some research work results are published on a USDOT website.



Source: Leidos Inc.

Figure 2-1. Current Acquisition Process for Application Development Services

In the closed environment, each project is developed by a project team in their own enterprise network and facility. Limited collaboration can be fostered by this environment, partly due to the fact that the project team is driven by a strict timeline to develop the deliverables.

Across USDOT, software application development efforts have, in many instances, been conducted independently in stovepipe project management organizations. Personnel involved in one project may not know what is going on in another even though these projects expense significant effort learning the software application life cycle, repeating similar processes, and creating similar code. The uncoordinated fashion of project management created much duplicative work throughout the departments and administration offices. Lack of visibility into other projects and their processes prevented the achievement of a higher level of effectiveness and productivity, and a collaborative application development environment.

Federal Open Space Environment Situation

Open source solutions are increasingly being used by federal agencies, and major information technology (IT) vendors and federal contractors are actively supporting the development effort. 2010 marked the first year that federal agencies operated under the *Open Government Directive* including a plan aimed at specific actions to implement the principles of transparency, participation, and collaboration. The plan, while not specifically addressing proprietary versus open technologies, demonstrates the Federal Government's understanding of the ways that technology can help the government achieve broad goals, not just of efficiency, but of providing transparency and collaboration for better serving its citizens.

In light of the benefits that open technologies can bring to government, Open Source For America (OSFA) published the results of a study measuring openness in government in January 2011. Fifteen Cabinet-level departments and agencies were included in the study and the USDOT was one of six departments

that ranked highest. This is encouraging news given that it is the first year under which agencies are operating under their Open Government Plans.

USDOT and its branch administrations, such as FHWA, have been leading initiatives and efforts to leverage the use of ITS technologies in creating new applications to provide viable solutions for our nation's transportation issues and challenges. However, the Department's current approach to application development is changing significantly through its implementation of open source solutions.

Modes of Operation

There is no equivalent system operating prior to OSADP. This section is intentionally left blank.

User Classes and Involved Personnel

User Classes and Other Involved Personnel

This section covers the types of user involved in USDOT application development.

The tasks of building a mobility application are the responsibility of specific team members who have direct accountability on the delivery of the application. A typical project team may include:

- Project Manager
- Project supporting staff such as a project scheduler or project controller
- Software developers
- System engineers
- Reviewers
- Testers
- Writers

After the application is developed, personnel from other involved organizations may participate during the field testing and deployment phases.

The major difference between the current environment and the OSADP is the wide spectrum of participation from different organizations and interested parties, ranging from university professors and students, research staff, contractors, consulting firms, private sector such as automobile-related industry manufacturers, technologists, suppliers, non-profit organizations, independent developers, specialists, etc. Everyone with common interest in the USDOT applications can participate in the DMA open source community. Depending on the project types, the open source community can participate fully or be selectively invited to participate on a procured project to play a long-term or ad-hoc role on a project. From this active synergistic community, new and innovative project ideas may be formed and eventually become an application, alliances may be built, and relationships encouraged. This type of gathering of minds, as proven in other open source environments, will be appropriate for true collaborative efforts.

Support Environment

Because there is no current system, this section is intentionally left blank.

Chapter 3. Justification for and Nature of Changes

Justification for Changes

The DMA program plays a key role in supporting Intelligent Transportation Systems (ITS) Joint Program Office (JPO) initiatives identified in strategic plans in the mobility area. Other federal agencies are proving the value of open source and USDOT does as well through its desire to expedite the life cycle process of deploying mobility applications that are innovative and transformative. Key benefits of USDOT open source application development are:

- ***Maximize productivity:*** By fully leveraging new and existing technologies, USDOT will maximize productivity and enhance the mobility of individuals who use the National Transportation System. With access to source code for existing capabilities, OSADP developers can focus on innovation and the new requirements that are not yet met by existing source code capabilities. Likewise, pre-existing government-funded components from different programs can be assembled without unnecessary costs or delays. Instead of having to start from scratch to develop or enhance a capability, the government can reuse and draw from a broad base of developers and contractors who are familiar with the source code and component and can rapidly assemble, merge, and modify existing systems and components with other existing source code.
- ***Reduce costs:*** The DMA program will reduce costs for both public and private sector participants in the areas of research, development, and testing of mobility applications by reducing uncoordinated or duplicative efforts, and by reducing the cost of attempting to commercialize and integrate non-interoperable or proprietary technologies and control systems.
- ***Improved collaboration:*** The OSADP offers dramatic and significant changes and a paradigm shift in software development and collaboration. It will serve to support the highest level of collaboration and preservation of intellectual capital generated from mobility application development under the DMA program's sponsorship, to include associated research activities. By adopting an open source approach for all methods, algorithms, and source code development, the OSADP also supports engagement of partners from academia and industry who may not be directly involved in funded applications development and testing.
- ***Increased agility / flexibility****:* The OSADP serves as the catalyst for the rapid development, testing, and deployment of mobility applications by providing transportation researchers, developers, analysts, and academics the type of collaborative environment they need to make it happen. It also serves to invite participation by like-minded community members who share the goals and interests of USDOT.
- ***More secure applications:*** Contrary to conventional thinking, open source application development leverages and re-uses existing code which typically is proven and well understood in other environments. Much of the risks associated with newly created code are negated. In addition, by having a wider participation from the community having access to the code, bugs and design flaws in the open source code have a better chance of being discovered and fixed sooner.

Description of Changes

This section outlines the changes based on the gap between the current state of practice and the envisioned system. The changes detailed in this section are used to bridge the gap between the current situation and future systems. The changes fall into four categories:

- ***Capability changes:*** The development workspace is hosted at a network location. With proper authentication, registered project Contributors and community members can access it from anywhere. Many functions and features are created to support an around-the-clock operational development environment. Crucial capabilities of the proposed system include:
  - Usability that enables users to navigate and find content easily.
  - Communication and attribution features for building an active and supportive community including news, blogs, and member networking.
  - A comprehensive development environment with software development tools and features.
  - Collaboration at multiple levels (e.g., Registered User community, project team members, inter- and intra-application bundles cross-pollination, etc.) with emphasis on teamwork, interaction, sharing, and leveraging of knowledge and expertise.
  - Infrastructure computing resource that can be scalable in time to match needs.
  - Promotion and recognition of individual and group contributions.
  - Well-defined and well-documented core assets with clear guidelines.
  - Open source repository to share code and artifacts and receive contribution from the community.

- ***Environment changes:*** The procurement and acquisition process will change to support different project types. Some projects will be procured, while others will be initiated by a challenge grant or seed funding; some will be born out of the collective effort of the community. The OSADP supports these types of projects simultaneously through use of access control and system administrative and support features, as follows:
  - Clear policies to promote a professional, friendly, and cooperative community.
  - Secure environments that protect users, prevent misuse, and promote collaboration, interaction, and sharing.
  - Web analytic capability to thoroughly and consistently capture data with real-time environment awareness.
  - Attended management according to governance and licensing established for each data environment, with automated monitoring and manual moderation.

- ***Operational changes****:* Governance, licensing, and user agreements are essential in managing the open source community. The above changes affect the system operational aspects including users' operational policies, procedures, methods, or work routines. From the reported findings as part of the scan and assessment task, some government website best practices are discussed and will be applied here. The portal system can:
  - Manage portal content to ensure accuracy and freshness.
  - Enforce governance consistently and in a timely manner.
  - Provide clear guidance and instructions on licensing application and compliance issues.
  - Allocate resources for the Application Development Environment.
  - Provide responsive technical support to user needs.

  The project team leveraged these available resources as part of the SyRS process.

- ***Support changes****:* New roles were created while some existing roles were redefined. Changes in the support requirements were driven by changes in the system and the environment.
  - Clear user instructions.
  - Ability for Registered User to report bugs, issues, and ask questions.

- Other resources such as checklists and tools.
- Portal stewardship defined with clear roles and responsibilities for maintaining different data environments.
- Clear understanding of who the users are and recognizing them and their needs in relation to the computing environment and infrastructure environments, and online resources and other useful links.

Priorities among Changes

Since the OSADP system was built from scratch, the creation and implementation of the OSADP represent a significant shift in the way applications are created. With potential users in mind, the requirements for the Application Development Environment are driven by user needs and identification of user needs is a critically important step in the OSADP's planning process. It was essential that, early in the project's development, stakeholders reached a clear understanding regarding system capability. It was equally important that stakeholders achieved a consensus regarding the prioritization of needs, in the event that any incompatibilities arise relating to delivery of multiple capabilities. For this reason, the project team engaged stakeholders in the cooperative identification of user needs during two workshops. As a prerequisite to engaging stakeholders, the project team performed a scan and assessment of over 25 federal and non-federal open source development web resources (Reference C). From the scan and assessment, the project team identified an initial list of OSADP sample user needs in the form of portal capabilities and features.

During the first User Needs Workshop held in January 2011, the project team presented its assessment of open source web resources and sample user needs to participating stakeholders. The stakeholders prioritized these sample needs and created and prioritized new needs as well. During the second workshop in February 2011, the project team and stakeholders further refined the user needs. The workshops' outcomes and project team's summary and analyses of the findings are documented in a technical memorandum (Reference D).

From the engagement efforts, 14 OSADP capability categories emerged:

- Asset and Content Hosting
- Configuration Management
- Operations & Maintenance
- User Accessibility
- Bug Reporting
- Documentation
- Storage and Backup
- Security
- Collaboration
- Recognition of Contributors
- Hosting Options and Associated Costs
- Prototype / Demonstration
- Portal Look and Feel
- Other

The project team and stakeholders identified these categories as a means to segregate user needs (portal features) into groupings that met the requirements of the Government's SOW, as well as to identify additional needs that are representative of an open source environment. Grouping needs in this fashion also facilitated the information gathering and stakeholder feedback processes, and promoted easier understanding.

Within each of the capability categories, the project team asked stakeholders to "prioritize" user needs based on a three-tier scale:

- "Must-Have / Essential" needs, including what would be considered essential features for the stakeholders to consider supporting the deployment and use of the OSADP.
- "Should-Have / Desirable" needs, including those for which there was considerable desire to address, but were not considered essential for OSADP.
- "Nice-to-Have / Optional" needs, including those features that may provide desirable functionality under certain conditions, or which could be add-on features.

The Must-Have / Essential OSADP needs are, for the most part, those that must be met in order to provide a secure, reliable open source portal that supports multi-modal and multi-sourced data, methods, algorithms, and source code that are available to a wide range of users. Table 3-1 shows the Must-Have / Essential and Should-Have / Desirable tiers of user needs in descending level of importance by capability category and description. These user needs supported the SyRS for the OSADP development.

Table 3-1. OSADP Prioritized Must-Have / Essential & Should-Have / Desirable User Needs

Capability Category	Necessity Ranking	Prioritized User Need / Description
Asset and Content Hosting	Must-Have / Essential	1. Source Code - Capability to store and share source code for a hosted application on the portal
		2. Algorithms - Capability to store and share algorithms for a hosted application on the portal
		3. Algorithmic Statements / Pseudo-code - Capability to store and share pseudo-code and algorithmic statements for hosted projects on the portal
		4. Benchmark Test Data Sets - Capability to store and share benchmark test data sets for a hosted application on the portal
		5. Metadata - Capability to store data about data of hosted applications on the portal
		6. Documentation - Capability to store documentation for a hosted application on the portal
		7. Type of Open Source Agreement - Capability to specify which open source agreement for releasing the open source applications
	Should-Have / Desirable	8. Test Procedures - Capability to store self-contained, self-validating, and executable formal specifications of test cases to be applied to one or more target modules of hosted projects
		9. Governance Document - Capability to store a governance document for a hosted application on the portal
		10. Data Interface Standards - Capability to store and share data interface standards (e.g., the interface between traffic signal controllers and RSE and/or OBE)
Configuration Management	Must-Have / Essential	1. Source Control - Capability to track and control changes to

Capability Category	Necessity Ranking	Prioritized User Need / Description
		hosted projects source code
		2. Version Control - Capability to track and control changes to hosted projects files, such as source code, documentation, and web pages
		3. Document Management - Capability to save, version, share, search, and audit electronic documents and/or images of paper documents related to a hosted project
	Should-Have / Desirable	None defined
Operations & Maintenance	Must-Have / Essential	1. Software Upgrade / Patches - Capability to patch defects and upgrade functions of the portal software
		2. System Administration - Capability to perform site maintenance by portal administrators
	Should-Have / Desirable	3. Application Support - Capability for users to submit e-mail-based bug reports specific to each DMA-hosted application into a threaded discussion viewable by other users
User Accessibility	Must-Have / Essential	1. Section 508 Compliance - Capability to meet Section 508 requirements
	Should-Have / Desirable	2. WYSIWYG Editor - Capability to easily create a custom home page for hosted applications through the use of a WYSIWYG editor
		3. Online Glossary - Capability to have a common terminology reference and acronym lookup table accessible by portal users and visitors
		4. Configurable User Interface - Capability to allow users to configure and customize the primary user interface screen for emphasizing features of interest to them
Bug Reporting	Must-Have / Essential	1. Bug Tracking - Capability to assign and track defects associated with a hosted application
		2. Issue Tracking - Capability for Contributors to track issues associated with the application
		3. Virus Protection - Capability to detect, eliminate or at least quarantine viruses from infected uploaded item and sweep site regularly for malware and any planted viruses
	Should-Have / Desirable	4. Lessons Learned Repository - Capability for users to document application specific resolution for technical issues such as API, objects, libraries and GUI
Documentation	Must-Have / Essential	None defined
	Should-Have / Desirable	1. Wiki - Capability to provide information about a hosted application in a Wiki format
		2. Author Attribution - Capability to credit and acknowledge the original creator and subsequent Contributors of the shared source code or application by displaying their name visibly in association with the shared item
		3. User's Guide - Capability to require Contributors to include a user's guide for the shared application or source code
		4. Metadata and Information - Capability to collect and display metadata describing the contents and context of a shared item such as purpose of the shared item, means of creation, time and date of creation, creator or author of shared item, and standards used

