Project Plan for The Interagency Fuels Treatment Decision Support System (IFT-DSS) Proof of Concept (POC) System

PROJECT DATA:	**Project Title:**	The development of an IFT-DSS proof of concept system; Phase IIIa of the Software Tools and Systems (STS) Study
	Project number(s):	909029
	Prepared by:	Tami H. Funk
	Client:	The Joint Fire Science Program (JFSP) – John Cissel JFSP Project Manager – Mike Rauscher
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	Contract period:	May 15, 2009 – May 31, 2010
	Project managers:	Tami H. Funk (STI); Mike Rauscher (JFSP)
	Project team leads:	Neil J. Wheeler (Principal Investigator, Task Leader, Scientific & Technical Advisor) Lyle R. Chinkin (Senior Advisor) Sean M. Raffuse (Task Leader, Scientific & Technical Advisor, External Communications) Steve Ludewig (Task Leader) Eric Gray (Task Leader) Judd Reed (Lead Architect) Steve Reid (Task Leader, Quality Assurance Lead) Dr. Stacy A. Drury (Senior Technical Advisor) Dr. Paul T. Roberts (Quality Assurance Officer)

BUSINESS NEED/PROBLEM STATEMENT:

Through the work performed during Phases I and II of the STS Study, a need has been identified to develop a decision support system and software framework that can provide organization, management, and access to the many software applications and data sources in the fire and fuels community. The IFT-DSS proof of concept (POC) will serve as a proof of concept system and will integrate selected existing vegetation data, vegetation simulators, fire behavior, and fire effects models into a common graphical user interface (GUI) that is accessible via the Internet.

PROJECT OBJECTIVES:

The objectives for the POC IFT-DSS are threefold:
(1) to provide the fuels treatment community with a proof of concept system capable of providing an organizational structure for a sub-set of commonly used software models, data, and tools;
(2) the POC system should be capable of performing a sub-set of the most commonly performed analyses for fuels treatment planning and will be immediately useful to the community; and
(3) to demonstrate the feasibility of the IFT-DSS; gain future support; begin to build a community of users and stakeholders.

CRITICAL SUCCESS FACTORS:

Internal success factors:

1) Design must be **practica**l.
2) Project **must stay on schedule –** any potential delays must be communicated to the PM immediately
3) Strong **team communication –** team must work together and communicate frequently
4) POC must be **functional and useful from a user perspective**

External success factors:

5) POC must be **user friendly** and straightforward
6) POC must be **useful early in the development process**
7) Must **demonstrate feasibility** and early success
8) External **communication and collaboration** with stakeholder communities must be strong and continuous

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PROJECT APPROACH:

The general IFT-DSS POC development approach will employ the following concepts:
• **User community engagement** (users will be engaged early and throughout the process to help ensure success; a system will be put in place to collect and quickly respond to user feedback; help build community and generate interest in the system)
• **Parallel development efforts** (the core system components: overall architecture, databases, data & services, and GUI will be developed in parallel by development teams working together)
• **Rapid prototyping** (web-based GUI mock-ups will be developed early and used as a platform to build upon as system features and functions are implemented; this will provide a way to share progress and to obtain user feedback.

PROJECT SCOPE: Summary of and task leaders for Phase IIIa of the STS Study (refer to Appendices for more specific task and staffing information):

- Task 1: Project Planning (*Tami Funk*)
- Task 2: Confirmation of POC Functionality & Continued Engagement With POC User Test Group (*Sean Raffuse*)
- Task 3: IFT-DSS Design (*Steve Ludewig*)
- Task 4: IFT-DSS Implementation (*Neil Wheeler*)
    - IFT-DSS Framework Development (*Judd Reed/Kevin Unger)*
    - IFT-DSS Database Development (*Eric Gray*)
    - IFT-DSS GUI Development (*Steve Ludewig*)
    - Data & Services Acquisition and Implementation (*Dana Sullivan*)
- Task 5: Testing & Quality Assurance (*Steve Reid*)
- Task 6: Documentation (*Neil Wheeler*)
- Community Development (*Mike Rauscher*)

SUMMARY SCHEDULE OF DELIVERABLES FOR SOFTWARE DEVELOPMENT TASKS:

Date	Deliverables (D) Milestones (M)	Activity or Item (Task #)
6/1/09	**D-Project Plan**	**This document delivered to client (Task 1)**
6/1/09	D-Progress Report	Progress report for May 2009
6/30/09	**D-Tech Memo**	**Documentation of POC functionality (Task 2)**
7/31/09	**D-Design Spec Doc**	**IFT-DSS design specification document (Task 3)**
7/31/09	**D-GUI Mock-ups**	**Web-based GUI mock-ups to serve as development platform (Task 3)**
8/31/09	D-Progress Report	Progress report for August 2009
9/30/09	D-Progress Report	Progress report for September 2009
10/31/09	D-Progress Report	Progress report for October 2009
10/31/09	**M-Interim Release**	**Planned interim release for super user group (Task 4)**
11/30/09	D-Progress Report	Progress report for November 2009
12/31/09	D-Progress Report	Progress report for December 2009
1/31/10	D-Progress Report	Progress report for January 2010
1/31/10	**M-Interim Release**	**Planned interim release for super user group (Task 4)**
2/28/10	D-Progress Report	Progress report for February 2009
3/31/10	D-Progress Report	Progress report for March 2009 including testing report **(Task 5)**
4/30/10	**M-POC Release**	**IFT-DSS POC release (Tasks 4,5)**
4/30/10	**D-User Documentation**	**User guide/help pages for IFT-DSS POC (Task 6)**
5/30/10	**D-System Documentation**	**Revised design specification document (Task 6)**
5/30/10	**D-Software Developer Guidelines**	**Documentation providing guidelines for integrating software applications into the IFT-DSS framework (Task 6)**
9/30/10	**D-IFT-DSS POC System Assessment**	**Documented assessment of the POC system (Task 1 of Phase IIIb)**

INFO. SYSTEMS REQUIREMENTS:

Preliminary list of IT/IS needs (to be finalized in design phase of project):

- dedicated development platform(s)
- dedicated server (s)
- specialty or additional software licenses
- website hosting

PUBLICATIONS REQUIREMENTS:

For publications staff review:

- Technical memorandum – documentation of POC functionality (6/30/09)
- Design specification document (7/31/09)
- User documentation (4/30/10)
- System documentation (5/30/10)
- Software developer guidance document (5/30/10)

ASSUMPTIONS:

- Timely cooperation from developers of proposed software applications and data providers
- POC implementation will meet IT requirements & constraints of the final hosting agency – The current requirements of USDOI-Bureau of Land Management and USDA-Forest Service are under review.

RISKS (Mitigation Strategy):

- Misunderstanding community needs (frequent engagement of the user community)
- Inadequate design (consider fully-implemented system in design phase)
- Routine development problems (rapid problem solving process and/or work around approach; "red alert" meetings)
- Failing to demonstrate progress (monthly progress reports; meet project deliverables and deadlines; communicate issues immediately)
- Lack of community participation (proactively engage community early and persistently)
- Incorrect or missing documentation (establish relationships with the science and development community)
- Access to component models and data (establish relationships with the science and development community)
- Changes to component models and data (establish relationships with the science and development community)
- Lack of internal coordination (weekly project meetings; communication mechanisms; close monitoring)
- Not meeting community needs (frequent engagement of the user community; rapid prototyping approach; engage users throughout development process)

PROCUREMENT PLAN:

Lead: Neil Wheeler (working with Matt Beach)
Hardware and/or software needs will be identified (6/30/09)
Hardware and/or purchases will be made (7/5/09)
Development platforms will be established and functional (7/20/09)

QUALITY PLAN:

Lead: Steve Reid (working with Paul Roberts and Dana Sullivan) will be responsible for scientific integrity of system outputs, unit testing, system testing, and the overall quality of the IFT-DSS POC. Refer to Appendix E of this project plan for the quality assurance plan.

Appendix A: Statement of Work

This section provides a conceptual statement of work for the IFT-DSS POC development. Note that this statement of work reflects the proposed IFT-DSS functionality and that this is currently being developed and refined as a result of Task 2 part of which is to confirm that what we propose will be immediately useful to fuels treatment specialists.

<u>Overview of the IFT-DSS POC System Functionality</u>

The IFT-DSS POC development effort will span approximately one year beginning in May 2009. The POC system will contain a subset of the functionality described in the STS Study Phase IIIa Task 2 Technical Memorandum entitled *Refined Work Flow Scenarios and IFT-DSS POC Functionality*. We realize that in order for the IFT-DSS to gain ongoing support and adoption, the POC system must be immediately useful and address one or more of the most common work flow scenarios. Based on user feedback, discussions with developers, and input from the POC Test User group, we are proposing to implement the following three work flow scenarios (to varying degrees) in the POC system: 1) the data acquisition and preparation work flow scenario, 2) the strategic planning work flow scenario, and 3) the prescribed burn work flow scenario. In addition to the existing software models and data listed above, a sophisticated GIS-based tool will be developed to view, select, manipulate, calibrate, and edit raster and polygon data. This tool will be sophisticated enough to handle the necessary data conversions and formatting required to make data transfers and conversions seamless. The tool will also generate .LCP files, a common data format for several fire behavior models including FlamMap.

Several key data sources, tools, and models will be implemented in the IFT-DSS POC during the first year of development. The implementation of these elements will be staged in a way that allows the POC Test User group to periodically view the progress and provide feedback on distinct system functionality. Figure A1 shows an overview of the data, tools, and models that are proposed for the IFT-DSS POC and the approximate timeline for implementation of the functionality and work flow scenarios.

