Fire Program Analysis Prototype Results

July 18, 2007

(FPA Project Briefing to the FPA Executive Oversight Group)

Issue: The FPA Development Team and Interagency Science Team (IST) have completed the analytical prototype for Alternative 3 – representing preparedness/initial attack, large fire suppression, fuels treatments, and tradeoffs without extensive simulation.

Background: The Wildland Fire Leadership Council (WFLC) in December 2006 endorsed development of a prototype to be delivered June 30, 2007. Since December, the FPA Development Team has worked with the IST and other partners to construct a series of interacting models that collectively address landscape-level fuel treatments, preparedness for fire and initial response (initial attack), and the consequences and costs. Additionally, WFLC requested a prototype of the large fire simulation model that could be used to validate the large fire surrogate indices that were envisioned.

These models comprise an analytical system that will help Fire Planning Units (FPUs) and the agencies' national budget planners analyze investment options for preparedness and fuels when proposing budgets to OMB and Congress beginning with the FY 2011 budget. Options for fire prevention programs will be incorporated into the analysis by June 2008. Prototype success criteria were approved by Executive Oversight Group co-chairs in January 2007. These criteria include the ability to calculate performance measures, demonstrate internal compatibility across subcomponents, meet subject matter expert expectations, ensure that workload demands are reasonable, and that cost and schedule for final delivery can be assessed.

Prototype Development Highlights and Key Considerations:

- Initial Response module runs are consistent with FPU expectations for all seven prototype FPUs
- Data from two of the prototype FPUs have run through the analytical models.
- The large fire surrogate is based on a statistical summary of the existing Fire Spread Probability (FSPro) model.
- The goal programming module for national decision makers has begun and initial results are being evaluated.
- The prototype large fire simulation model envisioned to validate the large fire surrogate indices was successfully developed and tested.
- Nonfederal partner involvement - the design has been enhanced to ensure it incorporates nonfederal resources in the trade-off analyses.
- The IST suggests the prototype is broadly consistent with the recommended system architecture and recommends continued development of the FPA system and strengthened interactions with the science team. A more detailed description of IST feedback can be found in Attachment 4.

Success Criteria – Scope, Schedule, and Cost

One of the primary reasons for conducting a prototype was to identify any risks that might affect the development of an operational FPA system. Listed below are highlights of that risk assessment. A more detailed discussion of these risks can be found in Attachment 1.

Scope:

- Little to no risk is perceived in meeting the scope or staying within scope of the project.

Schedule:

- Some risks are related to data availability of current information in LANDFIRE data, tight timelines for system integration of subcomponents, expectations for broader uses of the FPA system, potential expectations to expanded stakeholder involvement, and continued involvement of the science team – these risks can be mitigated to a substantial degree.

Cost:

- Cost risks are mostly related to scheduling and data availability – these can be mitigated to a substantial degree.

Recommendation:

It is recommended that the development and implementation of the FPA system should proceed with a June 2008 delivery.

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Attachments:

1: FPA Prototype Success Criteria & Results

2: Effectiveness, Efficiency, and Performance Measures (EEPs)

3: Key Design Feature Comparison of the Large Fire Module (IST Alternative 3) and the Large Fire Simulation Module (IST Alternative 4)

4: Interagency Science Team – Feedback on Prototype Results

Attachment 1: FPA Prototype Success Criteria & Results

The reader might find it useful to refer to Figure 1 below while reading the success criteria described in the sections that follow.

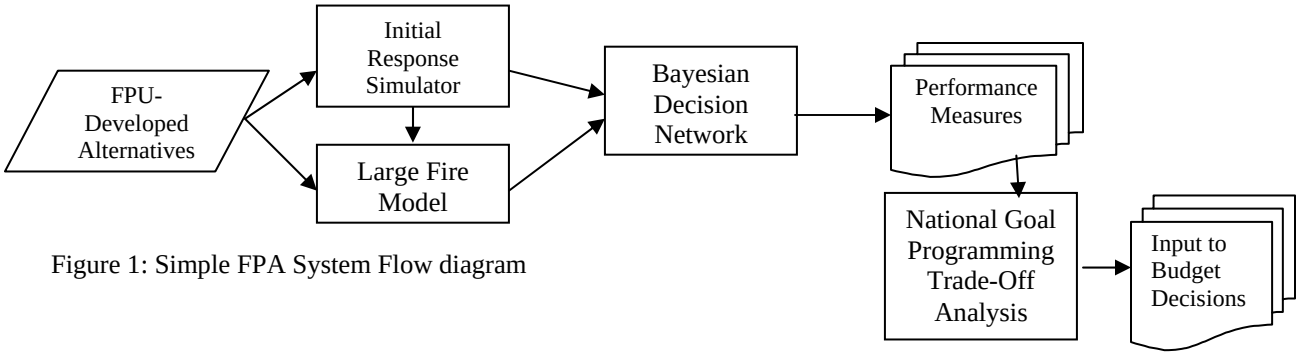

Figure 1: Simple FPA System Flow diagram

Success criteria were developed in January 2007 to judge whether the prototype results met expectations and provide background for decisions concerning continuing the development of the FPA system. Results from the prototype work are described in terms of the potential risks associated with the project scope, schedule, and costs.