Capability Category	Necessity Ranking	Prioritized User Need / Description
Storage and Backup	Must-Have / Essential	1. Data Backup - Capability to backup the portal and all hosted applications on the portal
		2. Download - Capability to download files related to a hosted application
	Should-Have / Desirable	3. Mass Upload - Capability for Contributors to upload multiple files simultaneously
		4. Zip Archives - Capability to create and store zip archives for a hosted application
		5. Content Mirroring - Capability to have application content recovered with minimum downtime
Security	Must-Have / Essential	1. Audit Trail - Capability to see an audit trail of modified files
		2. User Security Alert - Capability for the portal administrator or Contributors to notify all Registered Users of a specific application of any identified threats or vulnerabilities
		3. Site Sweep - Capability to ensure user that the site is clear of injected malware or viruses that could affect the portal users
		4. Content Approval - Capability to approve all content added to a hosted application
		5. E-mail Verification - Capability to confirm the e-mail address of users registering on the portal
		6. Portal Recovery - Capability for portal to recover, in case of an outage, all its functionality and contents within 1 week after loss of service
	Should-Have / Desirable	7. Anti-Hacking - Capability to minimize hacking to the system via all access points with strong security validation and authentication
		8. Granular Privileges - Capability to assign privileges at a granular level to users
		9. Login History - Capability to see a login history for users of the portal
Collaboration	Must-Have / Essential	1. Subscriptions - Capability to allow users to subscribe for notifications when documents or code has been changed
	Should-Have / Desirable	2. Developer Community News - Capability to share developer community news for a hosted application
		3. Online Help - Capability to provide online help
		4. FAQ Management - Capability to have a FAQ section that is easily updated for each hosted application
		5. Public Forum - Capability to communicate with the Contributors to a hosted application via a public forum
		6. Public Mailing List - Capability to receive notifications about a hosted application via e-mail
		7. E-mail to Discussion - Capability to contribute directly to a discussion about a hosted application via e-mail
		8. Groupware - Capability to collaborate on documents located on the portal
		9. Update Alert - Capability to notify Registered Users via e-mail prior to an interesting event taking place
Recognition of Contributors	Must-Have / Essential	1. User Contribution Recognition/Attribution - Capability to provide Contributor recognition and attribution for a hosted application

Capability Category	Necessity Ranking	Prioritized User Need / Description
	Should-Have / Desirable	2. Recognition of Contributors of Core Assets - Capability to provide recognition of Contributors of core assets for a hosted application
Hosting Options and Associated Costs	Must-Have / Essential	1. Hosted Applications - Capability to host multiple open source applications during all phases of development
	Should-Have / Desirable	2. Cloud Hosting Options - Capability to access hosted application data and files from any location
Prototype / Demonstration	Must-Have / Essential	1. Federal Project Repository - Capability to host open source applications and source code from various federal agencies including transit agency programs such as Safety Pilot Model Deployment and DMA applications
	Should-Have / Desirable	2. Application Usage Update - Capability for developers who use the shared item to provide updated information on its usage (e.g., name of project, role of the application in the project, etc.)
Portal Look and Feel	Must-Have / Essential	1. Robust Search Engine - Capability to search open source portal contents with parameters for targeting specific content types
	Should-Have / Desirable	2. Major Browser Support - Capability to support multiple major web browsers
		3. User Training - Capability to provide online user training or tutorial on how to use the portal
		4. Category Sort - Capability to sort projects and show related items by application category
		5. Usage Statistics - Capability to show usage statistics for shared items including user visit, hits, downloads, uploads, and other statistical usage information
Other	Must-Have / Essential	None defined
	Should-Have / Desirable	1. International Awareness - Capability for user to acknowledge similar or parallel international efforts
		2. User Profile Integration - Capability to link with user's existing code repositories, other profiles, and reputation systems

Changes Considered but not Included

In addition to Must-Have / Essential and Should-Have / Desirable, other user needs were also identified and considered in the previous tasks. Nice-to-Have / Optional user needs were identified and prioritized by stakeholders during the first User Needs Workshop held in January 2011. These needs include those features that may provide desirable functionality under certain conditions, or which could be add-on features. As stated in Reference D, these statements may not be inconsequential in their own right or as they relate to higher rated user needs; therefore, they are included to allow for proper system development documentation and to provide the project team developers an opportunity to review and include them in SyRS. For example, in Table 3-2, which shows these statements in descending level of importance by capability category, two statements were identified by stakeholders as having potential significance to OSADP operations: 1) workflow engine under the Configuration Management category, and 2) running daily error reports under the Bug Reporting category; both of which had a high level of importance within this necessity ranking.

With the exception of described statements in this necessity ranking that were developed and defined by the project team as sample user needs, most are not defined and are in their raw form as questions or comments because it was anticipated that they would not be included for further consideration in OSADP development. However, each of these statements were reviewed for their potential refinement and inclusion as part of the SyRS process.

Table 3-2. OSADP Nice-to-Have / Optional User Need Statements

Capability Category	Prioritized User Need Statement
Asset and Content Hosting	1. FTP access for internal and external use
	2. Prototype Test Environment - Almost like a debugger, however something that will be able to test code within a set of defined parameters or set of boundaries
	3. Sample templates for a scope of work to use and modify source code on the portal
	4. In 2011, the NTCIP.org website has instructions on how users can obtain the NTCIP MIBs (SNMP Management Information Base text files). The MIBs are compiled into code fragments used in Manager or Agent applications, which are development by manufacturers, system integrators, or agencies. Would these MIBs, and other ITS-standards-defined structures, be other candidates to be hosted on a more broadly-defined, one-stop-shop "Transportation Application Open Source Portal"?
Configuration Management	1. Workflow Engine - Capability to enforce the workflow definition and execute workflow events for a hosted project
	2. Asset Management - Capability of making the right decisions and optimizing the asset management processes related to hosted projects -- minimize life cycle cost of the project assets
	3. Control Portability - Capability to import/export configuration management data from/to the portal with an organization's own purchased/licensed software development tools and database
	4. Plan for next generation open source portal
Operations & Maintenance	1. Portal navigation/interface to group apples and oranges that are developed
	2. System Operations - It is important to follow the systems engineering process and be thorough for building open source portals. Don't get hung up on making perfect models, as new technologies may make the modeling efforts outdated.
User Accessibility	1. Spell Checker - Capability to spell check any text submitted to the portal
	2. A good data dictionary is important
	3. Portal interface (browser, menus, titles, etc.) supports multiple languages
Bug Reporting	1. Run error reports at the end of each day
Documentation	1. Non-Wiki - Capability to provide information about a hosted application (or other asset) in a non-Wiki format
	2. Produce a collaborative "cookbook" on documentation procedures/guidelines on open source portals/information
	3. User Manual populated by template use cases for different modal or agency applications that have or could use this portal
	4. An "everyman's" version or limited access for public transparency and to solicit traveler/user inputs of application needs

Capability Category	Prioritized User Need Statement
Storage and Backup	1. Green - Maintain and operate an energy efficient open source storage data system
Security	None defined
Collaboration	1. Prioritization of DMA needs is decided by USDOT based on collaboration input, policy and resource availability
	2. Live Chat - Capability to conduct live chat sessions between Contributors to a hosted application
	3. Content Syndication (RSS) - Capability to receive updates about a hosted application via RSS feeds
	4. Wanted Items - Allowing a user to publicly request for a certain type of open source items that may not already be shared to open source repositories
	5. Web hooks to Facebook and Twitter for social networking with other Contributors
	6. Ability to hold virtual meetings
	7. Recommend social networking that is applicable to transportation professionals (i.e., LinkedIn). Note that a fairly sizable minority of the population is not comfortable with sharing information on Facebook.
	8. Twittering and social networking are good tools to use
Recognition of Contributors	1. Academic Contributors would want easy way to get cited
	2. Links from the Portal - Capability to link to a "DMAappStore.com" site for free or priced apps, or to a transportation product manufacturer's site to download or purchase the DMAs for their type of products
	3. Recognition of Contributors is important, but what is more important is the ability to collaboratively share information at a lower cost and to build collaborative systems that others can use and maintain at reasonable costs
	4. Team recognition is important
	5. Consultants would want their names up there, too
	6. Annual Awards? Director's Blog (highlighting developments & developers)
	7. Option for showing a Contributor's photo (user's choice)
Hosting Options and Associated Costs	1. How about a central, secured site?
	2. Remember that if we include visualization and have any runtime apps or testing, the processing and storage requirements may be costly to fulfill
	3. May test a central location to host
Prototype / Demonstration	1. Strive to transfer technologies nationally
	2. Check in new prototype apps
Portal Look and Feel	1. And don't forget the more local agencies, since ITS is on the ground: must have look and feel good to cities, counties, TMAs, CMAs, and MPOs
	2. Portal should make you feel good
	3. If needed, certain platform products (software that is required to run other software) should be located centrally so that users don't get frustrated with programs that don't work as standalone products
	4. Market how the portal should look with blue ribbon prizes for the winners. For example, students from the academic arena and others from other agencies, private and public, and compete for best drawings, submissions, and white papers on the look and feel of portals, a blue print.
Other	1. Capability to host legacy codes and practices
	2. Consideration that certain apps be given a Seal of Approval, others use at risk, based on a screening/validation process
	3. Match agency needs with engineer interests, abilities and code
	4. Real time, run time capability

Capability Category	Prioritized User Need Statement
	5. Assessment Approach - The DMS Portal assessment activity should focus more on defining and interviewing the users for their requirements, and use the marketplace of existing open source portals to determine success, rather than use our speculation of what categories will predict DMA portal success
	6. As reported in the 1/3/11 Investor's Business Daily, in a summary of 2010's top stories, in 2010 it truly became a mobile app world. Apple says it has 300,000 iPhone apps. Google says Android apps already surpass 100,000. Therefore, a USDOT-sponsored open source portal could be used for development, but move app distribution to the big sites.

Chapter 4. Concepts for the Proposed System

This section describes OSADP at high level.

Vision and Goals for the DMA Program

Taking into account the need for improved collaboration and efficiency, the stakeholders involved, and the potential that open source technology holds, the following was the vision statement for the DMA program:

> *"Expedite the development, testing, commercialization, and deployment of innovative mobility applications, fully leveraging both new technologies and federal investment to transform transportation system management, to maximize the productivity of the system and enhance the mobility of individuals within the system."*[4]

In order to promote a complete and common understanding of the vision, Table 6-1 explains the key characteristic elements of the vision statement.

Table 6-1. DMA Program Vision Statement Characteristics

Key Characteristic	Description
Expedite development, testing, commercialization, and deployment	Create an open environment where innovative mobility applications can experience rapid, efficient and proven software lifecycles from incubation to deployment that are properly governed and licensed to protect IP and support commercialization.
Fully leverage new technologies and federal investment	Expand public-private partnerships by encouraging participation of the private sector and academia to support collaboration and new ITS technology development in a manner that is consistent with best practices and stewardship of federally-funded or federally-approved programs.
Maximize productivity	Create an open framework that meets users' needs, streamlines processes, and supports federal regulations and policy.

[4] Source: Background statement in the Government's Scope of Work for this project.

Key Characteristic	Description
Enhance mobility	Develop dynamic applications in support of USDOT initiatives that improve the mobility of individuals who use the National Transportation System.

The DMA program vision conveys the criteria and outcomes that define success[5]:

1. ***Speed in development and deployment*** - A successful program will lead to the more *rapid and cost-effective deployment of interoperable technologies and applications* that increase system efficiency and improve individual mobility.
2. ***Extensive collaboration during the research phase*** - The program will act to promote the highest levels of *collaboration and cooperation in the research and development* of transformative mobility applications.
3. ***Commitment to open source development*** - The program will *actively invest in open research and development activities with the overarching goal of maintaining a feasible evolutionary path from current technologies and practices to reach the desired end-state*. Collaboration development in an open source applications development environment charts a clear course for non-proprietary commercialization of applications.
4. ***Multiple organizations and partners are involved in applications development*** - Some of these participants are part of program funded efforts, while others participate with funding from other sources to *leverage the data, tools and development environment* made available by the program.
5. ***Transparent mobility applications research and development efforts*** prompt *private sector interest in commercializing* these new applications and speed their deployment.
6. The program will seek to facilitate ***the highest level of free and open competition in the commercialization of mobility applications as well as their integration and maintenance*** by *offering the applications under open source licenses*.

These program metrics for success define the end goals; overall, the policy identifies where policy and institutional issues may constrain or require trade-offs in reaching these end goals.

Operational Policies and Constraints

Technical Constraints

Some of the technical constraints on the OSADP were:

- ***System must be Internet-based*** – The system must be an Internet-based solution. This constraint was critical to ensure users can access the OSADP from any geographic locations via an Internet browser.
- ***System must support diverse data types*** – The core assets (algorithms, methods, source code, benchmark test data sets, and test procedures, etc.) should be well-documented and made accessible to stakeholders (e.g., members of the public and private sectors, and academia).
- ***System must support multiple programming languages*** – It is envisioned that the DMA program, like SourceForge™ and JavaForge™, will not restrict the type of programming tools

[5] Source: http://www.its.dot.gov/dma/appendix_a.htm

used for developing the applications to be made available via the portal nor will it require that all applications that are available on the portal are related as long as these applications address improving surface transportation system productivity and/or individual traveler mobility.

Organizational and Policy Constraints

The organizational and policy constraints on the OSADP are:

- ***Governance and licensing -*** A governance document that must clearly identify the rights and responsibilities of Users and Contributors of applications should be developed. The open source licensing agreement that protects IP rights of Contributors without hindering continued innovation and commercialization should also be identified.
- ***Secure environment that facilitates user collaboration and interaction*** - OSADP must not only host the core assets for the program but also facilitate interaction and collaboration among stakeholders. Thus, it is highly critical that the infrastructure is secure against hackers and misuse.
- ***Contributor recognition*** - OSADP must provide the ability to programmatically or manually recognize an individual or a team for contribution to the portal.
- ***Foreign export*** - OSADP must fully comply with federal policies, regulations, and guidelines regarding restrictions on the foreign export of federally-funded research materials.