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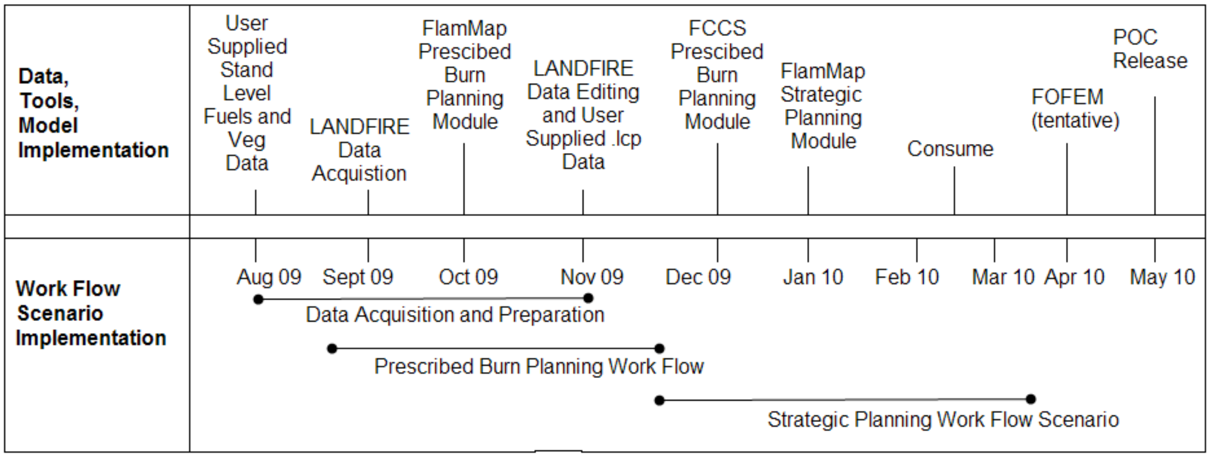


Figure A1. Target schedule and software tools implementation timeline for the IFT-DSS Proof of Concept. Data and Software Tools Implementation will begin in Aug 2009 and continue until May 2010.

Implementation will begin with the ability to access LANDFIRE National data for use with fire behavior and fire effects models. The LANDFIRE data will serve as the main data source for the strategic planning work flow scenario in the POC and will be the default data set for the prescribed burn planning scenario. Next, FlamMap will be implemented to simulate fire behavior in the prescribed burn planning work flow scenario. Following implementation of the prescribed burn planning scenario using FlamMap, the FCCS will be implemented as an alternative pathway for simulating fire behavior for the prescribed burn planning scenario. As the POC develops, data editing and user input functionality will increase providing the user with the ability to upload local data and/or to modify existing LANDFIRE data layers.

In the POC system, FlamMap will also be implemented to simulate fire behavior for strategic planning. Later in the development of the POC system, fire effects models will be added: initially Consume, and then as time permits, FOFEM.

Although not shown in Figure A1, the IFT-DSS development team is currently working closely with the INFORMS team to gain access to data (FSVeg) and software applications (yeImpute and FFE-FVS) that comprise the INFORMS system. The tentative plan is to stage the implementation of these tools immediately following the implementation of the strategic planning work flow scenario to support the use of tree-list vegetation and fuels data.

POC System Functionality - Data Acquisition and Preparation Work Flow Scenario

In the IFT-DSS POC, the data acquisition functionality will provide the user with access to LANDFIRE National data and/or the ability to import local data in LANDFIRE-like format (landscape, .lcp files). The LANDFIRE National data will be implemented first followed by import functions to upload local LANDFIRE-like data. As the POC is developed, additional functionality such as the ability to edit LANDFIRE data for local conditions will be added.

The current plan is to include the tree-list-FVS pathway shortly after the LANDFIRE pathway is fully functional; however, this is likely to be implemented early in year two (2010) due to data availability and software development issues.

POC System Functionality – Prescribed Burn Planning Work Flow Scenario

The IFT-DSS POC will have two options for performing fire behavior simulations: 1) running FlamMap for a single point location, and 2) the FCCS fire behavior calculator. For both options, users will input data parameters such as wind, fuel models, fuel moisture, and fuel loadings manually. If a user selects the FlamMap pathway, FlamMap will function behind the scenes on a point location. In the FCCS pathway, the FCCS fire behavior calculator will function on individual fuelbeds. Fire effects will be simulated using either Consume or FOFEM. Simulations of possible fire behaviors provide essential information for describing the burn plan prescription (Element 7), the ignition plan (Element 15) and the holding plan (Element 16).

<u>FlamMap pathway</u>

Using the FlamMap pathway in the POC, the user will input data parameters required by FlamMap. FlamMap outputs will include: fireline intensity, flame length, rate of spread, heat per unit area, horizontal movement rate, midflame windspeed, spread vectors, and crown fire activity as this information is crucial to determining how and when a prescribed burn should be conducted to meet specific objectives. As mentioned previously, Consume and FOFEM will be added to provide information about fire effects.

The POC will allow users to use the LANDFIRE National data layers for this workflow scenario if needed. To do this, the user will need to specify the prescribed burn geographic coordinates. The appropriate data will be retrieved and the fire behavior and fire effects programs will simulate fire behavior and fire effects for the specified geographic location. Figure A2 summarizes the process steps in this pathway.

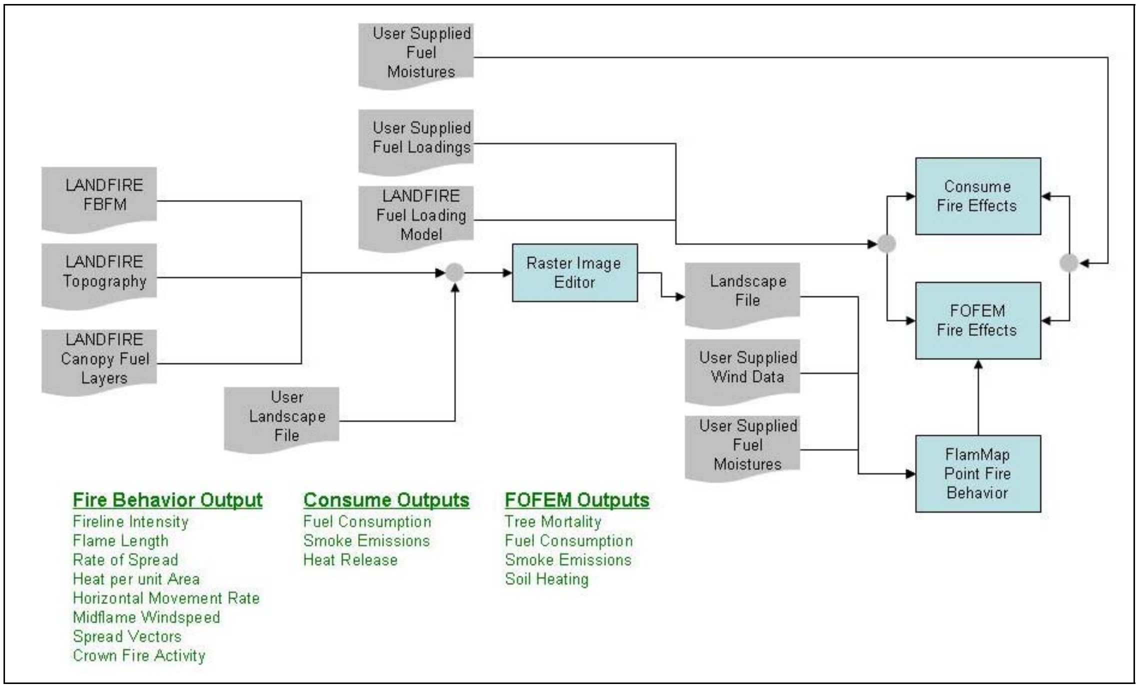


Figure A2. IFT-DSS POC Prescribed Burn Planning Work Flow Scenario. Option 1 – the FlamMap pathway. Initial functionality will provide fire behavior output for prescribed burn planning. As functionality is increased the ability to estimate fire effects using Consume and FOFEM will be supported.

Fuels Characteristic and Classification System (FCCS) Pathway

The POC will provide the surface and crown fire behavior outputs currently found in the desktop version of the FCCS. Of most use for prescribed burn planning are: reaction intensity, flame length, rate of spread, and crown fire potential. Figure A3 summarizes the FCCS option for meeting the prescribed burn planning work flow scenario needs and provides more information about the data inputs and specific fire behavior outputs from the FCCS calculator.

In the POC, users will have the ability to enter fuelbeds manually into the FCCS similarly to how fuelbeds are manually entered into the current desktop version. In addition, a default set of gridded fuelbeds will be provided. As functionality increases users will have the ability to manually edit fuelbeds within the FCCS using a FCCS fuelbed editor similar to what is available in the stand alone version of the FCCS; however, this functionality may not be available in the POC at the end of year 1 development.

In addition to fire behavior, the FCCS pathway will eventually include linkages to Consume and FOFEM. The Consume outputs (fuel consumption, smoke emissions, and heat released) or the FOFEM outputs (tree mortality, fuel consumption, smoke emissions, soil heating) provide information to address how a burn should be conducted to meet the prescribed burn objectives described in the burn plan.