Criteria 1: Demonstrate the capability to calculate the modeled performance measures based on input information available from data and models.

Results:

Initial Response Simulation (IRS) – The IRS module was developed based on the California Fire Economics Simulator (CFES2).

- The IRS module is used to compare multiple investment scenarios within each of the seven prototype FPUs.
- The prototype participants reported that the IRS analyses were consistent with expected results for their FPUs.

Large Fire Surrogate-Developing a large fire module that is reasonably accurate and straightforward to apply was a major challenge. Several options were explored, ranging from a primarily GIS-based exercise to a full simulation approach.

- The prototyped process combines simulation, statistical analysis, and GIS analyses to build a prototype large fire module. This process was applied to Northwestern Montana and Southern Sierra prototype FPUs.
- This large fire surrogate is a practical alternative to full simulation, and it reduces the number of computer runs and workload to the field when compared to the full simulation.
- While initial results required some modification to meet expected large fire outcomes, on-going work with the IST is automating and improving the process.

Bayesian Decision Network (BDN)- A Bayesian Decision Network was constructed to link the fire modules and generate the Effectiveness, Efficiency, and Performance Measure (EEP) values (see Attachment 2 for a list of these measures).

- A working version of the BDN has been developed for the NW Montana and Southern Sierra FPUs.
- Final validation of the BDN will be completed this summer when all seven prototype FPUs large fire surrogate results are available.

Goal Programming- Even though the goal programming portion of FPA was outside the scope of the 6-month prototype, design has begun and initial testing using simulated investment alternatives is underway.

- National decision product examples have been created using a limited data set.
- Refinement of the National Goal Programming module will continue as results are available from more than the prototype FPUs.

Risks:

Scope: Little risk with regard to meeting original scope.

Schedule & Cost: Modest risk because the user requirements for national level fire budget development has a tendency to expand beyond the original FPA scope. Risk can be reduced by deferring additional national budget development requirements to next release.

Criteria 2: Demonstrate that individual modules are consistent internally and compatible with other modules.

Results:

The analytical system is designed with modular construction and shared databases. This design eliminates duplication of data entry by field staff, and automates data sharing between modules. Improvements are being explored to tighten linkages between the IRS and the large fire modules including synchronization of the weather data.

The decision network utilizes the IRS and large fire module results to calculate the EEP measures.

The FPU investment alternatives, and the performance measures reside in a shared database so local FPUs and national decision makers can compare the cost and performance of alternatives using the goal programming module.

Risks:

Scope & Schedule: Little risk.

Cost: Modest risk since the Alternative 3 solution for large fire simulation surrogate may require additional development and computer investment. Risk will decline as analysis of all seven FPUs allows the Project to further validate the surrogate approach and further mitigation through shared computer resources with the Forest Service's Wildland Fire Decision Support System (WFDSS).

Criteria 3: Meet subject matter experts' expectations in terms of model results.

Results:

The seven FPUs have participated in two prototype workshops, January and May. They have provided timely and first hand feedback to the development team at each of these workshops.

- The prototype FPUs have tested the IRS module using actual data from their FPU.
- The FPUs concur that the IRS model produces expected results based on their knowledge of fire behavior within their planning units.
- The large fire module surrogate analysis was completed for the Northwest Montana and Southern Sierra prototype FPUs. Results have undergone initial evaluation and indicate a high level of agreement with the full simulation approach (see Attachment 3 for a brief comparison of the two large fire approaches).
- Data for the New Jersey FPU are being prepared for the large fire surrogate. Completion of this analysis will help demonstrate the model's utility in the Eastern Geographic Area.
- All seven FPUs will complete end-to-end analysis by the end of October 2008.
- The National Goal Programming module will be fine tuned as the FPUs complete their IRS, large fire and BDN analysis.

Risks:

Scope: Little risk.

Schedule & Cost: We will need to identify and prioritize expanded expectations for use of FPA in order to maintain expected cost and schedules. Risk can be reduced by deferring increased scope expectations until future versions. The cost savings potential of the innovative approach to large fire modeling are so key to the success of the Alternative 3 approach to FPA that it warrants validation on all seven FPUs which represent the varied geographic areas and the fire conditions they manage.

Criteria 4: Assess the workload demands on the field and that computational needs are reasonable.

Results:

The FPA prototype validated the feasibility of using existing data from FPA-PM, and then prototyped online interactive tools for the FPUs to use in updating and adding additional data.

A field workload estimate for the end-to-end FPA process was completed by the seven FPUs who participated in the prototype. Estimates were considered reasonable (ranging from 45 to 87 interagency total person days per FPU including cost and spatial data preparation and planning tasks).

The design includes the ability to import the FPUs' existing spreadsheets and databases, rather than require manual data entry.