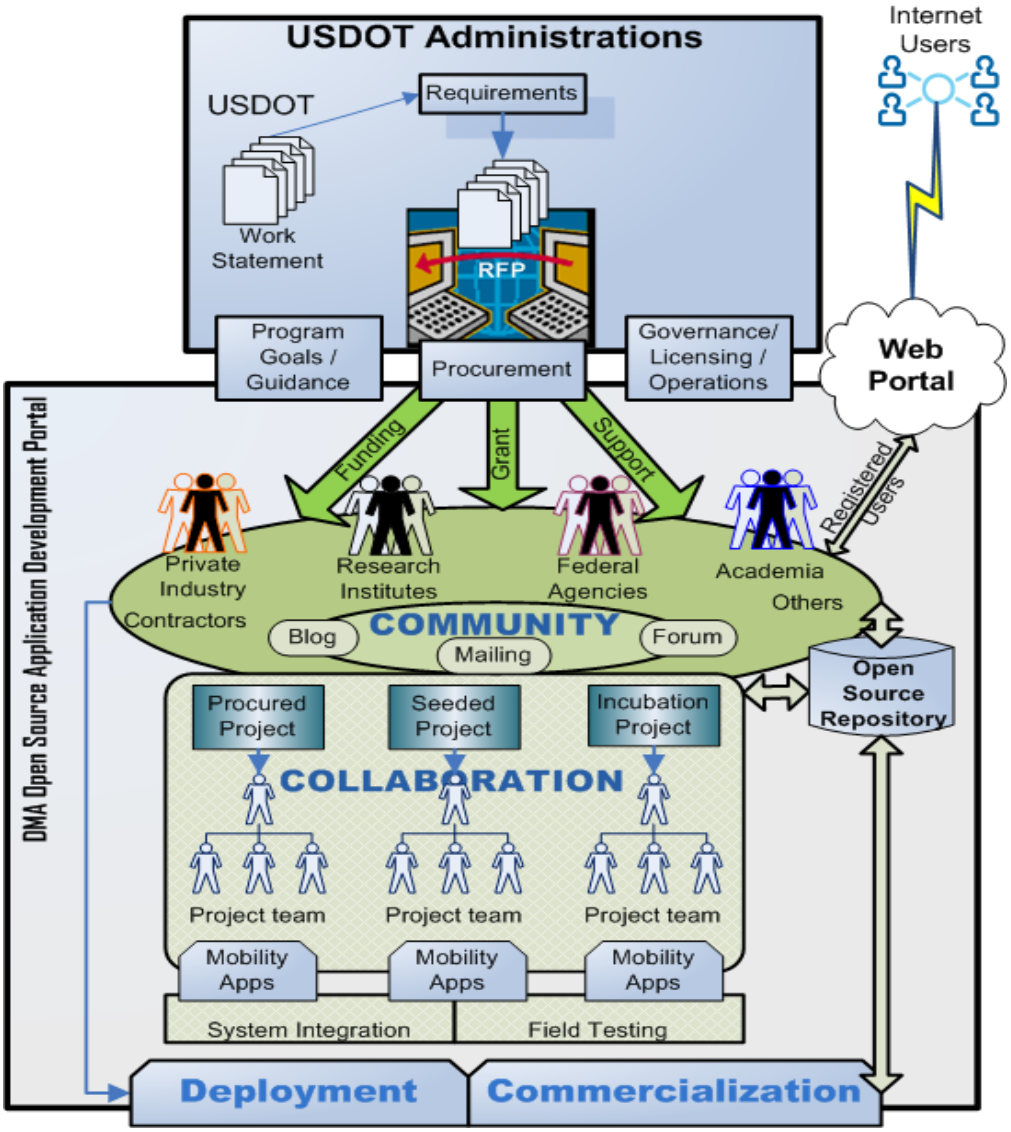
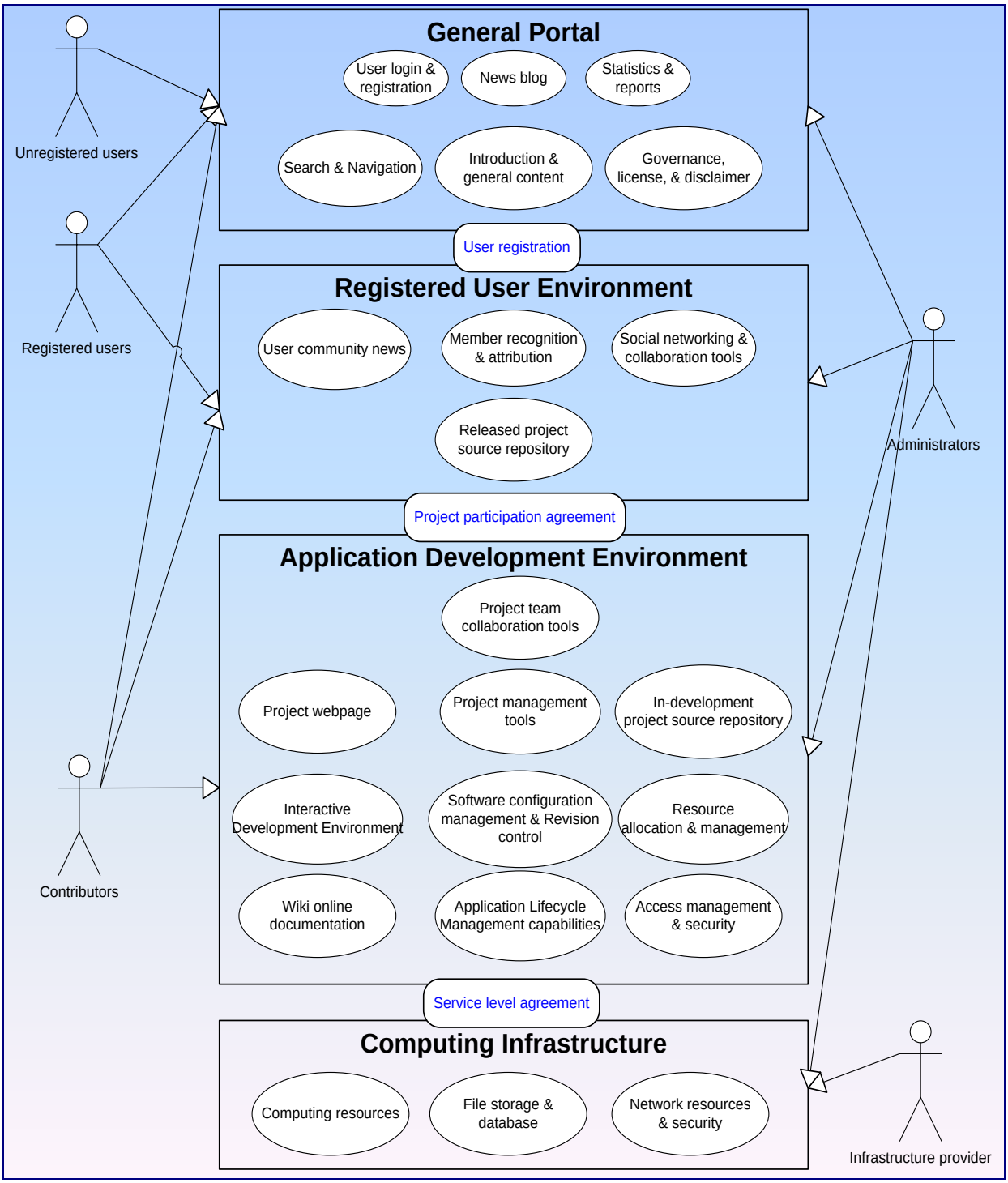


Figure 4-1. Notional OSADP Environment Overview Source: Leidos Inc.

Description of the Proposed System

Contrasting with the current acquisition process for application development services shown in Figure 2-1, Figure 4-1 shows a multi-tier environment designed to facilitate collaboration among the community members. The notional environment design allows mobility applications to be developed offline or online in a virtual and secure workspace that enables stakeholders and interested parties to take part in various capacities. The application source code is kept in an online repository and project members can review, make changes, and enhance it.



Source: Leidos Inc.

Figure 4-2. OSADP User Access Tier Architecture

Figure 4-2 shows a Unified Modeling Language (UML) diagram depicting OSADP's architecture consisting of four access tiers and user categories. Between each tier, conditions and requirements for accessing are shown.

The OSADP's multi-tier access architecture allows users of different user classes to see different types of content. OSADP access architecture is partitioned into four tiers, as follows:

- ***General Portal*** - Open to the public, the general portal is accessible to everyone on the World Wide Web, where general information is made available. An unregistered user visiting OSADP is be able to see news blog and information about the application environment, including descriptions of hidden content inaccessible to them. A link to user registration is visible and accessible at this level.
- ***Registered User Environment*** - By completing the user registration and being approved through an evaluation process, an Unregistered User may become a Registered User and gain access to this tier. At this level the Registered User, by agreeing to certain terms and conditions offered during the registration process, can gain access to additional content. In addition to content made publicly, Registered Users can also read detailed descriptions and documents about the applications, download them for use, and make changes to them as long as they agree to the terms of the licensing agreement. User community discussion forums are open for participation and some social networking communication tools are also accessible at this level for connecting professionals with similar interests. Member appreciation and Contributor attribution and accolades can be seen here as well. The primary content of this tier is the Released Open Source Repository where stable DMA application source code and associated artifacts are kept. However this repository can hold any other source deemed appropriate for this community. DMA program applications will not be loaded into the repository until after they are developed, tested and approved for release.
- ***Application Development Environment*** - This environment is accessible only by Project Contributors and Administrators by a selection process. Qualified individuals may request to collaborate on an existing project and get considered; and other may be invited to join the project.

  This architecture supports all three project management models: Directed Management, Guided Management, and Meritocratic Management, as discussed below. Initially, the directed management approach is the most common but the guided management and meritocratic management projects are very active as well. The advantages of the directed management projects include:

  1. Greater incentive by project members to participate.
  2. Improved contractor selection through managed project procurement process.
  3. Proven application development processes and methodology are used.
  4. Project contractual terms are well-defined.
  5. Project team structure is well-defined.

  These characteristics ensure that DMA program projects will be realized into applications in a timely manner, creating the foundation for further open source development after release.

  On the other hand, the meritocratic management projects are community-based, born out of synergy of the DMA environment. The advantages of these projects include:

  1. Greater range of participation from various disciplines and organizations.
  2. Application development follows true open source movement ideology.
  3. More innovation ideas created by the user community.

  However, a few characteristics of this project type need to be taken into consideration, including:

  1. Volunteered time and skill levels of participants are more unpredictable.

2. Project process and decision making may not be as formal as with professional contractors.
3. USDOT will have less influence and control on project direction, since no funding is present or limited in this case.

The guided management project type is a hybrid of the directed management and meritocratic management project types. Professional development methodology and process may be applied with resources recruited from the open source community. This model is ideal for seed-funded projects.

These three project models co-exist in the portal and leverage one another. Intra- and inter-application bundles are possible with governance and policies to delineate roles and rights of users based on the project model.

Regardless of project model, access to this collaborative development environment requires the user to electronically sign and accept additional license terms in the project participation agreement, stipulated by a range of operating policies including IP and responsibility to the development team and its objectives. This environment is organized by project. A Contributor from one project is allowed to participate in another, depending on several factors including interest, skills, affiliation, and status of funding. The decision rests with the Project Manager with final approval from the Project Sponsor.

Governance policies and instructions are articulated in an agreement to be signed by the Registered User who wishes to participate in the development of the applications. Membership is further classified into a number of project roles as described later in this document. Depending on the project roles and permissions, some users are able to view, edit, make changes, and perform certain functions that other project members are not be able to do. In this Application Development Environment, project members are offered a set of comprehensive software development tools and utilities, including software configuration management tools, project schedule management, workspace, project hosting, online documentation, and collaboration tools for virtual development team members.

All applications developed here are available in the Released Open Source Repository at the Registered User Environment tier, when they are ready. After this point, the released applications can be downloaded by a Registered User for further enhancements and commercialization. We anticipate new ideas and innovative solutions can be built on top of these developed applications developed in this environment.

- ***Computing Infrastructure -*** At this level, the computing infrastructure resources are provisioned and managed. Most users do not have access to this level; however, the resources at this level are indirectly provisioned for all other tiers discussed above. The System Administrator works with the Infrastructure Provider to ensure infrastructure services and resources are provisioned appropriately, such as computing resources (e.g., CPU, memory, etc., data storage capacity, database, and other network resources). The provider maintains overall infrastructure and allocates computing resources as necessary and provides network security to the entire OSADP environment.

Modes of Operation

This section outlines the different modes of operation for OSADP. By design, the OSADP tiers are modular and in some cases the modular components can operate independently. For instance, the General Portal functions can be segregated and taken down for maintenance or update without affecting

the Application Development Environment. The subcomponents in the Application Development Environment can also be independently disabled to service while others remain operational.

The OSADP has the following modes of operation:

Operational Mode - In normal condition, the system is fully operational around the clock, on a 24x7 schedule, and year-round. While running this mode, the system provides portal services and users can access the portal content at each tier. The general public can visit and view content on the General Portal; Registered Users can access community features and capabilities in the Registered User Environment; and project Contributors can collaborate and develop applications simultaneously.

Data Backup Mode - Data is backed up on a pre-determined periodic schedule. The system performs data backup in the background processing and it is tuned to run without affecting regular user operations.

Restore Mode - This mode is used when the system must be restored from a backup completed in a previous time period, due to a malicious attack or an internal error that brings down a subsystem or the entire system. During this mode, some portal services may be unavailable to the users until the restore is completed, at which time the system will be switched back to Operational Mode. In isolated incidents, restore operations may also be performed to fix or recover only the corrupted section without affecting the rest of the system.

Update Mode - As needed, this mode will be active when the system is going through a maintenance update to the functionality of the system. During this mode, users may have limited access to the contents and the downtime typically is brief. This mode should be scheduled in advance, with notices sent to members and posted to community bulletins announcing when this update will be conducted. Upon completion of the update the system will switch back to Operational Mode.

User Classes and Other Involved Personnel

This section identifies and describes the role of each user of the OSADP, including a description of the user, examples of the user, and the user's responsibilities. A user class is distinguished by the ways in which the users interact with the system. Factors that distinguish a user class include responsibilities, skill level, work activities, and mode of interaction with the system. Different user classes have distinct operational scenarios for their interactions with the system. In this context, a user is anyone who will interact with the proposed system.

Based on the two User Need Workshops' outcomes, the following user classes were initially suggested in Reference D for consideration in developing the OSADP:

1. Infrastructure / Highway-Side Software Engineer / Developer
2. Vehicle-Side Software Engineer / Developer
3. Project Sponsor
4. Academia / Researcher
5. Foreign Policymaker
6. Government Contractor
7. System Software Operator / Maintainer
8. Other

The above user titles and responsibilities represent some user categories of OSADP. In the following sections, these user classes are reclassified in category labels and specific classes based on access rights and privileges.