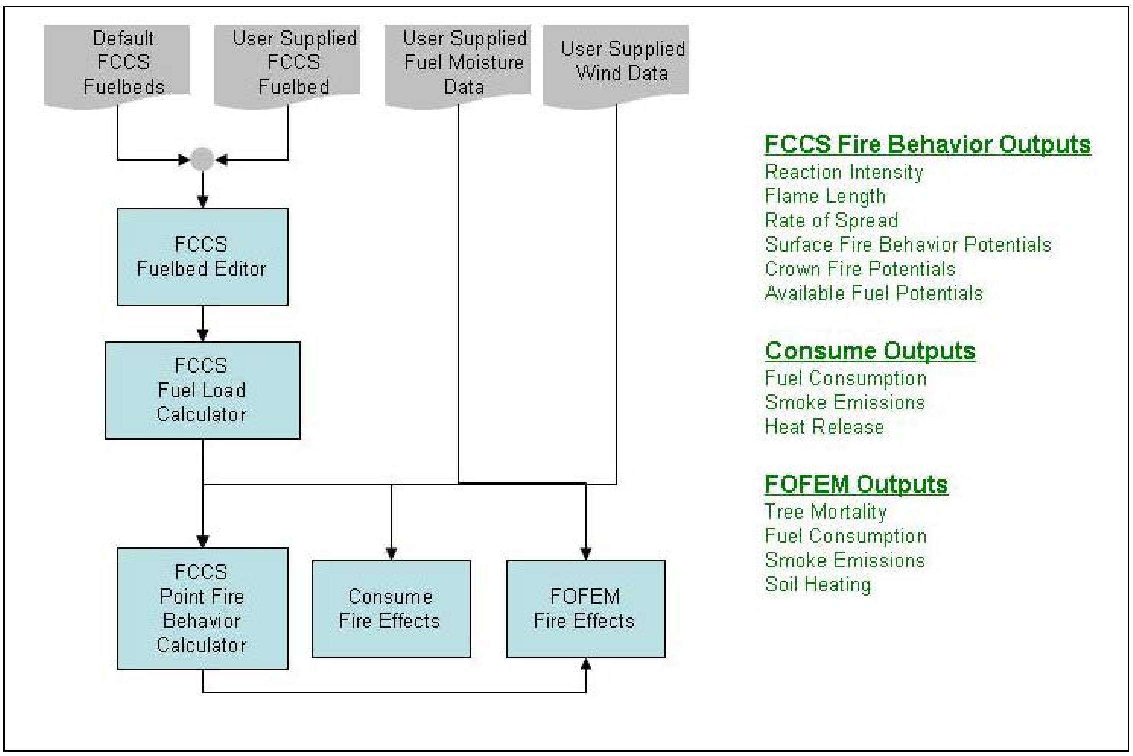


Figure A3. IFT-DSS POC Prescribed Burn Planning Work Flow Scenario. Option 2 – the FCCS pathway. Initial functionality will provide fire behavior output for prescribed burn planning. As functionality is increased the ability to estimate fire effect using Consume and FOFEM will be supported.

POC System Functionality – Strategic Planning Work Flow Scenario

In the IFT-DSS POC, FlamMap will be implemented to perform fire behavior simulations across all pixels in an area of interest. Once FlamMap is functional, work will begin to implement the fire effects models Consume and FOFEM. Consume will be implemented first, followed by FOFEM.

FlamMap fire behavior outputs include: fireline intensity, flame length, rate of spread, heat per unit area, horizontal movement rate, midflame windspeed, spread vectors, and crown fire activity. Consume fire effects outputs are fuel consumption, smoke emissions, and heat release. While FOFEM simulates tree mortality, fuel consumption, smoke emissions, and soil heating. Figure A4 summarizes the strategic analysis work flow scenario as proposed for the POC.

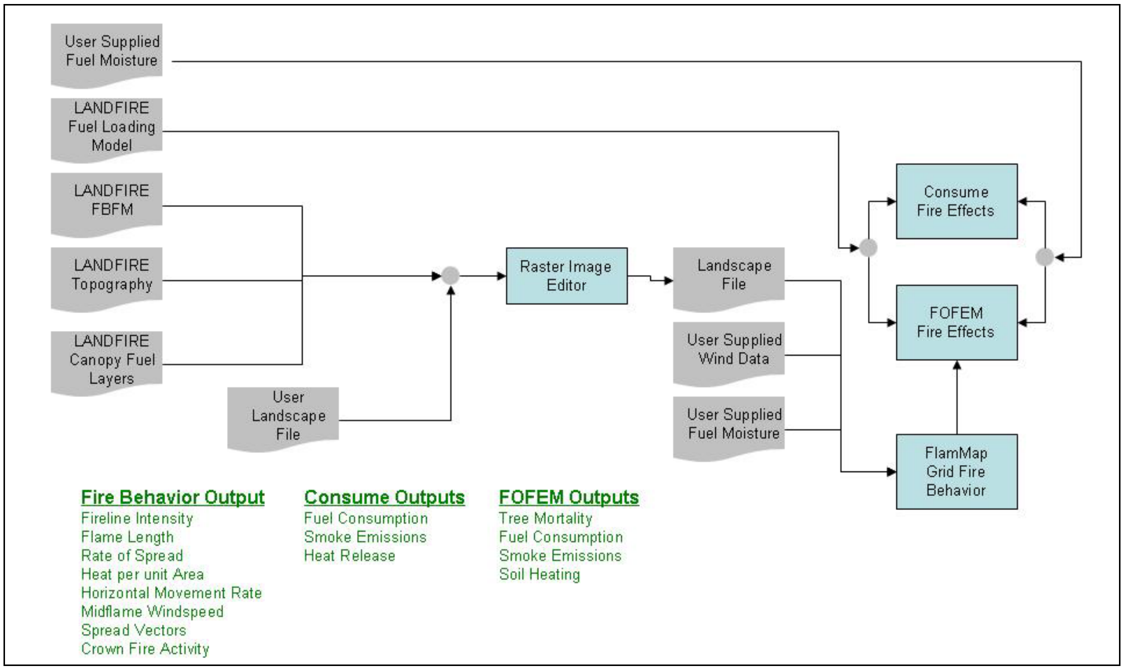


Figure A4. IFT-DSS POC Strategic Planning Workflow Scenario: Option 1. The FlamMap pathway. Initial functionality for the proof of concept will support the use of LANDFIRE National Data. As functionality is increased users will be able to upload LANDFIRE-like data and edit existing LANDFIRE data. In option 1 FlamMap will be the fire behavior engine. Later POC implementation will include the fire effects models Consume, and FOFEM.

Overview of Fully Functional IFT-DSS

Figure A5 illustrates how the work flow scenarios described above fit within the fully functional IFT-DSS.

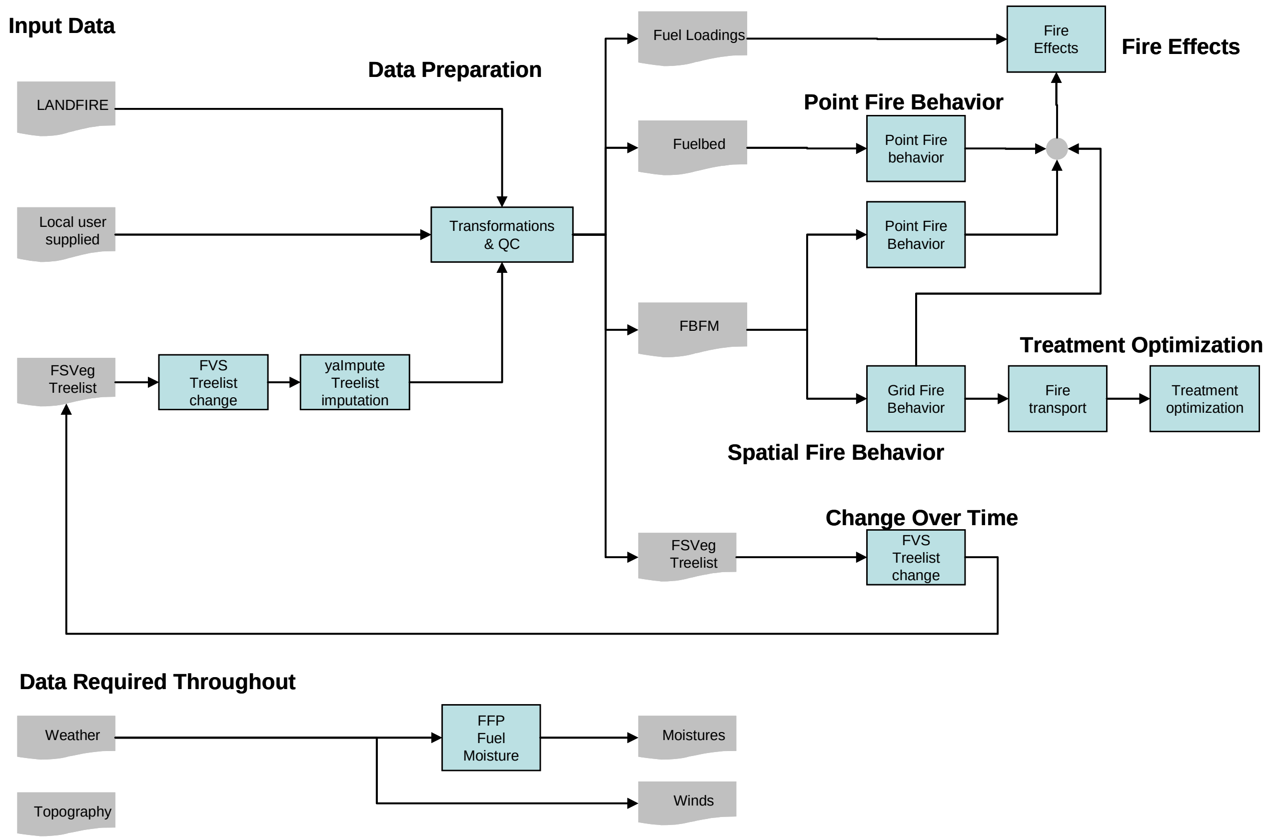
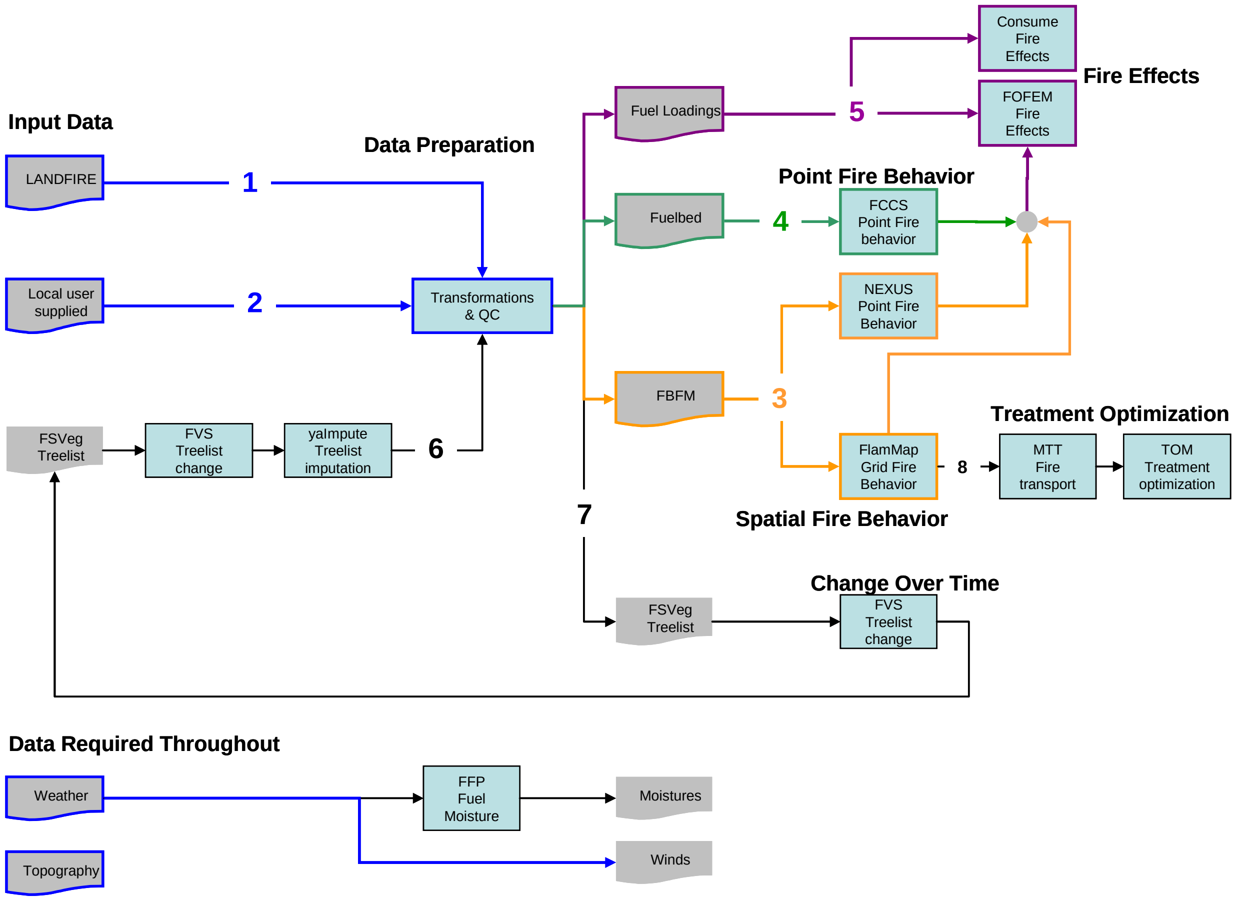