User Class Profiles

Generally, OSADP users can be classified into five user class categories:

1. ***Unregistered User*** - Any user who has access to the Internet can visit OSADP. Content access is limited for Unregistered Users.
2. ***Registered User*** - An Unregistered User who completes the online registration form and agrees to terms of user agreement is evaluated to become a Registered User. A Registered User can view additional content, participate in discussion, and is able to download any content made available in the Released Open Source Repository.
3. ***Contributor*** - A number of user classes are defined in the Contributor category; users in this category participate directly in projects. Each user is identified with a single or multiple projects in various roles. Users of this category sign and accept additional terms and conditions in the project participation agreement which may include stipulation on IP, governance policies, and open source license terms. A Contributor may assume various project responsibilities such as Project Manager, Developer, Committer, Reviewer, Tester, Technical Writer, etc. A Contributor may participate in multiple projects and assume different roles. Other roles may be created as necessary.
4. ***Administrator*** - Several user classes are grouped into the administrator category. Generally, these users provide oversight and steward functions of one or multiple OSADP projects, and they are not restricted to any particular tier. Project Sponsor, Portal Manager, Governance Administrator, and System Administrator belong to this category. Depending on their specific role, an Administrator may or may not have read or write access to the project files and documents in the Application Development Environment.
5. ***Infrastructure Provider*** - Not participating in project activity directly, this type of user provides the computing infrastructure services to the OSADP environment. The Infrastructure Provider interfaces with the OSADP System Administrator to ensure infrastructure resources are allocated as expected, and computing environments are functional at optimal capacities.

The Infrastructure Provider role is not a user category since this resource did not participate in the core activities of OSADP.

Table 4-2 shows a summary of the user categories and classes with role descriptions, details on permissions, access privileges, and capabilities.

Table 4-2. OSADP User Class Profiles

User Class Profiles	Role Description	Permissions and Capabilities
Unregistered User Category		
• *Unregistered User*	Unregistered users are defined as visitors from the general public who may or may not have an interest in the OSADP. They are not	▪ Browsing OSADP public web pages ▪ Viewing and downloading public content that does not require registration ▪ Completing and submitting online registration form that will

User Class Profiles	Role Description	Permissions and Capabilities
	registered with the portal and therefore cannot log in. An Unregistered User can view publically accessible information such as generation content about DMA, as well as other content and documents made available to the general public.	be evaluated. Completion of user registration form is a step for qualified Registered User to be considered for additional access as a Registered User.
Registered User Category		
• *Registered User*	Registered Users are users who register with and provide information to the OSADP. In addition to the privileges and access rights of Unregistered Users, Registered Users may have access to additional information and content. Specifically, they have access to resources that require registration.	▪ All privileges of Unregistered Users ▪ Bounded by user agreement terms in the registration process ▪ Having access to discussion forums, news blog, and announcements ▪ Ability to participate in online discussions ▪ Subscribing to news updates ▪ Reporting bug/error, limitation, and problems with portal content and portal software (e.g., broken links) ▪ Having access to released source code repository to view, download, test, and make changes to application open source ▪ Reviewing and updating their personal profile ▪ Submitting or proposing new and innovative ideas ▪ Reviewing and commenting on other approved projects ▪ Discussing related project ▪ Submitting source code or data to the community to use ▪ Viewing other Registered Users' public profile
Contributor Category		
• *Project Sponsor*	Project Sponsor is a person designated by USDOT to provide oversight for funded projects. The sponsor is involved in the process of funding and giving high-level guidance to the project as it relates to the DMA program. Not expected to be involved intimately with the project at a detailed level, the Project Sponsor interfaces with the Project Manager for project related status and updates.	▪ Representing USDOT as the main contact for the project ▪ Approving funding and resources ▪ Providing guidance to Project Manager relating to the DMA program overall direction ▪ Interfacing with Project Manager for status and updates ▪ Providing final approving for staff addition and reduction proposed by Project Manager ▪ Providing advisory role in open or meritocratic management projects

User Class Profiles	Role Description	Permissions and Capabilities
• *Project Manager*	A special project member who has project leadership responsibilities including directing application development effort, working with Project Sponsor, and making decisions relating to the well-being of project including staffing and resource issues.	▪ All privileges of Registered Users ▪ Ability to vote on project decisions ▪ Access to all in-development source code repository ▪ Working with Project Sponsors to secure resource and support ▪ Providing project leadership and direct application development effort ▪ Responsible for project management including scope and schedule management ▪ Leading system engineering process ▪ Evaluating and deciding on readiness of application ▪ Collaborating with other Project Managers as necessary ▪ Access to all project source code and resources
• *Developer*	A Developer is a Contributor who is directly involved in developing the project applications. Developers can play multiple roles.	▪ All privileges of Registered Users ▪ Access to all in-development source code repository ▪ Participating directly in the application development effort in many different project roles, including designing system components, creating source codes, developing software, troubleshooting and fixing bugs, writing documentation, etc. ▪ Participating in online discussions ▪ Performing peer review of codes, provide suggestions, and constructive criticism ▪ Active Developer may be promoted to a Committer who has specific privileges in version control of codes ▪ Attending project meetings and discussions and collaborating with other project team members regularly
• *Committer*	A Committer is an active project member who has all privileges that a Developer has with several additional access rights for configuration management, code build, and managing the Released Open Source Repository.	▪ All privileges of Registered Users and of Developer ▪ Committing code changes in configuration branches to the main trunk in code repository ▪ Initiating code build and compilation ▪ Preparing source code for release ▪ Ability to vote on certain project decisions ▪ Collaborating with other project team members regularly
• *Tester*	A Tester verifies functionality and features of an application or system per design document and test plan. Testing may occur at various phases of the development process.	▪ All privileges of Registered Users ▪ Access to application or target system ▪ Documenting bugs and issues and tracking them to resolution ▪ Building and compiling source code ▪ Collaborating with project team as required
• *Reviewer*	A Reviewer reviews and provides technical opinions and critical comments on engineering products, including designs, codes and documentation, etc., as needed.	▪ All privileges of Registered Users ▪ Reviewing system engineering and other documents ▪ Reviewing source code designs, source code, and test results ▪ Collaborating with project team as required
Administrator Category		
• *Portal Manager*	Portal Manager is responsible for the look-and-feel and content of the portal and the Registered User	▪ All privileges of Registered Users ▪ Responsible for user experience of General Portal and the Registered User Environment including usability, navigation

User Class Profiles	Role Description	Permissions and Capabilities
	Environment, including portal news blogs, announcement bulletins, and overseeing the discussion forums	and search, as well as the overall look-and-feel of these environments ▪ Producing and editing blog articles ▪ Managing moderators of discussion forums and bulletins including removal of unwanted information or messages ▪ Adding, updating, and deleting data files ▪ Working with Governance Manager in adding, updating, and deleting terms of use, governance, license, policies and legal related content ▪ Portal Manager manages all content on the portal, but consults with Governance Manager and Project Managers for their respective content areas ▪ Working with Project Manager who is responsible for project specific content in the Application Development Environment
• *Governance Manager*	Governance Manager oversees the practice of governance policies and ensures that they are implemented properly and is also responsible for preparation and revision of license agreement, disclaimer, and other legal statements to be posted on the portal.	▪ All privileges of Registered Users ▪ Leading the practice on all governance policies, regulations, compliance, and disclaimer statement, etc. ▪ Providing oversight and management of risks ▪ Performing auditing of license agreement terms ▪ Enforcing proper insertion of open source license statement in source code and monitoring open source content for compliance and compatibility ▪ Having read-only access to both Released Open Source Repository and in-development source code repository for inspection purposes
• *Portal Moderator*	Portal Moderator monitors discussion forums, instant chat, social networking, and other collaborating tools in the Registered User community and has ability to remove or delete content, if deemed inappropriate based on governance and portal policies. Portal Manager may promote and demote Registered Users from the community to become Portal Moderators. Portal Moderator may be assigned to use specific communication tools or an area within the community communication forums.	▪ All privileges of Registered Users, with limited read/write access within the community communication tools ▪ Reporting inappropriate activities to Portal Manager ▪ Monitoring violations of governance and policies
• *System Administrator* *If SaaS or PaaS is used, some of these services may be provided.	System Administrator is in charge of installing, supporting, and maintaining servers and other computer systems, and planning for and responding to service outages and other problems. Other duties may include scripting	▪ All privileges of Registered Users ▪ Having system root access and be able to allocate system resources as needed ▪ Responsibility for system access security ▪ Adding, removing, and updating user account information, resetting passwords, etc. ▪ Assigning access rights to project content based on Project

User Class Profiles	Role Description	Permissions and Capabilities
	or light programming, project management for systems-related projects, supervising or training computer operators, and being the consultant for computer problems beyond the knowledge of technical support staff.	Manager's direction ▪ Ensuring network infrastructure is up and running ▪ Troubleshooting any reported technical problems ▪ Analyzing system logs and identifying potential issues ▪ Installing and maintaining software applications and tools for the Application Development Environment ▪ Auditing performance of systems and software applications ▪ Planning system capacities and disaster recovery ▪ Performing data backups and restoring system from backup after a problem or disaster occurs ▪ Applying operating system updates and patches ▪ Monitoring the sharing of data, meta-data, or other information ▪ Removing unwanted information or messages ▪ Testing and checking new data sets ▪ Adding new data sets ▪ Adding, updating, and deleting history/context information within the portal environment. ▪ Answering technical queries ▪ Responsibility for documenting the configuration of the system
Infrastructure Provider Category		
• *Infrastructure Provider* *If IaaS or PaaS is used, this function may be included by the service.	Infrastructure Provider delivers computer infrastructure environment that supports advanced data acquisition, data storage, data management, data integration, data mining, data visualization, and other computing and information processing services distributed over the Internet for enabling OSADP virtual collaboration.	▪ Access to the computing resources, including processing capabilities, network resource, data security and data storage system, etc., for provisioning infrastructure services, but no access to the Application Development Environment ▪ Working with System Administrator to provide requested infrastructure resources and services for OSADP

Depending on the hosting options, some of the System Administrator functions may be provided by the Infrastructure Provider. In traditional data center operations, the system administration and other infrastructure expertise and resources are required to provide back-end system environment support. However, if cloud computing hosting options are implemented, some of these functions may come with the hosting services. For example, Infrastructure-as-a-Service (IaaS) and Platform-as-a-Service (PaaS) are cloud computing hosting options that include basic system administration and infrastructure administration in their services. If cloud computing Software-as-a-Service (SaaS) option is used, the provider will be able to supply many desired features and operational functions for OSADP. For any cloud computing options, extensive customization and configuration will be required. Some essential system administration functions will continue to be maintained by OSADP personnel, including user account management, access right administration, and data backup and restoration.

Project Classes

Hosting a wide range of collaborative application development activities, OSADP will support three project management approaches as described below:

1. ***Directed Management Approach*** - may be applied to a project that goes through the USDOT procurement process. This is the most common project type during the initial phase of the DMA program; however, it is conceivable that this approach may be broadened to include certain projects procured by State DOTs or local agencies. For example, this could include a State DOT-procured or State DOT-led pooled fund procured project. During initial development phases, the project may operate in a directed management approach, analogous to typical USDOT funded projects today. The awarded contractor will hire and staff a development team with appropriate skill sets for performing the project deliverables. All engineering and system development will take place in the OSADP environment.

2. ***Guided Management Approach*** - may be applicable for a project that gets initiated from a challenge grant or seed funding from USDOT. Initial guidance and direction may be applied in this scenario. Project leadership will be assigned by the USDOT sponsoring organization while project team members will be recruited from the Registered User community, who has qualified skills and relevant knowledge of the project scope. Further funding for this project type may come from different sources including private firms and the commercial industry.

3. ***Meritocratic Management Approach*** - may be appropriate for a project where the conceptual idea arises from within the community and it forms and gathers sufficient support. This type can become a meritocratic management project. Synergistic and innovative ideas will spur from the community and fresh initiative will take shape. The meritocratic management approach, as used in the Apache projects, delegates to the project organization the central decision making authority over the development of its software and provides for a great deal of latitude in designing its own technical charter and governance. Within this context, meritocratic governance is a commonly found model in which project participants gain influence over the project through the recognition of their individual contributions. Funding may come from USDOT and other sources including support from private firms and the commercial industry. It is possible that a meritocratic management project can be forked out of a stable released directed management project.

Forkability

Regardless of project management approach, all products and applications created from this environment are released into the open source community via OSADP when they are stable and ready. All relevant open source application code and associated artifacts are accessible by all Registered Users of OSADP. A meritocratic type of open source collaboration will take place in the meritocratic management project environments.

As discussed in Reference F, a fork may either be a complementary or competing project established using a copy of an existing project's software. In some cases, the fork creator requests that developers and users shift their focus from the original project to a new forked project, since supporting both projects is typically impractical over time. In other cases, forks can also occur because the existing community does not have a plan to include a feature set that part of the community deems important; reasons could include support for a different operating system or middleware, or inclusion of a new programming language.

The DMA program, through its governance, must be capable of supporting and managing project forking. For a procured project, it is feasible to fork an application project after the source code is released into the

Released Open Source Repository. For seeded and incubation projects managed by the meritocratic management of the community, a project may be forked if a sufficient number of community members feel that it should be.

Accommodation for project forking is needed because it provides opportunity and incentive for project leadership to be responsive to users and developers. The collaboration that occurs can complement existing software development on original projects and may actually result in improvements instead of creation of competing projects.

OSADP provides a universal infrastructure to accommodate these project types and promote collaboration across different interested parties within the community. The user classification and permissions previously discussed in this document provides the organizational structure needed to support project forking environments.

Support Environment

The OSADP will operate at the direction of the USDOT under the DMA program. The initial system will be implemented by Leidos. Long-term operations and maintenance responsibility for the OSADP environment has not yet been determined, but it is likely that USDOT will outsource this to a support contractor.

- ***DMA program management -*** USDOT provides program management support and designates project sponsor resources to provide oversight, guidance, and monitor progress of the DMA program. A board of governance may be established to handle governance and licensing issues.

- ***Hosting services*** - The system is hosted in a secure network within a cloud computing hosting facility where system hardware, network infrastructure, data storage capacity, computing resources, security and other infrastructure services will be provisioned by the hosting provider.

- ***Portal and system operations*** - The OSADP environments and portal functionality was acquired, created, configured, and administered by a Leidos. In addition to hosting services, Leidos provided resources to perform system administrative and maintenance services for the portal and system environment.