Figure A5. Overview of how the fuels treatment planning work flow scenarios fit within the fully functional IFT-DSS.

Overview of the Proposed IFT-DSS POC

The ultimate goals for the IFT-DSS POC at the end of the first year (May 2010) are to demonstrate the feasibility of the system and to deliver a product that is useful for the fuels treatment planning community. To maximize the functional capabilities of the POC within the limited, one-year time frame, we have tentatively chosen to focus on the implementation of three input data types and three work flow scenarios. **Figure A6** illustrates the pathways (colored lines) and the order of implementation (numbers) proposed for the POC during the first year of development.



FigureA6. Illustration of the pathways (colored lines) and implementation order (numbers) proposed for the IFT-DSS POC.

The pathways indicated by black numbers are proposed for the second year of development. It should be noted that the risk assessment work flow scenario is not shown on this diagram; however, the tentative plan is to implement that portion of the system in the third year of development.

The implementation plan and priority for the POC system and the implementation approach presented here is based on a variety of factors. The following summarizes the rationale for the proposed POC implementation approach in the context of the two key objectives of the POC which are to demonstrate the feasibility of the IFT-DSS and to deliver a product that is useful for the fuels treatment planning community. To satisfy these objectives, we have chosen to implement those work flow scenarios that have been identified as the most immediately relevant based on feedback from the fuels treatment planning community: (1) data acquisition and preparation, (2) the strategic planning work flow scenario, and (3) the prescribed burn planning work flow scenario.

For the data acquisition and planning work flow scenario, we have initially chosen to focus on three types of data for input and preparation: (1) manually entered data for a single treatment unit analysis, (2) local data in .LCP file format that can be uploaded to the system, and (3) LANDFIRE National default data. These data choices will allow the IFT-DSS POC development team to implement useful, complete workflow scenarios rather than focus all efforts on implementing both data types (gridded LANDFIRE and tree-list) at the risk of not being able to implement complete work flow scenarios at the end of the first year. We chose to start with user-provided .LCP file formats and the LANDFIRE National data set because .LCP files are commonly used for fuels treatment planning and can be developed from tree-list data for importation to grid-based fire behavior applications such as FlamMap. In addition, the LANDFIRE National data are available for immediate use, and the data set provides complete coverage of the United States and is suitable for use in the strategic planning work flow scenario. The LANDFIRE data set also provides fuel information for non-forested areas.

Implementation of the tree-list data pathway is tentatively planned early in the second year of development because we are currently working with the INFORMS team to acquire the necessary data, software tools, and algorithms needed for implementing the tree-list pathway. FSVeg data are currently expected to be available for access outside the Forest Service firewall sometime between fall 2009 and spring 2010.

We have chosen to implement the software applications indicated in Figure 3-6 because (1) they have been identified as widely adopted and used by the fire and fuels community, and (2) they are likely to be the most technologically feasible for implementation into the system in the first year of development.

POC Implementation Plan

The IFT-DSS POC implementation will be completed in the following seven general tasks:

Task 1 – Project Planning

Task 1 will involve scoping and planning for the IFT-DSS software development effort. Planning activities will include assembling the project team, scoping out and scheduling the work to be performed in Tasks 2 through 6 and preparing a project plan.

Task 1 Deliverable: Project Plan.

Task 2 – Confirm the Functionality of the Proposed IFT-DSS POC and Continued Engagement with the POC User Test Group

A key aspect of the POC development effort is the continued engagement of the IFTWG and consensus that the IFT-DSS POC will fulfill, as well as possible, the most urgent needs of fuels treatment practitioners. To ensure that the vision for the IFT-DSS POC is consistent with user needs, the draft design specification and user interface design for the IFT-DSS POC will be shared with the group for input and feedback and will be modified as needed to ensure that the IFT-DSS POC will be immediately useful for fuels treatment practitioners. A sub-group of the IFTWG will also serve as the first users of the system.

Task 2 will involve confirming the proposed functionality of the IFT-DSS POC and the use cases that it will address with field practitioners. This will involve assembling a group of fuels treatment specialists and soliciting their review and input on the use cases and the functionality proposed for the POC. We will also solicit review and feedback from the science and software developer community through in-person meetings at the Pacific Northwest and

Missoula Fire Labs. Based on feedback provided, we will refine the conceptual design of the POC and prepare a technical memorandum discussing the revised proposed POC specifications and the use cases and the specific questions/functions that the system will address.

Another aspect of this task will be to continue to engage the POC user test group throughout the IFT-DSS POC development process by soliciting feedback on the IFT-DSS graphical user interface and on the actual system as functionality is added throughout the year. A discussion forum has been established on the FRAMES website that will serve as a feedback and discussion portal for the IFT-DSS. Stacy Drury of STI will lead the effort to interact with the POC test user group.

Task 2 Deliverable: Technical Memorandum. Milestones: ongoing engagement of the POC test user group.

Task 3 - Develop the user interface design, and web-based graphical user interface mock-ups and the IFT-DSS POC design specification

Prior to implementing the IFT-DSS POC, a software system design specification document will be developed. The design specification document will be based on the strategic architecture design produced in Phase II of the STS Study. The IFT-DSS POC design specification will include detailed technical specifications that will be followed during implementation including the back-end system design and the graphical user interface design. The graphical user interface will be designed and developed in parallel with the IFT-DSS POC system. Web-based user interface mock-ups will be developed and will be shared with the user community for review and feedback in parallel with the development of the IFT-DSS back-end system. The web-based GUI will serve as a development platform and as a mechanism to engage the user community early.

Task 3 Deliverables: One draft and one final design specification document; web-based graphical user interface mock-ups.

Task 4 – Implementation of the IFT-DSS POC

Upon acceptance of the design specification document (Task 3), STI will implement the IFT-DSS POC. We propose to use a phased, rapid-POC approach during application development. Conceptually, rapid-prototyping involves dividing the system implementation into discrete elements so that individual processes and/or modules can be developed, rapidly tested, and refined during the implementation process. When a process or module is acceptably functional, it can then be connected to its neighboring processes. The benefit of rapid-prototyping is that individual system components can be made accessible and tested during early development to ensure that the components are functioning properly from technical and user perspectives. At the onset of implementation, a small group of fuels treatment specialists will be identified and asked to periodically review system components throughout the implementation phase.

STI assumes that the IFT-DSS POC will reside on a server(s) hosted by STI throughout POC development and that STI will host the IFT-DSS POC for a period of one year beyond the POC development period.

Task 4 Deliverable: Functional draft IFT-DSS POC hosted by STI and available via the Internet.

Task 5 – Testing and Quality Assurance of the IFT-DSS POC

Upon completion of the IFT-DSS POC development, STI perform in-house unit and system quality assurance and software testing. Following the in-house testing, STI will make the system available via the Internet to a group of fuels treatment specialists who will test and provide feedback on system performance and/or possible refinements to the system. A prioritized list of system modifications will be compiled and implemented under the direction of the JFSP manager. Following the testing and refinement period, a final version of the IFT-DSS POC will be made available via the Internet and will be hosted at STI for a period of one year following POC development.

Task 5 Deliverable: Functional IFT-DSS POC hosted at STI and available via the Internet.

Task 6 – Document the IFT-DSS POC System

In parallel with the implementation of the IFT-DSS POC system, user documentation and help pages and technical system documentation will be developed. The user documentation will mainly exist as electronic help pages within the IFT-DSS POC. The final technical system documentation will be a revised and updated version of the system design specification document developed in Task 3. The user documentation is intended to serve the end users of the system. The technical documentation is intended to serve future developers or maintainers of the system.

Task 6 Deliverables: one draft and one final version of the technical system documentation; one draft and one final version of the user guide and/or electronic help pages. Guidelines for software developers to integrate applications with the IFT-DSS will also be provided.