- ***Governance and license administrative tasks*** - USDOT outsourced this responsibility to a USDOT support contractor.

- ***Project environment management -*** Depending on type of project as described previously, the project management approach may be different. Each project will be led by a Project Manager who will work closely with the project sponsor to fulfill the statement of intent and project goals.

Chapter 5. Operational Scenarios

The OSADP is an online collaborative application development environment, accessible via the Internet. Different types of users with various roles, responsibilities, and interests may access this portal and depending on their access privileges, certain content is made available to them.

Before going into the details of the operational scenarios, the following sections will describe the OSADP environment by discussing user accessibility in the context of system architecture and user classes.

Basic Scenarios

This section provides a high-level view of basic OSADP operations. In Section 6.2, users' activities at each tier are described based on typical operational scenarios.

User Registration Process

Any Unregistered Users with an Internet browser can access OSADP and read the public web pages. Accessing other content beyond this point requires access login authentication. Other areas reserved for Registered Users on this website are hidden from public view. This user access control is a security measure necessary to direct different users to where they may want to go on the website.

Registered Users have read / write access to the Registered User Environment resources, which includes discussion forums, articles, instructions, and other community resources.

One way to gain Registered User status is to complete the online user registration form. Some user classes, as described in the previous section, can be registered by virtue of the user's role or being a procured project member.

Below details the mandatory information required for online registration:

- Full name (first, last)
- Organization (company name, affiliated professional organization, [blank])
- Email address (operational and accessible email address)
- Login username (minimum 5 characters)
- Password (minimum 8 characters with at least 1 capital letter, and 1 numeric value)

The registration process asks how a user plans to participate in OSADP, enquiring into the user's skills and background, and requesting other related information that helps describe the user's profile.

To block registration attempts by computers, a CAPTCHA challenge-response is displayed at the bottom of the registration form. A CAPTCHA phrase is randomly displayed requiring the user to type alphanumeric letters from a distorted image appearing on the screen. See an example of CAPTCHA challenge in Figure 5-1.

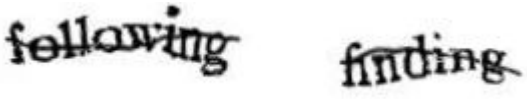


Figure 5-1. A CAPTCHA challenge example

Source: OSADP Website

The user registration process is driven by an unattended software module. A user agreement with terms and conditions is presented and the user must

accept them to complete the registration. The user agreement includes usage policies and open source license terms for delineating liability in case of misuse or violation. The registration process establishes a legal protection for OSADP operations.

The registered email address must be real and accessible since the user is required to complete the verification process by checking the email inbox for a confirmation message sent by the user registration module. Clicking the provided Uniform Resource Locator (URL) in the email message sends a confirming message to OSADP's registration module that completes the registration process.

Typical Operations in Registered User Environment

With username and password, a Registered User can login at the OSADP's front page. After successful authentication, the Registered User can see additional content that was previously hidden, including community information and resources.

News blog and bulletin, Discussion forum, Social network

The news blog and community bulletin gets updated frequently and disseminates information about the open source projects, provides updates to the existing application, and announces upcoming meetings, webinar, and other stakeholder events, and organizational changes, etc. The user can subscribe to a Real Simple Syndication (RSS) which automatically pushes news updates to a user's news reader of choice such as Microsoft Outlook RSS reader.

This community consists of government employees, international agencies, representatives from federal and state departments and branches, academic professionals, experts in transportation-related fields, contractors, private industry, and automobile-related commercial company representatives. The open user registration has attracted people with interest in transportation research projects and applications.

At this level, the user can also participate in the community discussion forum where many topics that are relevant to DMA program applications are posted. The user can read and post opinions on any discussion topics. A user may report application bugs, report problem with the portal, etc. Depending on how active the community is, new ideas and innovative solutions are discussed here. Meritocratic management projects are known to spur from this type of community setting.

Professional social networking can also occur at this level. A user may learn about other members and make new "friends" on these networks. The ability to tap into other networks and gain relationships and professional exposure may by themselves justification for being a part of this community.

Released Open Source Repository

This repository is the primary home of DMA program applications. Registered Users can browse and download any released application source code. To save storage space and increase download speed, source code is packaged in zip archive format which can be easily unraveled, once downloaded. The application code package includes installation instructions and guide, with other documentation that provides background and a description of the downloaded application.

Each element of the source code package contains a block of prepared text at the beginning identifying copyright's owner and open source license agreement terms or link to where the agreement is kept on the Internet. At this point, the open source code is applied as is or modified to fit the user's need, as long as the terms of the license agreement are respected.

To monitor future updates of a specific DMA program application, a user can subscribe to a mailing list that provides notification of any changes to an open source codebase.

Registered User's Participation in Application Development

Based on the three project types discussed previously, qualified Registered Users may apply and be evaluated for becoming a project Contributor. Particularly for guided and meritocratic management projects, a Registered User can participate in the various roles of a project. Before partaking in any application development, a Registered User needs to complete an application process and agree to terms and conditions in a project participation agreement. An eligible candidate is evaluated and granted access to become a project Contributor. The detail of the evaluation process has been specified by USDOT and is based on the applied user's qualification in contrast to the project requirements. Other factors include the user's established reputation, interest area, prior and / or planned work in relation to the application or project area, and type of application to be evaluated. The applicant's prior contributions to the OSADP community is an important factor for consideration as well.

Typical Operations in Application Development Environment

At the heart of OSADP is the Application Development Environment. As a virtual development environment, various tools specific to software development such as compiler, version control and management, bug tracking, etc., is available to allow project Contributors to take an application from concept definition to product release. To enable project members to communicate, coordinate, share and work together cohesively and efficiently, this environment offers a set of online utilities and tools specifically designed for virtual team collaboration. In this setting, besides the development tools, other project management tools and resources such as project scheduler and task tracker, etc., are available, including project schedule and resource management.

Practical use cases can be walked through step by step in the next section, which conveys the capabilities for this Application Development Environment.

Typical Operations in Infrastructure Environment

Cloud computing and hosting facilities were used to provide the infrastructure for OSADP for the following reasons:

1. A network domain such as cloud hosting provides convenient network access to everyone versus the option of having the system infrastructure hosted inside a USDOT network.
2. Cloud computing provides scalable and flexible infrastructure to meet the needs of DMA program projects that can be increased readily.
3. No capital expense outlay for hardware, software, network, tool, and development environment. These can be acquired by purchasing the options from the cloud computing services.

Amazon hosting servers were acquired and a service level agreement (SLA) was executed to ensure robust infrastructure services for OSADP operations, including 99.9 percent system uptime and provision of additional computing resources within several hours.

Use Cases

In this section, several use cases have been selected for detailed examination. For each use case, the actors, the environment, and preconditions are discussed up front. Going through the use cases steps, the reader will gain a better understanding and insight of the OSADP operations.

User Interaction, Registration, and Login

Operational Scenario: View Publicly Accessible Content

Actors: Unregistered User, Registered User, Contributor, Administrator (collectively referred to as User)

Description: A user reads publically accessible content including getting started information, terms of use information, DMA program history/context information, news articles, and the glossary.

Preconditions: The User has navigated to the system using Internet browser.

Steps:

1. User navigates to the publicly accessible content of interest.
2. User reads desired information.

If the user wishes to view other publicly accessible content, continue from the beginning.

Operational Scenario: Search Publicly Accessible Pages

Actors: Unregistered User, Registered User, Contributor, Administrator (collectively referred to as User)

Description: A user is looking for certain content. The User inputs search criteria into the system to find the desired information.

Preconditions: The User has navigated to the system using Internet browser.

Steps:

1. User inputs the search criteria, which is either a website link selection or a keyword.
2. User views publicly accessible information

Operational Scenario: Register with System

Actors: Unregistered User, System Administrator

Description: An Unregistered User wants to become a Registered User and have access to additional data and/or participate in the community resources provided by the OSADP. The Unregistered User registers on the site to become a Registered User. A System Administrator reviews the Unregistered User's information to make sure the new Registered User is valid. See Figure 5-2.

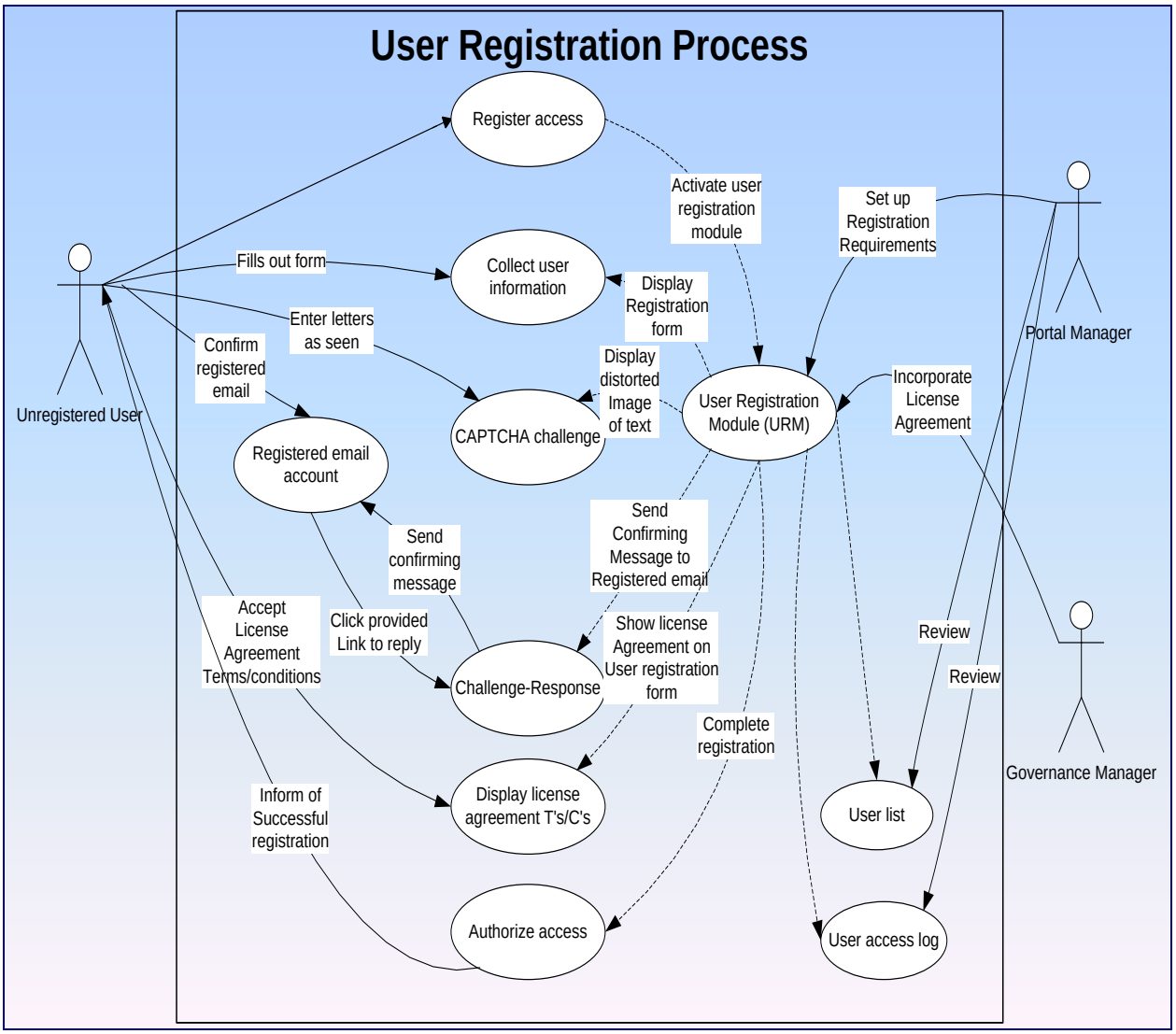
Preconditions: The Unregistered User has navigated to the system using Internet browser.

Steps:

1. Unregistered User navigates to the registration page.
2. Unregistered User reads the terms of use of the site.
3. Unregistered User agrees to the terms of use of the site.
4. Unregistered User enters all mandatory information and, at their discretion, optional requested information. [The specific mandatory and optional information has not been determined. Mandatory information is expected to include: desired username, desired password, valid email

address. It may also include full name, organization, organization type, country, and interest with DMA program.]

5. System and Administrator utilize some combination [to be determined] of automated and manual authentication and registration review procedures (e.g., CAPTCHA[6] required response to automated email, etc.) to validate registration request.
6. If User passes validation checks, Administrator approves registration and provides email to user.
7. If User fails to authenticate (e.g., User provides an invalid email address or fails to respond to the registration email), Administrator rejects registration.



Source: Leidos Inc.

Figure 5-2. OSADP User Registration Process

[6] CAPTCHA is a type of challenge-response test that attempts to ensure that the response is generated by a human rather than a computer. "CAPTCHA" is a contrived acronym for "Completely Automated Public Turing test to tell Computers and Humans Apart."

Operational Scenario: Unauthorized User Tries To View Content that is Not Publicly Accessible

Actor: Unregistered User

Description: An Unregistered User tries to access information that is not available to the public using non-traditional means. The Unregistered User is denied access to the content.

Preconditions: None.

Steps:

1. Unregistered User attempts to view content that is not publicly accessible by going directly to the URL of the content or accessing the page through non-traditional means.
2. Unregistered User is denied access to the content.

Operational Scenario: Ask the Portal Manager a Question

Actors: Unregistered User, Registered User, Contributor, or Portal Manager and Administrator (collectively referred to as User)

Description: A User has a question about information in the OSADP or about the way the OSADP is working. The User sends a message to the Portal Manager, who answers the question or fixes the problem if necessary.

Preconditions: User has navigated to the system using Internet browser.

Steps:

1. User navigates to the appropriate section to send a message to the Portal Manager.
2. User inputs email address, a message subject, and question.
3. Portal Manager reads the question, sends a notification reply that the question has been read and any action that may need to be taken.
4. User reads the Portal Manager's response message.

Operational Scenario: Login to the System

Actors: Registered User, Contributor, Portal Content Manager, or Portal Manager (collectively referred to as User)

Description: The User wants to access the information available at his/her user level in addition to the publically accessible information. The User inputs login information and the system authenticates the User. The User then has access to the information available at user level. See Figure 5-2.

Preconditions: The User has navigated to the system using Internet browser.