Phase IIIa Schedule

We anticipate that the implementation of the IFT-DSS POC will span one year beginning in May 2009. Figure A5 shows a schedule for the proposed implementation schedule of tasks and deliverables for the first year POC development. We have assumed a project start date of May 15, 2009. Refer to Appendix C for a more detailed task schedule.

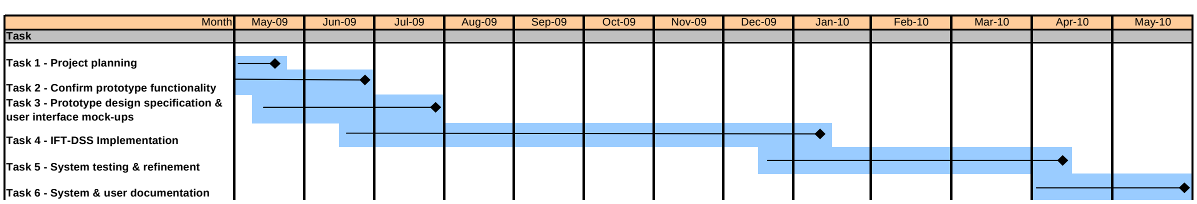
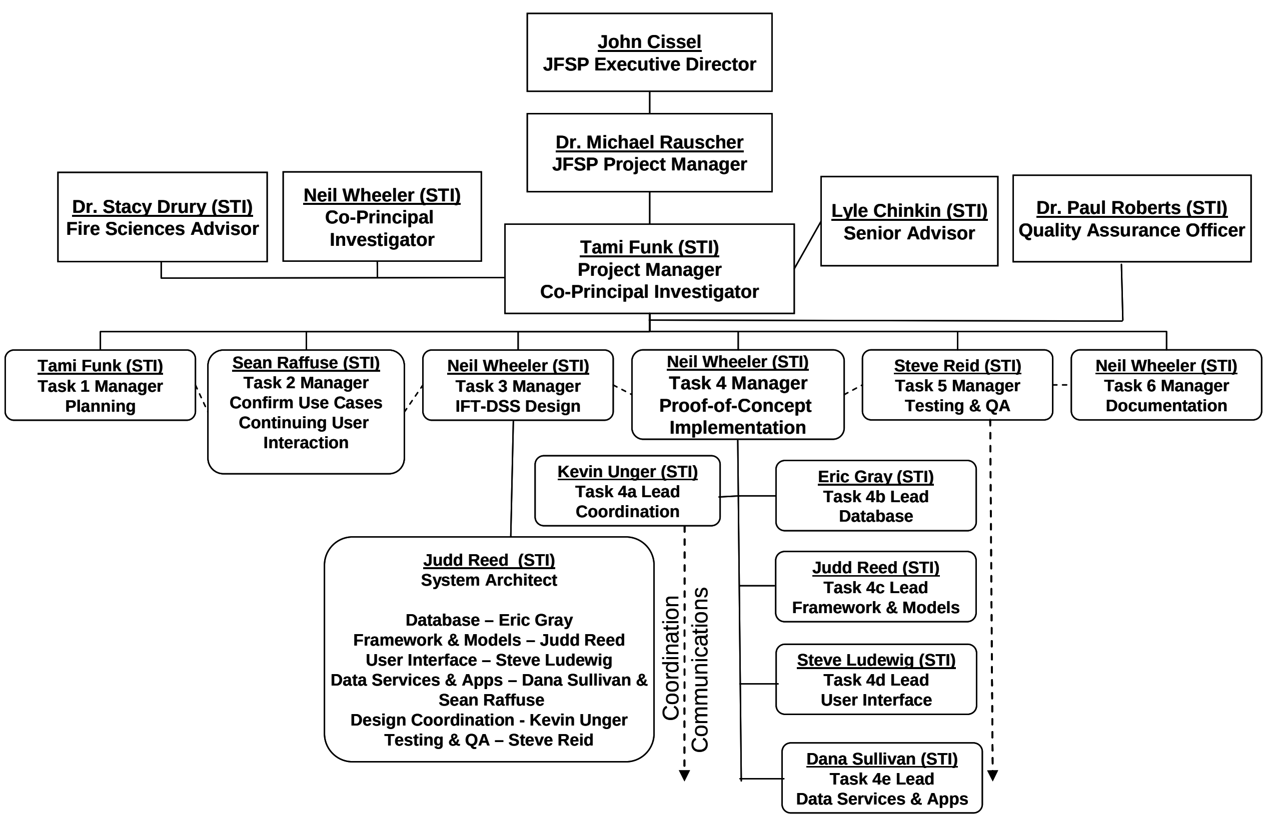


Figure A5. Proposed project schedule including tasks, milestones, and deliverables.

Appendix B: Organizational Structure and Staffing Plan

The figure below illustrates the organizational structure and staffing plan for Phase IIIa of the STS Study. Biographical paragraphs for each of the task leaders identified in the organizational chart are also included in this section. Complete resumes for STI staff can be viewed at http://www.sonomatech.com/resumes.htm.



Biographical Paragraphs for the Phase IIIa Task Managers and Key Staff

Tami H. Funk – Ms. Funk will serve as STI's Project Manager and Co-Principal Investigator (Co-PI) for Phase IIIa of the STS Study. Ms. Funk joined STI in 1996. Her primary duties are project management and the use of technology-based tools to display, develop, and analyze environmental data. Ms. Funk has served as STI's Project Manager for Phase II of the STS Study to develop a software architecture for the IFT-DSS. She is currently involved in several projects that require the development of software systems to support environmental data analysis and decision-making, including the STS Study for the Joint Fire Science Program and a software design for a Fire and Fuels Application for the Fire and Environmental Applications Team within the U.S. Forest Service. Ms. Funk also contributes to projects that combine and analyze data to support environmental decision-makers, including regional and national air monitoring network assessments and emission inventory studies. Ms. Funk's background includes using spatial analysis techniques to quality assure, analyze, and develop applications for displaying and manipulating environmental data. Her background involves mapping air quality data using statistical techniques, developing spatial data for use in epidemiological studies, and developing new methods for improving the quality and representativeness of emission inventory data.

Neil J. Wheeler – Mr. Wheeler will serve as Co-PI and Task Leader for Phase IIIa of the STS Study. He will serve as the main point of contact at STI for any agency IT/IS-related issues. Mr. Wheeler joined STI in 1999 and currently serves as STI's Senior Vice President for Atmospheric Modeling and Information Systems. He is responsible for planning and leading air quality modeling studies and software development projects as well as the application of meteorological and air quality models for use in regulatory and research studies. As an officer of STI, Mr. Wheeler has oversight responsibility for all of the company's information systems and related infrastructure. He has 35 years of practical experience in the atmospheric sciences and more than 25 years of experience developing, applying, and evaluating meteorological and air quality models. The American Meteorological Society awarded him the designation of Certified Consulting Meteorologist (No. 529). Mr. Wheeler also serves as a member of the External Advisory Committee to the Community Modeling and Analysis System, which maintains the Community Multiscale Air Quality (CMAQ) model and the Sparse Matrix Operator Kernel Emissions (SMOKE) processing system for the U.S. Environmental Protection Agency.

Lyle R. Chinkin – Mr. Chinkin is STI's President. He will serve as the Corporate Senior Advisor to the project. This will ensure that the IFT-DSS project receives appropriate resources at the highest levels within the company. Mr. Chinkin has served on a number of national peer review panels, including the National Research Council of the National Academy of Sciences Committee on the Effects of Changes in New Source Review Programs for Stationary Sources of Air Pollutants and a panel to review "Improving Emission Inventories for Effective Air Quality Management Across North America, a NARSTO Assessment" (2005). He was invited by the EPA to be an external peer-reviewer of the 2006 EPA Report on the Environment. He is a nationally recognized expert in air quality analysis and emission inventory preparation and assessments. He has worked on projects for federal, state, and local government agencies; universities; public and private research consortiums; and major corporations. Mr. Chinkin's areas of expertise include (1) developing and improving regional emission inventories; (2) providing independent assessments of emission inventories using bottom-up and top-down evaluation techniques; (3) conducting field studies to obtain real-world data and improve activity estimates and emission factors; (4) conducting scoping studies to develop conceptual models of community-scale air quality; (5) assisting with State Implementation Plan (SIP) development; and (6) providing expert testimony and presentations to public boards.

Dr. Paul T. Roberts - Dr. Roberts joined STI in 1986, and is STI's Executive Vice President. Dr. Roberts has designed and managed many air quality field, data management, and data analysis projects. Besides serving as STI Executive Vice President, Dr. Paul T. Roberts also serves as STI's Corporate Quality Assurance Officer (QAO). As the QAO, Dr. Roberts is responsible for formulating STI's quality systems and directing their implementation. During his career, Dr. Roberts has been involved in a wide range of quality assurance activities, including drafting Quality Assurance Project Plans to meet EPA guidelines, managing systems and performance audit contractors and reviewing their work, leading projects to develop procedures to estimate data quality summary reports for large field studies, and ensuring that the data from field and data analysis projects meet their data quality objectives. For STI, Dr. Roberts has lead the scientific and quality review of STI proposals, reports, and other products for over 10 years.

Sean M. Raffuse – Mr. Raffuse is the Fire Sciences Program Coordinator and a Senior Air Quality Analyst at STI. He will serve as a Task Leader and external communications liaison for the IFT-DSS project. Mr. Raffuse will serve as STI's main point of contact for the developer community. Mr. Raffuse creates and applies geospatial analysis techniques, develops web-based and desktop Geographic Information System (GIS) tools, and explores methods to apply satellite data to air quality applications. Mr. Raffuse has participated in the design and development of several software products and decision support systems including the BlueSky Framework which provides a software framework for modeling smoke impacts from wildfires and the AIRNow-Tech Navigator, a web-based GIS tool that displays hourly pollutant, wildfire, and meteorological information collected from the AIRNow program in an interactive geographic context in near real time. He designed the Satellite Mapping Automatic Reanalysis Tool for Fire Incident Reconciliation (SMARTFIRE) algorithms. SMARTFIRE uses GIS technology to combine satellite-detected fire information and ground-based fire reports and reconciles them into a unified data set for input to BlueSky.