Steps:

1. User navigates to the login area.
2. User enters his login information.
3. User enters his information correctly.
4. User is authenticated.
5. User is given the ability to access data, review his/her profile, and access the community collaboration sections of the DMA OSADP. If the User is a Contributor, the User is also given access to the specific restricted access area within the portal. If the user is a Portal Manager, the User is given the ability to create, update, and delete certain content information. If the User is a Portal Manager, the user also receives the ability to modify all portal system information.

6. The System Logger records the date, time, and description of the login event.

Extensions:
3a. User enters his/her information incorrectly:
    1. The system does not authenticate the login information and displays an error message.
    2. Use case resumes at step 2 above.

Operational Scenario: Request a new password

Actors: Registered User, Contributor, Portal Content Manager, or Portal Manager (collectively referred to as User)

Description: The User wants to login to the system but has forgotten password and so requests a new one. The User must provide identification information before the password is reset. The User then creates a new password and logs in.

Preconditions: The User has navigated to the system using Internet browser.

Steps:

1. User navigates to the request new password area.
2. User provides identification information.
3. The system sends a confirming message to the Registered User's email
4. User clicks on the provided URL that takes user back to the system password reset screen.
5. User is allowed to create a new password.
6. User is logged into the site.

Registered User Environment Operations

Operational Scenario: Review and edit profile

Actors: Registered User, Contributor, Portal Content Manager, or Portal Manager (collectively referred to as User)

Description: The User wants to view and edit a user profile. The User inputs the updated profile information and the system saves the changes.

Preconditions: The User has navigated to the system using Internet browser and is logged into the system.

Steps:

1. If the User is not an Administrator or Portal Manager, the User navigates to personal profile. If the User is an Administrator or Portal Manager, the User has the ability to navigate and access any user's profile.
2. User inputs updated profile information such as email address, password, name, organization, organization type, country, and interest with DMA program.

Operational Scenario: Collaborate with other Registered Users

Actors: Registered User, Contributor, or Portal Manager (collectively referred to as User)

Description: A User wants to share information with or ask other users a question. The User posts an opinion or question on the discussion forum, or participates in a social network by leaving message or comments on another user's wall, so they can then choose to respond and collaborate with the first user. See Figure 5-2.

Preconditions: Users have navigated to the system using Internet browser and are logged into the system.

Steps:

1. Registered User navigates to collaboration area.
2. Registered User inputs message information including the title and the actual message. The message could be a question, a request for help, posting a message expressing an idea, contributing to an existing discussion, or information that other Registered Users may find useful.
3. Another Registered User navigates to the collaboration area.
4. The other Registered User views the message.
5. If the other Registered User chooses to respond to the message, the subsequent steps take place:
6. The other Registered User submits a reply message.
7. The first Registered User views the reply. If this user chooses to send a response back, continue from step 5.

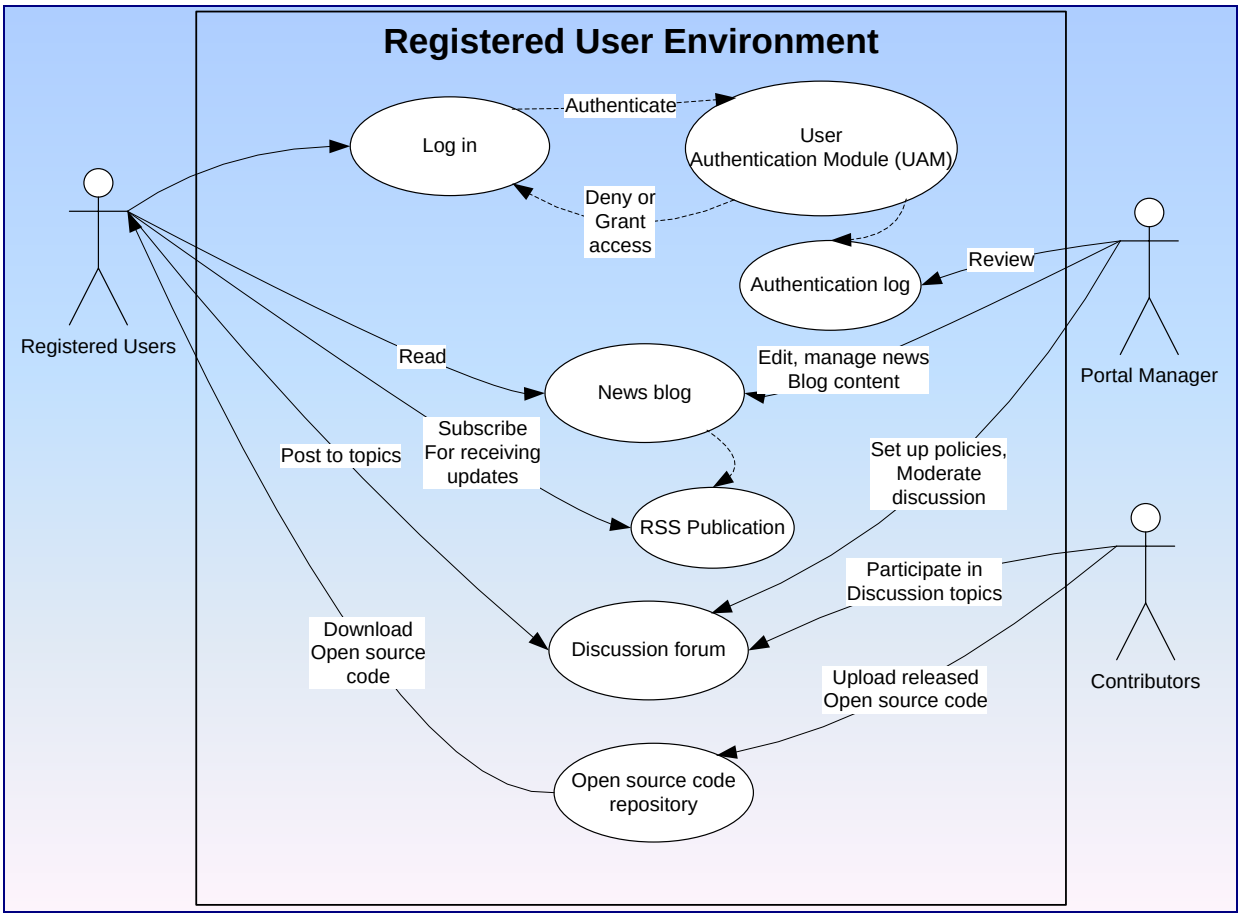


Figure 5-3. OSADP Registered User Environment Source: Leidos Inc.

Operational Scenario: View Project Information

Actors: Unregistered User, Registered User (collectively referred to as User)

Description: The User navigates to the projects list or news blog entry list and views all of the projects. The User selects a project and views that project's information. See Figure 5-2.

Preconditions: User has navigated to the system using Internet browser.

Steps:

1. User navigates to the projects list.
2. User selects a project of interest.
3. User views the information for that project.

Operational Scenario: Search for and Download Application from Released Open Source Repository

Actors: Registered User, Contributor, Portal Content Manager, External Application, or Portal Manager (collectively referred to as User)

Description: The User finds application and wants to download it. If required for the information in question, the User logs into the system and credentials and permissions are checked against those required for accessing the requested data. If there are no restrictions on access or the user is authenticated and has the required permissions, the user downloads the application archived package and views the data. See Figure 5-3.

Preconditions: The User has navigated to the system using Internet browser and is logged into the system. User has found the information to be downloaded.

Steps:

1. User selects the data or application software to be downloaded.
2. If the User is not logged in and login and/or additional permissions are required for the data in question, the User logs into the system.
   - The system checks the credentials and permissions of the User
   - If the User is authenticated and has the appropriate permissions, he/she is granted access. If not, an error message is returned to the User.
3. User downloads the software application or data and implicitly accepts the terms of open source licensing and acknowledges existing copyrights
4. User views the open source application software locally.

Extensions:
3a. User does not accept terms of the licensing agreement.
4a. System denies access.

Operational Scenario: Upload Enhanced Open Source Code to Released Open Source Repository

Actors: Registered User, Contributor (collectively referred to as User)

Description: The User downloaded the data or application software and has enhanced the code. User would like to upload the enhanced source code back to the repository. See Figure 5-3.

Preconditions: User is authorized to download application software or data and make enhancement to the download materials (see *Search for and download application from Released Open Source Repository*).

Steps:

1. User selects the data or application software area on the repository to upload.
2. If the user is not logged in and login and/or additional permissions are required for the data in question, the User logs into the system.
   - The system checks the credentials and permissions of the User.
   - If the User is authenticated and has the appropriate permissions, access is granted. If not, an error message is returned to the user.
   - A limited number of attempts are allowed.
3. User uploads the software application or data.
4. User checks status to confirm that the data or application software has been uploaded successfully.

Operational Scenario: Submit an application bug report

Actors: Registered User, Contributor

Description: The User downloads an application and installs it as instructed. However, the User finds a bug in its application functionality and submits a bug report so that the technical issue can be corrected.

Preconditions: The User is authorized to download application software or data.

Steps:

1. User logs into the portal and navigates to the issue tracker application.
2. User opens a new bug report and describes the symptom of the bug in detail including software version, conditions for the bug to occur, sequence of events leading up to the error, and any system environment that may help replicate the error in the lab.
3. User selects a sensitivity and criticality level for the reported bug and selects type *application bug.*
4. Contributor reviews the bug report, reproduces, and fixes the application bug and tests it.
5. Contributor updates the bug status in the issue tracker application.
6. User later can download and verify the bug fix in the next version release.

Operational Scenario: Submit a portal content error

Actors: Registered User, Portal Manager

Description: The User notices a portal content error and submits a report about it.

Preconditions: User can login to the Registered User Environment

Steps:

1. User logs into the portal and navigates to the issue tracker application.
2. User opens a new portal content error report and describes the error in detail including section or area where the error is found, any side effects, sequence of events leading up to the error, and any system environment that may help replicate the error in the lab.
3. User selects a sensitivity and criticality level for the reported error and selects type *portal content error.*
4. Portal Manager reviews the error report, reproduces, and coordinates with other portal administrative staff to fix the error and test it.
5. Portal Manager updates the portal content error status in the issue tracker application.
6. User later can verify the solution after it is implemented.

Application Development Environment Operations

Operational Scenario: Access Application Development Environment

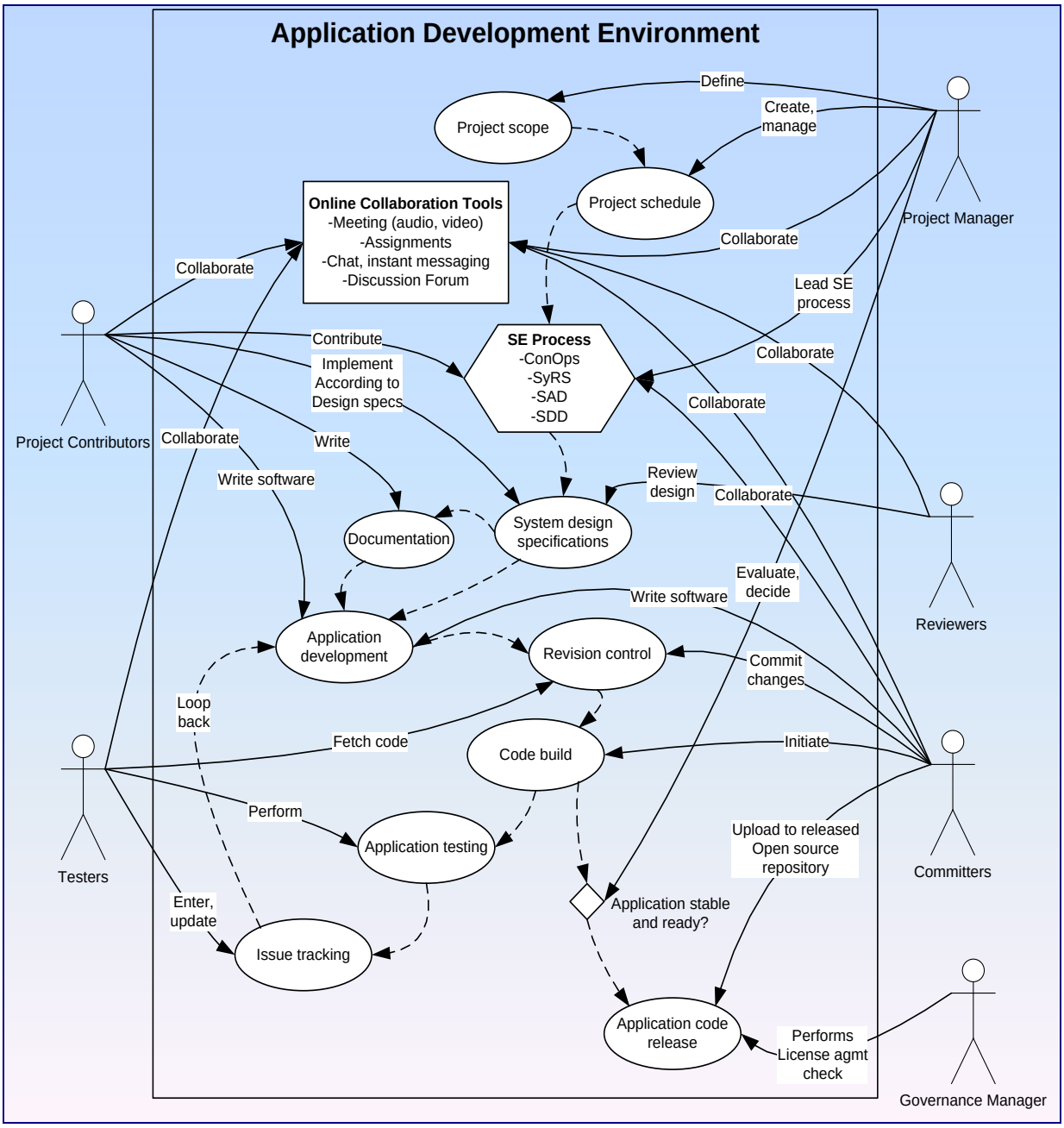
Actors: Contributor, System Administrator, or Portal Manager (collectively referred to as User)

Description: The User wishes to update a particular project's information. The User accesses the Application Development Environment and inputs updated project information, which could include the project's reference information and project development code and documents. See Figure 5-4.

Preconditions: The User has navigated to the system using Internet browser and is logged into the system.