Judd Reed – Mr. Reed joined STI in 2007 as a software engineer in the Information Systems Group. He has been the principal architect of systems ranging from complex software systems to data acquisition and electromechanical controls hardware for specialized instrumentation. Mr. Reed has more than 25 years of experience developing scientific visualization and analysis software. He has worked extensively in satellite remote sensing as well as computed tomography (CT) and other imaging techniques used in the medical field. He is proficient with a wide variety of systems and programming languages (including C#, C++, C, Assembly, Java, VB.net, Perl, and Python). In addition to developing scientific visualization and image processing tools, Mr. Reed has significant experience leading diverse, cross-functional teams and facilitating effective communication among scientists, engineers, and other highly specialized professionals. Prior to joining STI, Mr. Reed was the Director of Software Development at Image Analysis, Inc. He was responsible for the company's line of CT quality control and quantitative density assessment products. He also worked for nearly 15 years at the Mayo Clinic in Rochester, Minnesota, where he held titles of Programmer Analyst, Sr. Programmer Analyst, Informatics Team Leader, and Investigator. He developed the first clinically viable tool to use CT to measure the mass and density of calcified lesions in the coronary arteries.

Kevin Unger - Mr. Unger joined STI in 2008. He will serve as the Task Leader for the architecture framework development. Mr. Unger is currently working on projects for the U.S. Forest Service's Fire and Environmental Research Applications team (FERA), including a redesign of the Fuel Characteristic Classification System (FCCS), and the development of a new software tool that integrates the processes of the FERA tools. Mr. Unger has been designing and developing software for 22 years. He made major contributions to various CAD and 3D graphics systems in C/C++ on UNIX platforms before moving into server-side business and web application development in Java and Python. Mr. Unger was a member of the core team of developers of the seminal Computervision CADDS4X CAD/CAM application, written in C, that ran on Sun workstations. Mr. Unger architected and developed an integrated version of a suite of graphics animation tools at Wavefront Technologies, Inc. The Advanced Visualizer animation toolset was the industry's first off-the-shelf, high-end solution for computer graphics animations that was used widely by most of the television networks and movie post-production shops. Mr. Unger was a significant contributor to AutoCAD, the industry standard PC CAD application developed by AutoDesk, Inc. He helped design a new version of the 3D graphics API used by third-party vertical market applications built on the AutoCAD platform, and he added 3D concave polygonal clipping to AutoCAD. Another major project Mr. Unger worked on was the conception, design, and development of an entire business workflow automation product, MobileForm, which is a distributed system, with clients that run on many platforms including wireless handheld devices, a desktop monitoring and control application, and a web-based server that accommodates plugin modules to access various business databases and applications.

Steve A. Ludewig – Mr. Ludewig manages STI's Web Services Group, which focuses on the design, development, and operation of web-based software applications. He will serve as the Task Leader for the graphical user interface design and development for the IFT-DSS. He has extensive experience designing and developing dynamic, database-driven websites displaying real-time data, geographic information systems (GIS), and tools for environmental data analysis. Mr. Ludewig has been involved in the EPA's AIRNow decision support system program since 2001, both as a project manager and software engineer, and has had a key role in the development and operation of applications such as AIRNow-Tech (including the Forecast Submittal System and Navigator), AIRNow Gateway, Notifier, AirShare, AIRNow International, and EnviroFlash. He is currently involved in the design and implementation of newer methods and technologies (e.g., Web 2.0) for sharing air quality information; these include standardized web services, geospatial web services conforming to Open Geospatial Consortium (OGC) standards, data feeds, social networking tools, and the creation of Keyhole Markup Language (KML) outputs for viewing data in mapping tools such as Google Earth and Google Maps.

Eric A. Gray – Mr. Gray is the Systems Engineering Group Manager at STI. He will serve as the database development Task Leader for the IFT-DSS. Mr. Gray has over 25 years of experience in project management, software engineering, and database development. His special interest and expertise lie in scalable database architectures. Mr. Gray designed and developed AIRNow's decision support system architecture, the system's Oracle database, and its automatic data processing and quality control software. The system has been running since summer 2001 and has successfully processed hundreds of millions of data records. He is currently completing the Data Management System (DMS) for quality control of data from monitoring sites for the Bay Area and South Coast Air Quality Management Districts. Mr. Gray has extensive database design and implementation experience for a wide variety of applications such as environmental data, customer support, medical imaging, inventory, payroll, human resources, purchase order, contract estimation, and industrial and scientific equipment control systems. Mr. Gray has worked as a software engineer using C#, Java, C++, Oracle, and MS SQL Server.

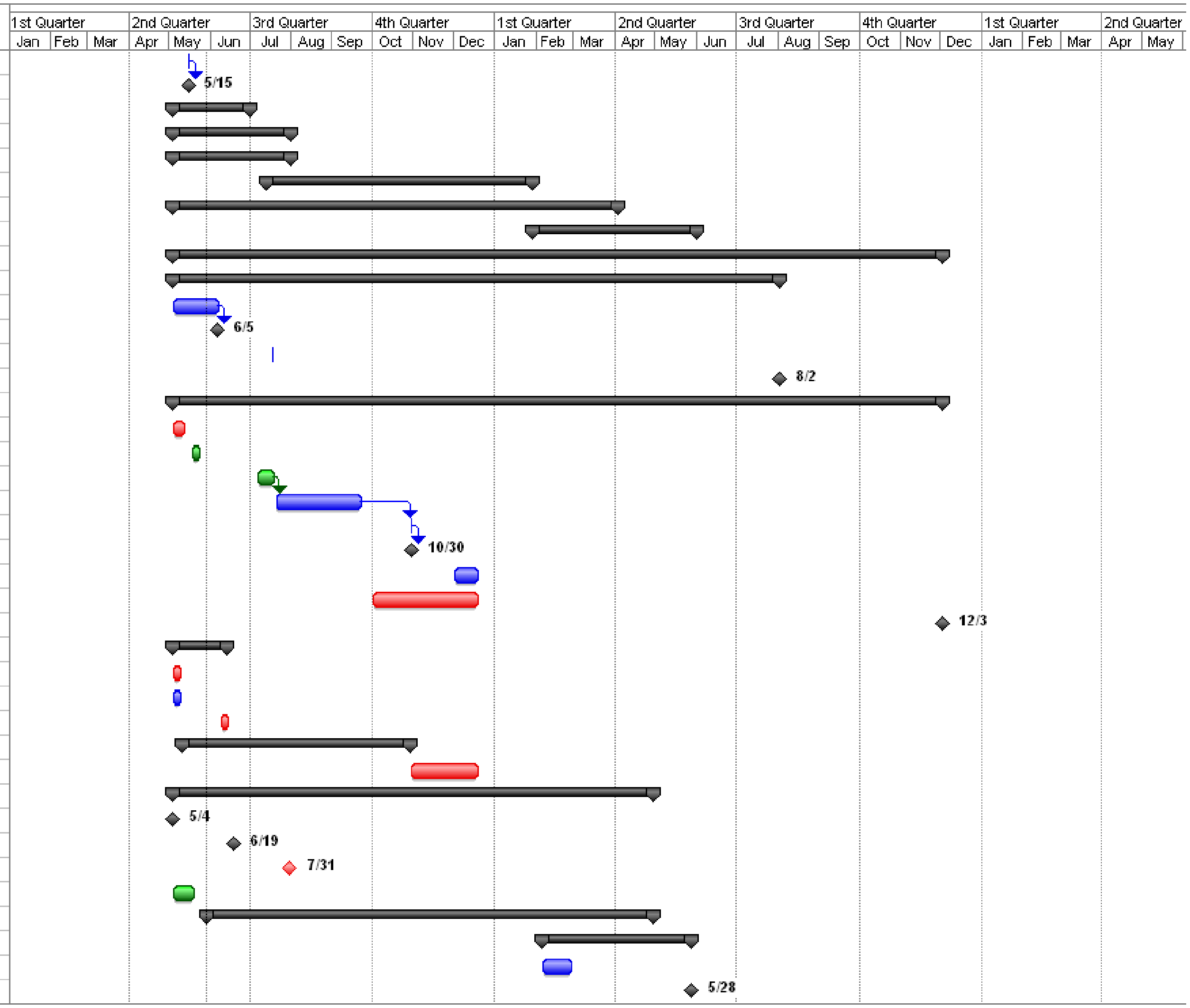
Dana C. Sullivan - Ms. Sullivan joined STI in 1995. She will serve as a Task Leader for the IFT-DSS and will be responsible for ensuring that the software applications and data that are integrated in the IFT-DSS are implemented properly. Her work has focused on emissions studies, including emission inventory development, emissions data analysis, development of emissions guidance, software design, and measurement of emission factors and activity levels. Currently, Ms. Sullivan is managing a large project for NASA to expand the BlueSky System—a decision support system for predicting the emissions and air quality impacts of wildland fires. She is also managing a project for the Fire and Environmental Applications (FERA) Team within the U.S. Forest Service to redesign the Fuel Characteristic Classification System (FCCS) and to develop a software architecture design for a Fire and Fuels Application (FFA) that integrates the four main software products developed by the FERA Team.

Steve B. Reid – Mr. Stephen B. Reid is the Manager of the Emissions Assessment Group in STI's Information Systems and Atmospheric Modeling Division. Mr. Reid will serve as a Task Leader for the IFT-DSS project and will be responsible for testing and quality assurance of the IFT-DSS POC. Mr. Reid's experience includes project management, the development and quality assurance of emission inventories, and the preparation of emissions data for use in air quality models. Recently, Mr. Reid has managed a number of studies related to the quality assurance and improvement of emissions-related data, including evaluations of the spatial and temporal characteristics of emissions inventories being used for ozone modeling in Central California and the methodologies used to assemble stationary source emissions inventories in the Midwestern U.S. Mr. Reid's other recent work includes software development and testing projects. For example, Mr. Reid led the development and testing of an ammonia emissions inventory tool for the Bay Area Air Quality Management District, and he also set up emissions modeling and quality assurance processes for an expansion of the BlueSky Framework, a decision support system for predicting the emissions and air quality impacts of wildland fires.

Dr. Stacy A. Drury - Dr. Drury joined STI in 2009 and is a Forest Ecologist. Dr. Drury will serve as STI's main point of contact for the POC user test group. His efforts focus on developing and improving vegetation data and fire and fuels models through the use of new data, research, and information systems. Dr. Drury will serve as a key technical advisor for the IFT-DSS project. As a Forest Ecologist, Dr. Drury examines issues associated with forest and fire ecology including examining the relationships between fire occurrence, fire severity and effects, climate, and vegetation characteristics. Before joining STI, Dr. Drury worked as a Fire Ecologist and GIS Specialist at the Rocky Mountain Research Station in the Fire, Fuels, and Smoke Science Program at the Fire Laboratory in Missoula, Montana. Dr. Drury was involved with the development and evaluation of a spatially consistent tree-list database and map for the United States using the LANDFIRE data products. He developed GIS data for a variety of applications including the development of land cover data for use in the Ecosystem Management Decision Support (EMDS) system. As part of the EMDS work, LANDFIRE data were used as input to the fire research model FIREHARM to create spatial fields of predicted fire effects and behavior. These data were then input into the EMDS logic model for consideration in land management decisions. Dr. Drury is proficient in the use of many software tools including ArcGIS, SAS, FHX2, COFECHA, FOFEM, Consume, BEHAVE, FARSITE, and MS Office programs. He has used the VBA and Python programming languages.

Appendix C: Summary of Task Schedule

ID	Task Name
1	**Phase IIIa Contract Initiation**
2	**Task 1 - Project Plan**
3	**Task 2 - Confirm Prototype Functionality**
13	**Task 3 - IFT-DSS GUI Design**
21	**Task 3 - IFT-DSS Back-end System Design**
48	**Task 4 - IFT-DSS Prototype Development**
56	**Task 5 - Testing & Quality Assurance**
63	**Task 6 - Documentation**
66	**Community Development**
67	**Governance Community**
68	Draft mission/vision statement
69	Submit for review by Governance community
70	Revise/finalize based on feedback
71	Submit IFT-DSS prototype assessment to Gov. community
72	**Developer/Database Community**
73	Establish group of Developers to work with in 2009
74	Seattle & Missoula meetings
75	Organize meetings w/ Developers & System reps to develop transition plan
76	Develop transition process & plan
77	Draft transition plan
78	Submit for review by Developer community
79	Revise/finalize based on feedback
80	Identify additional Developers to participate in future
81	Test transition plan (Phase IIIb)
82	**Field User Community**
83	Initiate contact w/ Prototype Test Group (PTG)
84	Establish communication plan w/ PTG
85	Interviews w/ select users for prototype confirmation
86	**Periodic contact w/ PTG**
92	Recruit additional PTG members (15+)
93	**IT & System Maintenance Community**
94	Submit IT Investment Process proposal
95	Initiate IT Investment Process
96	Periodic check-in on IT Investment Process
97	Identify agency IT requirements/constraints
98	**Periodic check-in w/ agency IT folks**
102	**System Transition Community**
103	Identify responsibilities
104	Identify long-term transition team (Phase IIIb)



Appendix D: Community Development and Communication Plan

Note: A more comprehensive community development plan is currently being drafted (by Mike Rauscher and Tim Swedberg of the JFSP) that will eventually replace the plan included here.

It is axiomatic that a large, multi-faceted software product such as the IFT-DSS can only be used effectively if a well organized community of interested stakeholders exists. During Phase II of the STS Study, five stakeholder groups were identified: 1) the Governance community, 2) the Developer/Database community, 3) the Field User community, 4) the IT and System Maintenance community, and 5) the System Transition community. During Phase IIIa, we will further define the five communities of stakeholders, describe the roles that members of each community should play, and form a core group of stakeholder participants that will actually perform these roles as they interact with developing the IFT-DSS POC system. The following provides a discussion of how we plan to engage these five communities during Phase IIIa of the STS Study.

Governance Community:

The governance community is concerned with the effectiveness of the IFT-DSS from the business point of view. Members of this community are not only concerned that the IFT-DSS provides real help to the user community but more broadly, that the vision for the IFT-DSS supports the business needs of the fire agencies in all their dimensions. It is ultimately the concern of the governance community that the IFT-DSS software system and the community of stakeholders that operate it are effective.

During the IFT-DSS POC development, the IFT-DSS will be governed jointly by the JFSP Board and the NIFCG Committee of the NWCG. John Cissel, Nate Benson, and Mike Hilbruner will represent the JFSP Board. Erik Christiansen, chair of the NIFCG will represent the NIFCG Committee. In addition, Paul Schlobohm, IT Branch Coordinator of the NWCG has agreed to represent the NWCG Directors (i.e., senior management) when governance questions need to be answered.

Mike Rauscher will draft a mission/vision document for the governance community representatives listed above, have it reviewed, and accepted. As the IFT-DSS POC becomes available and the stakeholder communities begin to engage, the governance community representatives will be periodically updated on progress, usage, satisfaction, and activity levels. The governance community representatives will have explicit opportunities to provide suggestions and guidance that will help the IFT-DSS position itself effectively within the business operations of the fire agencies.

At the end of the first year of POC development, an assessment will be made to gauge the status of the overall IFT-DSS program and the success of the POC. The results of this assessment will be provided to the governance community for review. Fig. 1D summarizes the plan for engaging the Governance community.

Developer/Database Community:

The Developer/Database stakeholder community is vitally important to the development and ongoing success of the IFT-DSS. This stakeholder group develops new science, software applications, tools, and data that comprise the IFT-DSS. Because the IFT-DSS will serve as a framework for integrating legacy, existing, and new software applications and data, it is important that the developers of these applications and data are willing and motivated to participate. Initially, the Developer/Database stakeholder community will consist of the individuals who have developed products that are proposed for implementation in the POC IFT-DSS. The following table includes a list of current Developer/Database stakeholders.

LOCATION	PERSON (AFFILIATION)	DATA/APPLICATION
Seattle, WA	Sim Larkin (BlueSky)	BlueSky Collaboration
Seattle, WA	Roger Ottmar Susan Prichard	FCCS-CONSUME
Ft. Collins, CO	Eric Twombly	FSVeg; INFORMS
Missoula, MT	Kristine Lee (LANDFIRE)	LANDFIRE; collaboration
Missoula, MT	Mark Finney	FlamMap
Missoula, MT	Pat Andrews	BEHAVE
Missoula, MT	Alan Ager John Anderson	ArcFuels
Moscow, ID	Nick Crookston	Impute; FFE-FVS
Boise, ID	Rob Seli (WFDSS)	WFDSS; WIMS; LANDFIRE; collaboration

Note that two key stakeholders included in the Developer/Database community are the technical program leads for the BlueSky Framework (Sim Larkin) and WFDSS (Tom Zimmerman/Rob Seli). The BlueSky Framework and the WFDSS currently serve the fire and fuels community in different ways, but include many of the same tools and functionality desired for the IFT-DSS. One of the main goals of the IFT-DSS development effort is to establish a collaborative relationship with these existing systems with the ultimate goal of leveraging the services among each. We are currently working with Tom Zimmerman, Rob Seli, and Sim Larkin to identify overlap among systems and to develop ways to work together on future development efforts. Specific to WFDSS are several tools (i.e., geospatial tools, .lcp file converters, data services) that would greatly benefit the IFT-DSS. Rather than reinvent these tools, we are pursuing the potential opportunity to leverage what has already been developed for WFDSS. John C. is taking the lead to work with Tom Zimmerman on IFT-DSS/WFDSS collaboration.

The Developer/Database stakeholder community will be engaged in several ways. As a starting point, the people listed in the table above and members of the Missoula and Seattle Fire Labs have been contacted and asked to represent the Developer/Database Community for the IFT-DSS POC development. Meetings were conducted with this group May 2009 to discuss options for incorporating existing services into the IFT-DSS. The primary objective of these meetings was to establish a working relationship between the STI team, represented by Sean Raffuse and Stacy Drury, and the various developers and database managers that have resources that will become services within the IFT-DSS framework.

New services in the form of functions and databases are continually being developed by the science/technical fire research community. A voluntary transition process will be negotiated with the Developer/Database community that facilitates an orderly and publicly known and accepted process for moving services from research to operational versions residing in the IFT-DSS framework. An effective feedback system from the field user community to the Developer/Database community will be established. A more comprehensive group of Developers and Database Managers should be identified to help the IFT-DSS development team design the mechanisms for adding new services and databases to the IFT-DSS. Mike Rauscher will lead the effort to draft a plan for updating functions that already exist in the IFT-DSS and for placing new functionality into the IFT-DSS.

Finally, once the plan and process has been produced and reviewed, it will be tested early in Phase IIIb of the STS Study. Software requirements and upgrades to perform this test will be identified and organized in Phase IIIa.

Field User Community:

Built for Fuel Managers by Fuel Managers

The field user community consists of approximately 800-1,000 fuels treatment planners from a variety of land-management agencies throughout the U.S. The field user community is the key stakeholder group because the IFT-DSS will be expressly constructed and maintained to make their job easier. During the IFT-DSS POC development effort, we will actively engage and solicit feedback from a sub-set of users which we will refer to as the POC Test Group. Prior to IFT-DSS POC development, it is of vital importance that we have identified the correct and most helpful fuels treatment planning use-cases as they will form the basis of the IFT-DSS POC system. The most immediate need is for Sean Raffuse and Stacy Drury to confirm the use cases (Task 2) that the POC system will address during the May-July 2009 time frame. Sean and Stacy will examine the use-case descriptions from the Phase II documentation, update and refine it where needed, and have this reviewed by the POC Test Group: Randi Jandt, Brad Reed, Tessa Nicolet, Sean McEldery, Jon Wallace, Mack McFarland, Brenda Wilmore, Jim Rossler, and three other members to be identified shortly.