Steps:

1. If the User is a Contributor, the User navigates to the project repository. If the User is a System Administrator or Portal Manager, the User navigates to any project of desire.
2. If User is not a Contributor, an Administrator, or a Portal Manager, the User cannot access the Application Development Environment and is not be able to access in-development projects.
3. If User is a Contributor, User enters Application Development Environment to update project information, which may include any or all of the following: reference information and project development source code and documents.
4. Regular Registered Users cannot access Application Development Environment.



Source: Leidos Inc.

Figure 5-4. OSADP Application Development Environment

Operational Scenario: Project Meeting

Actors: Contributors

Description: The Contributors of a particular project hold weekly virtual meeting to get update on project's information. The Project Manager uses an online tool to schedule meetings on specific date and time,

conference pass code, and sends out an invitation about the meeting to all Contributors of that project. Contributors call in at a predetermined conference number at scheduled time with a pass code to attend the meeting. See Figure 5-4.

Preconditions: Contributors have navigated to the system using Internet browser and are logged into the system for interactive video meeting tool and have access to a telephone for joining the audio conference. Every project has a web page for posting notes, bulletins, assignment and other project information.

Steps:

1. Contributors dial the conference phone number.
2. Contributors open a computer window on their computer and join a video meeting tool.
3. Project Manager leads the meeting.
4. All invited Contributor can participate on meeting topics and discussion.
5. Project Manager captures meeting notes with action items and posts them on project web page.

Operational Scenario: Project Collaboration

Actors: Contributors

Description: As needed, Contributors can collaborate via communication tools such as instant messaging, project technical forum, one-to-one video conference, and computer-to-computer audio/video chat. Through these tools, Contributors can discuss and collaborate on project related efforts.

Preconditions: Contributors have navigated to the system using Internet browser and are logged into the system that have the collaboration tools enabled for them. See Figure 5-4.

Steps:

1. Contributor may schedule a session to collaborate with other Contributors, one-to-one or with several others, or the Contributor can attempt to connect directly with another Contributor, impromptu.
2. The other Contributors may respond and participate in technical discussion related to the project.
3. Contributors can brainstorm on an idea, a topic, or help each other on technical topics.
4. All collaboration sessions using these tools will be logged by the system for record purposes.

Operational Scenario: Source Control

Actors: Contributors

Description: Contributors belong to a project can save their source code in a shared workspace. They can use the source control system to check in and check out their in-development source code. The revision control system will keep track of the changes and allow the Contributor to make notes about the changes made. See Figure 5-4.

Preconditions: Contributors have navigated to the system using Internet browser and are logged into the system that allows them to navigate to the source control server.

Steps:

1. Contributor develops a source code or a document and wants to save work in provided workspace.

2. As good progress is made on the code or document, Contributor checks in the code or document to a branch in the source control directory.
3. The system automatically increases the version number of the check-in item and prompts the User for entering notes on the changes.
4. The changes are made and the source controlled can be retrieved; Contributor can go back to earlier changes.

Operational Scenario: Code Review

Actors: Reviewer and other Contributors

Description: Code review will be performed to ensure quality and assess security vulnerability. Peer Contributors or a qualified Registered User may be promoted to Contributor status for a short duration for performing code review. See Figure 5-4.

Preconditions: Contributors have navigated to the system using Internet browser and are logged into the system that allows them to navigate to the source control server.

Steps:

1. Reviewer performs code review.
2. If a qualified Registered User is invited to join a project, the Project Manager sends an invitation to the user and by accepting the invitation the user will be able to access the open source code for review.
3. The Reviewer performs code review.
4. Reviewer documents all findings and recommendations in a report to the Project Manager.

Operational Scenario: Code Build

Actors: Committer and other Contributors

Description: At certain point in the code development, a software build is needed. The Contributors meet and decide what is to be included in a code build based on its readiness. The Committer works with the other Contributors to make the determination, then commits some code changes to the source control tree trunk for a code build.

Preconditions: Contributors have navigated to the system using Internet browser and are logged into the system. Contributors have checked in all their relevant changes.

Steps:

1. Each Contributor checks in code or document changes to the source control system.
2. Committer ensures the changes are in the system and copies them into a build directory.
3. Committer orders the build and the system completes the code build.

Operational Scenario: Code Testing

Actors: Tester, Project Manager, Committer, other Contributors

Description: The Tester prepares application test plan specific to the system requirements and specifications. The Tester gets approval from Project Manager for the test plan prior to testing. As the code is ready, the Tester will test the code and report bugs and issues. See Figure 5-4.

Preconditions: The Tester has access to the code to be tested and the targeted system to test them on.

Steps:

1. Tester installs the test code.
2. Tester follows the test plan to verify functionality and features specified in application requirements.
3. Tester documents findings including bugs, issues, and observations.
4. Tester describes the failure conditions so the Contributors can recreate the issues and fix them.

Operational Scenario: Code Release

Actors: Tester, Project Manager, Committer, other Contributors

Description: After rounds of testing, including possibly field testing, if the application code passes the tests satisfactorily, the application code will be prepared for release. See Figure 5-4.

Preconditions: Testing completes with satisfactory results.

Steps:

1. Project Manager assesses test results.
2. If they are deemed acceptable, the code will be prepared to be released.
3. Committer oversees the process of preparing the release package, including documentation.
4. Project Manager will document the event and prepare a report to the project sponsor.

Notes: For procured projects, the application development process terminates here. If the application is functional and the program decides to commit the resources, the application will then undergo limited deployment in field testing. Only if the field testing shows the application to be viable and offer transformative benefits, will the application then go to the repository, assuming it is suitable to be offered under an open source license to all the Registered User community.

Operational Scenario: Upload Application to Released Open Source Repository

Actors: Tester, Project Manager, Committer, other Contributors

Description: With the release source code, the application will be packaged with documentation and instructions. The process of a User downloading the application will be simulated to ensure the application will have no transmission or installation problems. See Figure 5-4.

Preconditions: Release code is ready. After DMA program has commissioned a field test and the application is proven viable and offers transformative benefits, it authorizes the application to be released to open source community.

Steps:

1. Project Manager prepares application code release document and announcement.
2. Committer oversees the process of packaging the code.
3. Governance Manager ensures appropriate license information is inserted in the header of application source code files and appropriate documentation is prepared.

4. Committer simulates the process of downloading and installing the application package for detecting any problems with packaging process.
5. If the download and installation test is problem free, the Committer uploads the application package to the Released Open Source Repository.
6. Registered User community will have access to this application after this point.

Operational Scenario: Evaluate a new Contributor from Open Source Community or Other Funded Projects

Actors: Registered User, Project Manager, Project Sponsor

Description: If a Registered User or a Contributor of another project wishes to collaborate in another project. This process involves an evaluation process to qualify the candidate. See Figure 5-4.

Preconditions: The candidate must be a Registered User of the OSADP and have ability to access the OSADP.

Steps:

1. Project Leader identifies and announces project needs to the Registered User community in form of a staffing requisition that outlines the job responsibilities, requirements and expectations.
2. Candidate Registered User or a Contributor of another project responds to the requisition and accepts all terms and agrees to all project requirements through the application form.
3. Project Leader must initiate the project membership qualification evaluation process that evaluates the candidates on case-by-case basis based on possible criteria as follows:
    a. Project specific needs
    b. Candidate's motivation
        1) Becoming a project Contributor
        2) Just checking out open source code
        3) Non-technical, just want to know
    c. Qualification
        1) Skills
        2) Experience
        3) Background
    d. Association / Affiliation
    e. Funding status
    f. Sponsored by a federal agency
    g. No conflict of interest
4. The Project Leader submits proposed candidate to Project Sponsor for final approval.

Administrative Tasks

Operational Scenario: Manage Uploaded Files

Actors: Registered User, Portal Manager, System Administrator

Description: The User wants to add new files to a user upload area. The User inputs the associated file information including the title, description, and categorization. If the User is a System Administrator, assigning categorization includes assigning access to the files. The User inputs the actual file.

Preconditions: The User has navigated to the system using Internet browser and is logged into the system.

Steps:

1. User inputs file information including: title, description, categorization (if the User is a System Administrator, this includes who has access to the file), and the actual file.
2. The User runs an anti-virus scan before uploading the files and quarantines any infected files.
3. The system stores the date, time, and description of the "add file" event as part of the event log in the data store.
4. If no infection, the system stores the data in the intended location in the Released Open Source Repository.

Extensions: If the file information input is not valid:

1a. User receives an invalid input error message.

2a. User reenters the file information, if chooses. Repeat from step 2 if the input is valid or from step 5 if it is not.

Operational Scenario: Update Portal Content

Actors: Portal Manager, Governance Manager, System Administrator

Description: Portal Manager or Governance Manager has updated getting started information, terms of use information, history/context information, or an updated news article, glossary term, or website link to modify in the OSADP. The Portal Manager or System Administrator input the updated content information.

Preconditions: The Portal Manager and System Administrator have navigated to the system using Internet browser and are logged into the system.

Steps:

1. Portal Manager has ownership and authority over all portal contents.
2. Portal Manager works with Governance Manager for the governance related content.
3. Portal Manager works with Project Managers for project specific contents. Changes in the Application Development Environment are dynamic and frequent and the project Contributors will update these accordingly.
4. Portal Manager works with the System Administrator to change, update who has access to the content, if necessary.
5. The system stores the date, time, and description of the "update content" event as part of the event log in the data store.
6. System Administrator or Portal Manager receives a "content updated" validation message.

Extensions: If the System Administrator or Portal Manager enters invalid information:

3a. System Administrator or Portal Manager receives an error message.

4a. System Administrator or Portal Manager reenters the information. If the new information is valid, continue from step 5. If the information is not valid, continue from step 3a.

Operational Scenario: Promote/Demote a Registered User to be a Portal Moderator

Actors: Registered User, Contributor, or Portal Manager

Description: Based on needs, a Registered User may be promoted to a Portal Moderator. The Portal Moderator takes guidance and direction from Portal Manager and enforces portal governance and policies based on assignment. The Portal Manager also can demote the candidate based on performance.

Preconditions: The Portal Moderator has navigated to the system using Internet browser and is logged into the system. The Portal Manager promotes Registered User to Portal Moderator based on qualifications.

Steps:

1. Portal Manager reviews Registered User's profile and qualifications.
2. Portal Manager discusses moderator's responsibilities and expectations with the candidate.
3. If acceptable, Portal Manager changes the Registered User's access level to that of a Portal Moderator.
4. If the Portal Moderator is not performing the responsibilities to expectations, the Portal Manager may withdraw the Portal Moderator's access level.

Operational Scenario: Notify Misuse of Collaboration Area so Unwanted Information can be Removed

Actors: Registered User, Portal Moderator, Portal Manager

Description: A User creates a message that is inappropriate or unrelated to DMA program. The Portal Manager receives notification of misuse of the collaboration area or notices the misuse himself. The Portal Manager removes the unwanted message.

Preconditions: The User, Portal Moderator, and Portal Manager have navigated to the system using Internet browser and are logged into the system.

Steps:

1. User posts an inappropriate or non-DMA program-related message in the collaboration area.
2. If someone informs the Portal Manager of the misuse of the collaboration area, the subsequent steps take place:
    a. Portal Manager receives notification that the collaboration area has been misused.
    b. Portal Manager navigates to the collaboration area or asks a Portal Moderator to take this action.
    c. Portal Manager or Portal Moderator views the recent messages, including the inappropriate or non-DMA program-related message.
    d. Portal Manager or Portal Moderator deletes the message from the system.
    e. Portal Manager or Portal Moderator may also take any or all of the following optional actions:
        1) Notify the Registered User, the originator, that their post has been removed, along with the reason.
        2) Warn the originator that they are at risk for removal from the OSADP if misuse or abuse of the system continues.
        3) Remove the User's registration. The former Registered User is now an Unregistered User.

Operational Scenario: Acknowledge User's Contributions

Actors: User, Portal Manager

Description: User contribution of various types is acknowledged and recognized publicly and periodically.

Preconditions: The User completed one of the actions or tasks deemed useful or beneficial to the community.

Steps:

1. User fixes a reported bug in an application and uploads the fix back to repository.
2. Committer verifies that the bug is solved satisfactorily, includes in a major code branch, and acknowledges the User's contribution in the release notes.
3. User's work is recognized in the release notes published with the release of the application version so that the credit is known publicly.

Extensions:

1a. User contributes significantly in a discussion forum on a topic that leads to an innovative solution for a technical issue.
2a. Other Users recognizes the User's contribution.
3a. Portal Manager acknowledges the User's contribution in the weekly blog entry that posted publicly on the Community area.

Operational Scenario: Perform Data Backup

Actors: Infrastructure Provider, System Administrator

Description: Data backup of the portal environments including the Application Development Environment is performed periodically by the Infrastructure Provider.

Preconditions: The System Administrator works with the Data Provider to specify what data to back up.

Steps:

1. System Administrator specifies data sections and schedule that should be backed up.
2. Infrastructure Provider performs data backup according to the schedule.
3. System Administrator has access to verify the backup data.

Operational Scenario: Perform Data Restore

Actors: System Administrator, Contributor

Description: Folders of source code and supporting assets get corrupted as a result of virus attack. A Contributor requests that the content of folders get restored from the last backup before the attack.

Preconditions: The System Administrator has access to backup content and can perform the data restore operation.

Steps:

1. Contributor submits the data restore request.
2. System Administrator verifies the request and performs the data restore.
3. The system records this action in the event log.
4. System Administrator notifies the Contributor that the request has been fulfilled.

Extensions:

1a. If a major portion or the entire system needs to be restored, the System Administrator works with the Portal Manager to come up with a data restoration plan including a schedule and a contingency plan.
2a. System Administrator coordinates with the Infrastructure Provider to perform the data restore operation.
3a. The system records this action in the event log.

Operational Scenario: Perform Data Migration

Actors: System Administrator, Portal Manager

Description: A major portion or the entire system data structure needs to be backed up and moved to a different system.

Preconditions: A complete data backup of the system is available (see *Perform data backup*).

Steps:

1. System Administrator works with the Portal Manager to come up with a data migration plan including a schedule and a contingent action if the restoration did not succeed.
2. System Administrator coordinates with the Infrastructure Provider to stop taking more data files, performs a complete system data backup into external media or alternative backup site according to the data migration plan
3. System Administrator performs a data restoration operation to place the data into the new system environment and makes appropriate adjustment to allow data to be accessible.
4. The system records this action in the event log.