We will ask the POC Test Group to contact other members in their working circle and specifically acquire use-case reviews from a small group of different users. In addition, the Developer/Database community was also asked to provide feedback regarding the use cases at the May meetings in Seattle and Missoula,

The larger group of “44” field users (identified and recruited during Phase II) will be asked to review the refined use-cases and to comment on it/them. In addition, select phone interviews will be scheduled with this larger group. Once the use-cases have been confirmed, the field user stakeholders, as represented by an explicitly identified "group of 44", will be kept continually aware of progress, as they need to review, critique, and guide the progress of the POC to ensure that it is as useful as possible as soon as possible. This group of field users is considered to be flexible, changing, and continually expanding. We envision having field users from this group actually use the POC in their work as soon as March/April 2010. Sean and Stacy will take the lead in managing the continuous testing of the POC by field users as soon as added functionality becomes available. The goal is to have the POC used routinely by a small core group of field users by the end of the first year of development.

IT, System Maintenance Community:

The members of the IT and System Maintenance community focus on agency and inter-agency software, hardware, web-operations, and security issues. Of key importance is this community's role as a managing partner and long term hosting agency for the IFT-DSS. At this point, a managing partner and hosting agency for the IFT-DSS has not yet been identified; however, communication on this subject is currently underway and the WFIRB is planning to make a managing partner recommendation at their July 2009 meeting. Once a managing partner is identified, the IT requirements and constraints specific to the managing partner agency and the agency-specific Capital Planning and Investment Control (CPIC) processes will guide the development of the IFT-DSS. This community will help guide the design and implementation of the IFT-DSS to ensure that the system is compatible with agency IT requirements and constraints. We have identified the representatives of this community and have initiated communication with them. Specifically:

- Carol Saras - NWCG IT Investment Management Process: we have submitted a proposal for the IFT-DSS to the IT Investment Process Manager, Carol Saras.
- Paul Schlobaum – NWCG Branch Director: we have initiated communication with Paul Schlobaum and he will serve as the NWCG representative for the IFT-DSS.
- Laurel Hill, Forest Service IT community; Joe Frost, Forest Service IT community; and John Noneman, BLM IT Community: we have initiated communication with Laural Hill, Joe Frost, and John Noneman to understand agency-specific IT/IS requirements for consideration in the IFT-DSS design and to help identify a potential future managing partner for the IFT-DSS.

Through interaction with this community, we have become aware of several Enterprise Service Buses that the IFT-DSS development team will consider during design and implementation. These buses are "business standard communication backbones". John N. and Joe suggested that the IFT-DSS would need to connect to these busses. The FS Enterprise Service Bus contact is Keri Vest (kvest@fs.fed.us). There is a Data Warehouse project that we also need to be aware of. Contact Brad Harwood (bharwood@fs.fed.us). We will continue dialog with this community throughout the development process.

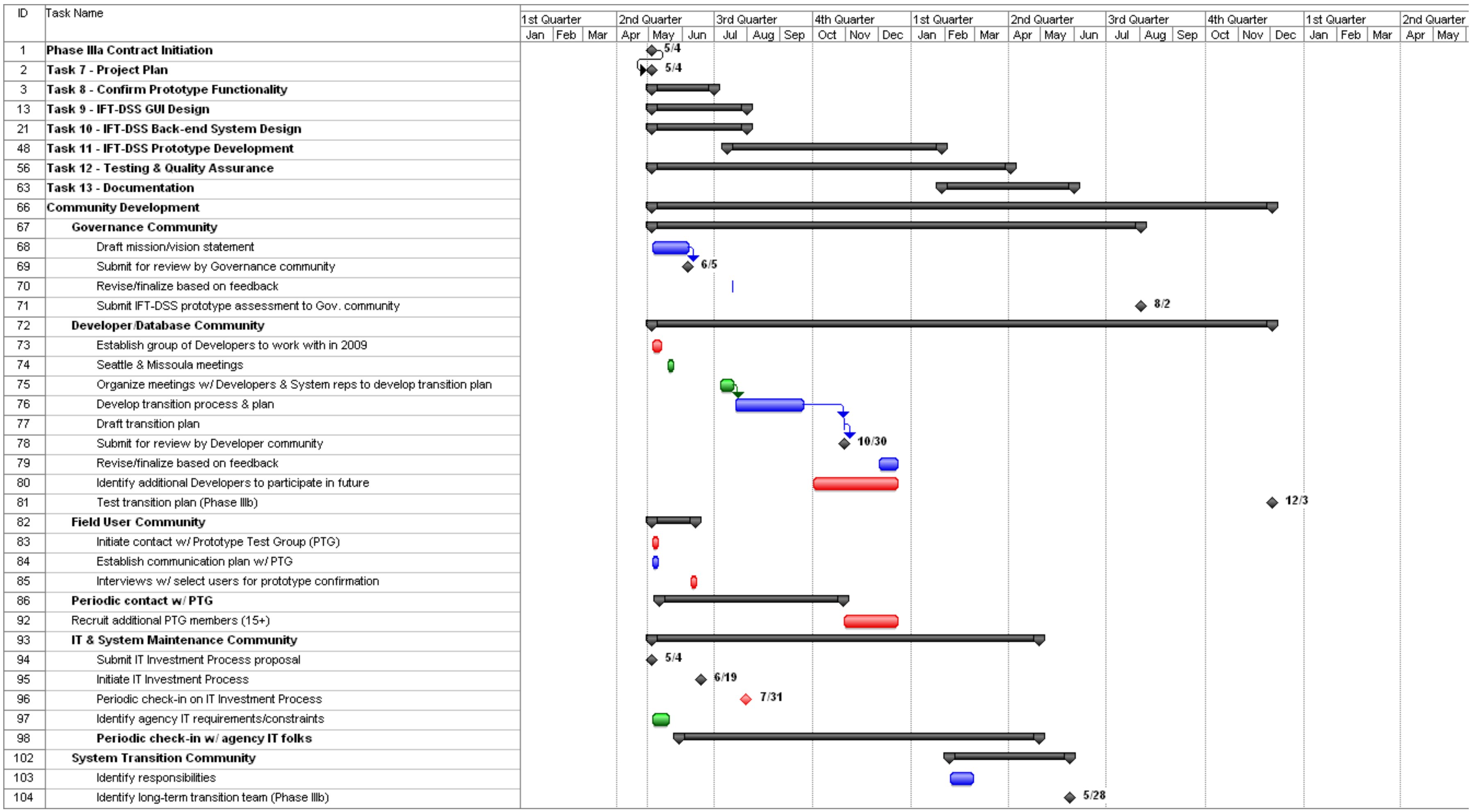
System Transition Community:

The system transition community is responsible for moving the system from design, to POC, to deployment, to diffusion into the communities of interest and to establish and maintain informational contact among all of the communities of interest throughout the life-cycle of the system. The system transition community is at the center of an organized development and deployment process for the IFT-DSS project.

The earliest stages of this task will involve the preparation of adequate technical software documentation. User documentation will be developed to help end users navigate and understand the system. In parallel with the development of the IFT-DSS, tools and guidance for the Developer/Database community will be created to aid this community in adding new services and data to the system. Prior to the deployment of the IFT-DSS, an outreach campaign will be developed to begin to spread awareness of the system. For example, the JFSP is planning to dedicate a Digest to focus on the IFT-DSS and there are plans to present a poster display for the IFT-DSS at the Savannah fire congress in November 2009. Upon deployment, training courses and workshops will be conducted. An effective method for recruiting users is to conduct on-site training, we will explore this as an option for expanding the IFT-DSS user group over time. During the coming year, we will work to develop a public outreach campaign for the IFT-DSS (Lead: Tami Funk, STI; Mike Rauscher, JFSP; Tim Swedberg, JFSP).

Figure 1D shows a draft timeline for implementing the community development activities described above.

Figure 1D. Draft timeline for implementing the community development activities described in Appendix D.



Appendix E: Quality Assurance Plan

Mr. Steve Reid will serve as the testing and quality assurance Task Leader for the IFT-DSS POC. Mr. Reid will work with Dr. Roberts to ensure that the IFT-DSS meets specified quality objectives. Testing and quality assurance of the IFT-DSS POC will be based on the IFT-DSS POC design specification document (developed as part of Task 3). The design specification will identify the functional expectations for the IFT-DSS POC, including requirements for system design, interface, functionality, and performance. Upon finalization of the design specification document, Mr. Reid will be responsible for updating the design specification document based on design changes or modifications that may occur during the development phase. He will then use the design document as a basis for testing and quality assurance.

The testing and quality assurance process will ensure that the outputs of individual components and the POC as a whole meet all of the specified requirements, and this process will take place in two major stages: (1) internal testing by STI software testers; and (2) user tests by fuels treatment specialists. Internal software testing will occur throughout the implementation phase of the IFT-DSS POC to ensure that individual components are functioning properly from a technical and from a user perspective and that all system requirements defined in the design specification are met. This testing will be performed by individuals who understand the goals and requirements of the IFT-DSS POC but are not directly involved in the software development effort (i.e., programmers). In general, internal testing procedures will involve running system components under known conditions with pre-defined inputs and comparing results with pre-defined expectations. Important aspects of this process include:

- Designing sample cases that consider the full range of input combinations a software unit or system may encounter during operation;
- Assembling input data sets for each sample that should result in pre-defined outcomes (these data sets should include invalid inputs to test software responses to such data);
- Performing unit (or module) level testing to ensure that IFT-DSS components provide the same outputs as stand-alone versions of each component;
- Performing system level testing to ensure that all the POC's functionality and system performance (e.g., response times) meet design specifications;
- Documenting all test procedures and outcomes.

During the internal testing process, STI software testers will work collaboratively with the software development team to ensure that all errors and shortcomings identified through the testing process are corrected.

Following internal testing of the IFT-DSS POC, STI will make the system available via the Internet to a select group of fuels treatment specialists who will test and provide feedback on system performance and/or possible refinements to the system. These user tests will verify the functionality of the system and ensure that users are able to understand the system and interface with it easily. At the conclusion of the user testing period, a prioritized list of system modifications will be compiled and implemented under the direction of the JFSP manager.