Operational Scenario: Add New Section in the Collaboration Area

Actors: Portal Manager, System Administrator

Description: The Portal Manager has a reason to add a new section in the collaboration area. Possible reasons include the addition of new data sets, the need for an existing category to be broken into more specific categories, or the addition of similar projects which could benefit from a new collaboration area geared toward those projects. The System Administrator creates a new section per request, and specifies who can access the section.

Preconditions: The System Administrator has navigated to the system using Internet browser and is logged into the system.

Steps:

1. Portal Manager specifies information about the new section including a title and who can access the section.
2. System Administrator creates the new section based on specified information.
3. System Administrator logs the date, time, and description such as “add new section in the collaboration area” as part of the event log.

Operational Scenario: Add New Application Development Project

Actors: Project Sponsor, Portal Manager, Project Manager, System Administrator

Description: The need for a project has been established. A Project Sponsor from USDOT makes a request to Portal Manager to create a new project on the OSADP. This project may be one of three types: directed management, guided management, or meritocratic management project. The Portal Manager works with System Administrator to set up the project environment.

Preconditions: The USDOT Project Sponsor and Portal Manager have agreed that a new project will be added to the OSADP. The System Administrator, or both Portal Manager and System Administrator have navigated to the system using Internet browser and are logged into the system. The project requirements and access control policies have been agreed to by the parties. The required information about the new resource has been provided to the Portal Manager including name and contact information of the potential Project Manager and project team members.

Steps:

1. Portal Manager works with the System Administrator to allocate project resources including workspace, webhosting, access to the Application Development Environment systems (e.g., configuration management system, bug tracking application, etc.).
2. Portal Manager works with the System Administrator to enable access and grant permission to the project Contributors of the project based on their roles.
3. Portal Manager updates the portal with information on the new environment.
4. The system stores the date, time, and description of the “add new project” event as part of the event log in the data store.

Operational Scenario: Delete user

Actors: Registered User, Portal Manager, Project Manager, System Administrator

Description: The System Administrator has a reason to delete a User. Reasons to delete a User include: the User misused the collaboration area, the User misused data, or the User no longer needs access to DMA program data. The System Administrator removes the User from the system per the Portal Manager’s request.

Preconditions: The System Administrator has navigated to the system using Internet browser and is logged into the system. Some violation has been noticed or a request to remove a project member comes from a Project Manager.

Steps:

1. Portal Manager assesses the violation and decides whether to remove or delete a Registered User.
2. Portal Manager requests that the System Administrator remove or delete the Registered User.
3. If the request comes from the Project Manager, Portal Manager will request the System Administrator to remove or delete the Registered User.
4. System Administrator navigates to any User’s profile.
5. System Administrator deletes the User’s profile information and removes the User from the system.

Chapter 6. Summary of Impacts

Adopting open source for DMA program development is unprecedented by USDOT. OSADP will have significant impacts to USDOT programs because it represents a paradigm shift in openness and transparency. The view of IP rights was adjusted. From a closed loop development, future programs will embrace open technology development. Expectedly, USDOT as an organization will experience a learning curve and go through some degree of acclimation to adjust itself to this open source mindset. On the positive side, the promise of open source for USDOT, based on successes experienced within other federal government departments and agencies, will be immense and long lasting. In this section the potential organizational and operational impacts of OSADP are highlighted, as well as impacts during the portal system's development.

Operational Impacts

The primary goal of the OSADP is to leverage and re-use existing source code to meet new demand faster, more cost effectively, and with better quality. Operationally, OSADP effectively is a departure from the mentality of application development in stovepipes. Application source code developed in the portal will be used, re-used, and enhanced wherever applicable, across organizations, and even national boundaries. Mutual benefits will be realized from the collaboration and sharing of knowledge and expertise. It is envisioned that the following operational impacts from the new portal will be achieved:

Information Security: Since the portal system is hosted in a cloud computing environment, a network site, the system allows convenient but secure access for Registered Users and project Contributors without network security hindrance. Security risks or threats to the USDOT network are minimized.

User Protocols: While the OSADP encourages and promote openness, it also establishs protocols and set expectations by requiring every Registered User to agree to terms and conditions before gaining access to use the system. The protocols are designed to protect Contributors and establish guidelines on how productive collaboration should be conducted. They include guidelines on user role and responsibility, respect for IP rights, and other users' privacy.

Collaboration Workspace for Users: The system provides different tools for members to collaborate with one another. Using these tools, Registered Users can virtually contribute in project efforts, participate in discussion and brainstorming sessions, report errors or bugs, ask questions, and explore how other members are using certain data sets, etc. The portal system hosts the community and allows its members to share collective knowledge.

Central Virtual Environment for DMA Program Application Development: The portal system provides a single development environment where users access and participate in transportation application development. Being centrally located, the users are exposed to and benefit from the awareness of related programs and related applications.

Designed to Reinforce Long-Term Stewardship of the DMA Program: The portal system provides a means by which members are able to store and share any improvements that they have made to existing application source code, core assets, and artifacts including important meta-data and supporting contents. One of the goals of this portal is to promote commercialization of the latest transportation concepts. Initially, the applications developed here will be managed under the DMA program; however in the long run, this portal may provide stewardship of applications and derivative works that will become available in the future from the community.

User Activity Tracking: The portal system tracks usage so the Portal Manager and system administrative staff are informed of what data and functions in the system are most popular or rarely used for making appropriate adjustments. Knowledge of user behaviors and preferences are essential in the constant effort to improve the portal system.

Project Activity Transparency: The portal system is able to provide real-time project information and updates. With applications being developed on the portal, USDOT now has visibility into progress made in each effort and are able to discover issues early in the process. For instance, the researchers of the community discussing design issues and challenges of an application. This ability helps shed light on issues, potentially minimizes duplicative efforts, and avoids technical pitfalls. Transparency serves great benefits to the application projects.

Lessons Learned for Use in Deployment: The experience gained from developing, operating, and managing the system provided valuable insights, requirements, and lessons learned that can be used by implementers of mobility applications and systems, including data providers, systems integrators, and applications developers.

Organizational Impacts

USDOT will modify its communication protocols to more effectively engage the open source community to share interests in DMA program applications. Through open source, USDOT will also become more engaged in application development. Traditional administrative roles will be enhanced and new roles created to allow more active engagement in portal environments. It is envisioned that the following organizational impacts from the new portal will be achieved:

Working with Open Source Community: An effective way to embrace open source application development is to encourage an environment that fosters dynamic interaction among the users of the community of interest. In this portal system, USDOT can now work directly with the community where members come from different disciplines and organizations and who have shared interests in DMA program applications. Communication protocols between application implementers and USDOT can be modified to be more effective, reflecting the needs of the community.

USDOT's Active Role: Breaking away from the traditional procurement practices where USDOT procures application development through federal contractors, USDOT can become more engaged in the application development process. Some traditional USDOT administrative roles are enhanced and some new roles can be created to allow even more active engagement in the portal environments.

Upfront Investment for Cost Reduction: The goal is to achieve more with fewer resources by leveraging expertise across the community. The advantage of open source is source code is now open for use and enhancement. Instead of reinventing an application code base from scratch, a mobility application can be leveraged from previous work and concentrate on a fraction of the functionality that has not been developed. New applications in the future can build upon what will be building on the portal. By leveraging existing source code, knowledge and data will save costs for USDOT and the transportation industry. The outlay cost may be higher during the initial phase until some core applications are completed and shared. However, long-term open source application development will reduce costs for the DMA program and for USDOT in general. As one of the goals is to involve private industry in the application development process to encourage commercial adoption, faster commercialization of these applications will mean significant overall cost savings.

More Exposure to Ideas: More collaboration means more exposure to great ideas. A stovepipe development approach may have some advantages however, with the open source initiative the

proprietary restrictions will vanish or be significantly reduced, allowing ideas to cross-pollinate freely and openly. Inviting wide participation from all interested users, the mobility applications will be exposed to new ideas and viewpoints that we may otherwise not know about.

Faster Time-to-Market: Application development time can be reduced primarily due to the fact that applications are not be developed from scratch. Time-to-market can also be reduced by involving stakeholders, the commercial interested parties, transportation policy making bodies, academia, and industry experts early and throughout the development process. The time consuming process of sequential reviews can be abridged by the fact that the stakeholders and experts can get involved early and proactively during the development process.

Mitigating Security Risks: Typically, program security risks get exposed through time. Using open source from existing applications that have been time-tested will reduce overall risks. For data security, sensitive data is thoroughly access controlled. For elements of a project that are private or sensitive in nature, those gaining access to these elements must be carefully vetted and monitored.

Impacts during Development

Since there is no precedence for this type of application development, the construction of the OSADP system may have already had some immediate impacts on the current environment, as discussed below:

Bootstrapping Initial Portal Environment: The initial OSADP system is a critical first step for the DMA program. The portal system already has several applications of open source code in its code repository. Due to success of the initial implementation bootstrapping this environment to get more applications loaded was not necessary. As the community grows, more source code contribution from members is expected. Beyond the initial phase, application source code developed on the portal and other source codes have been populated into the repository.

Open Source Community Growth: The portal community will continue to experience a gradual growth period and the growth pace will depend on how proactive the community building activities by USDOT and stakeholders will be. The activities may include target outreach programs and promotion of special professional groups and associations.

OSADP System Enhancements: The first iteration of the OSADP system was very functional but it was not feature complete. Many enhancements were implemented but more new capabilities may take some time depending on budget and the nature of the requirement.

Operation and Maintenance Support: Long-term operation and maintenance support for OSADP will be outsourced to a contractor. Any new enhancements will need to be tested to ensure the features and capabilities are functioning as designed.

Governance and Licensing: Portal governance and policies were established and integrated into the system prior to the portal's first production use. The open source licensing model is unambiguous with sufficient instructions to the users. The legal aspect of open source licensing is often complicated and complex; the users appeared to understand the licensing requirements.

Chapter 7. Analysis of the Proposed System

Summary of Improvements

As stated in the SOW, the keys to the success of an open source program are:

- Development of governance and identification of licensing agreement
- Provision of well-documented core assets
- Deployment of secure infrastructure that facilitates collaboration and interaction

In addition, the USDOT ITS JPO initiated the DMA program to:

- Expedite the development, testing, commercialization, and deployment of transformative mobility applications by fully leveraging new technologies and federal investment.
- Enhance the mobility of individuals within the system.
- Reduce public and private sectors costs for research, development and testing of mobility applications by reducing duplicative efforts and avoid non-interoperable or proprietary technologies and control systems.

Taking these factors into consideration among several options for OSADP implementation, the choice should satisfy short- and long-term business as well as technical program goals, while allowing the open source community to thrive in an active and dynamic environment.

Disadvantages and Limitations

The following sections discuss several perceived disadvantages and limitations of OSADP. Some of these perceptions may change with time.

Disadvantages

Changes to the procurement process: To some, a disadvantage would be the fact that the procurement process, as we know it, will be changing significantly from how it operates today. As discussed in Section 5.5.2 above, a project in the DMA environment can be procured or come into existence in one of several ways. Procurement for Direct Management Approach project still follows the USDOT traditional process of bid and proposal however the Guided Management and Meritocratic Management Approaches will be run and operated by the community with minimal USDOT involvement. This change is a crucial paradigm shift that allows the open source movement ushering in different project management approaches to garner the synergistic power of the open source community. The initial unfamiliarity toward this new way of procurement should subside as stakeholders see the positive benefits that an open source environment can offer.

Separation from the USDOT network: Another possible perceived disadvantage is OSADP will be co-located in a cloud computing environment outside of the USDOT network. The USDOT network and system administration staff and contractors who traditionally manage these systems may not be directly involved in the daily operation of OSADP. These roles will likely be performed by an OSADP

management team, yet to be determined. The separation of OSADP from the USDOT network and its hosting on a computing cloud may be viewed by some as losing control of the environment. Cost savings, scalability, system security, and other benefits gained from cloud hosting should eventually address initial concerns.

Limitations

Not every flavor of programming language will be offered initially: It is early to determine what developmental resources will be made available, however, it is reasonable to speculate that the initial OSADP will not support all variations of programming languages. Typical and popular programming languages will be offered initially. As the program matures, and based on user demand, the OSADP development environment may offer additional programming languages supporting resources.

Primary language of OSADP will be English only: Even though membership of OSADP will be open to everyone on the Internet including international users, the primary language will be English only. Additional languages for the portal user interface and navigation may be augmented in the future. The portal management team will have to weigh actual user demand against the burden of hosting and maintaining the portal with multi-lingual capabilities.

OSADP will host mobility-related applications only: The DMA program delineates the type of application development projects that will be hosted on OSADP. Although OSADP may accommodate projects related to such programs as AERIS, it will unlikely expand to become more generic or broad in scope, such as might be found on Github™ or SourceForge™. Users in other communities, who have interests that align with mobility-related applications, will be welcomed on OSADP.

Alternatives and Trade-Offs Considered

The USDOT decision to develop mobility applications in an open source environment is part of its effort to support the *Open Government Directive* including the principles of transparency, participation and collaboration in supporting citizens. However, more specifically, the choice of developing mobility applications in an open source environment is driven by the vision and goals of the DMA program, which include a *commitment to open source development*. The decision to embrace open source is a new direction for USDOT in developing mobility applications. From this perspective, alternatives and trade-offs have already been considered, and this project is one of many that are moving down this new path.

Implementation options and alternatives for the OSADP system were discussed with USDOT and the final development platform, Github™ was selected.

References

A. USDOT Work Order with Statement of Work (SOW) for *Dynamic Mobility Applications Open Source Application Development Portal*
B. IEEE Standard 1362™ - 1998 (R2007): *IEEE Guide for Information Technology—System Definition—Concept of Operations (ConOps) Document*
C. *Task 3.1: Open Source Development Web Resources Scan Assessment Report*, dated 28 February 2011
D. *Task 3.2: Elicited User Needs for Open Source Portal Technical Memorandum*, dated 11 March 2011
E. *Task 3.3: OSADP Operational Scenarios,* dated 26 May 2011
F. *Open Technology Development Lessons Learned And Best Practices For Military Software, Version 1.0,* dated 16 May 2011

U.S. Department of Transportation
ITS Joint Program Office-HOIT
1200 New Jersey Avenue, SE
Washington, DC 20590

Toll-Free “Help Line” 866-367-7487
www.its.dot.gov

FHWA-JPO-17-488

U.S. Department of Transportation