The IRS module has been prototyped on desktop PCs and on the FPA development server. Computation loads are within reasonable bounds of a prototype.

- The large fire module requires approximately 10 hours of computer processing per FPU in its current prototype construction.
- Operational implementation computer use is expected to be less, but additional servers may be required to run all 138 FPU and nationwide analyses in FY2009.
- Cost savings are possible through sharing of computer systems resources with the Forest Service's Wildland Fire Decision Support System (WFDSS).

Utilizing the large fire module surrogate should reduce the workload and computational requirements for the field personnel as compared to full simulation approach proposed in the original Alternative 4.

- Increased efficiency comes from use of a statistical model that duplicates the simulation results and allows rapid evaluation of multiple investment alternatives.

- A core set of simulations is still required, but these can be done independent of the evaluation of alternatives. (See Attachment 3 for more details on the two large fire approaches).

Risks:

Scope: No risk.

Schedule & Cost: The Project's commitment to use LANDFIRE as the source for fuels information to run the FPA models was based on the assumption these data would have a currency that is not in the LANDFIRE Charter, nor in the proposed LANDFIRE O&M Plan. Consequently, there is substantial risk that field personnel will need to invest time in updating their fuels data layers, or that FPA will have to invest money in assisting the field in updating these fuels layers. Risk will be further evaluated through sensitivity

testing using 2000/2001 LANDFIRE fuels data and local updated fuels data available from the prototype FPUs.

Criteria 5: Accurately assess the expected cost and schedule for implementing the scope of FPA as recommended by the Interagency Science Team and approved by WFLC.

Results:

Based on the success of the two FPU prototypes, the schedule to release FPA in June 2008 as a tool to help prepare the FY2011 budget request, although challenging, is feasible without compromising the project scope.

Project cost estimates to implement the FPA approach as being developed is within the budget approved for FPA shown in the table below.

FPA Phase	Cost ($M)
Prototype (FY '07)	**4.9**
Two-year Development (FY '07/'08)	**9.0**
Two-year Transition O&M (FY'09/'10)	**6.9**
Total	**20.9**

Risks:
Scope, Schedule and Cost: The overall Project risk is low to modest if:

- Expanded stakeholder requirements are deferred to subsequent FPA system versions.
- LANDFIRE adopts and implements an O&M process that incorporates local fuels characteristic changes and other major landscape disturbances to the vegetation.
- IST members are engaged and participate in developing validation processes for the large fire surrogate.

Attachment 2: Effectiveness, Efficiency, and Performance Measures (EEPs)

The Wildland Fire Leadership Council (WFLC) recognizes the following positive goal statements as outcomes that, if FPA can deliver information on status with respect to each item, would be extremely helpful in their deliberations regarding budgets and planning:

EEP # 1: Reducing the probability of occurrence of costly fires

EEP # 2: Reducing the probability of occurrence of costly fires within the Wildland Urban Interface

EEP # 3: Increasing the proportion of land meeting or trending toward the attainment of fire and fuels management objectives

EEP # 4: Protecting highly valued resource areas from unwanted fire

EEP # 5: Maintaining a high initial attack success rate

Attachment 3: Key Design Feature Comparison of the Large Fire Module (IST Alternative 3) and the Large Fire Simulation Module (IST Alternative 4).

1. Both module approaches have at their core the Fire Spread Probability (FSPro) fire behavior model developed by Mark Finney at the Rocky Mountain Research Station in Missoula, MT.
2. The large fire surrogate (Alternative 3) is designed to run FSPro once for each FPU per budget season by FPA Project staff before the field units begin their FPA analysis. All alternatives developed in the FPU analysis utilize this FSPro run. This will minimize the field workload and give the FPUs maximum flexibility to explore investment alternatives without requiring additional runs of FSPro.
3. The Large Fire Simulator approach (Alternative 4) requires the field personnel to run FSPro for each alternative to be analyzed in the FPU. It is anticipated that the operational costs of these multiple runs may make this approach cost prohibitive and a significant burden in terms of field workload.

Attachment 4: Interagency Science Team – Feedback on Prototype Results

Some members of the Interagency Science Team (IST) were involved in interactions with the FPA Development Team during the prototype process. All members of the IST were invited to participate in a conference call/meeting to discuss prototype results with key members of the Development Team. The results of that call/meeting are summarized below:

- The IST recognizes that substantive progress has been made in developing and testing major parts of the FPA modeling system.
- The prototype is broadly consistent with the system architecture recommended by the IST, with the substitution of a promising surrogate fire model for the full fire simulator.
- While significant progress has been demonstrated, considerable work remains to complete development of a fully operational FPA modeling system. That said, the IST believes that the FPA Development Team has done an excellent job in bringing the prototype system to its present state of completion in the time available.
- Consequently, the IST believes that sufficient progress has been demonstrated in developing the current prototype system to recommend proceeding with development of the full FPA modeling system based on the decision of WFLC in December 2006.
- The IST recognizes the need to manage risks associated with completing all system components and their integration on the present timeline.
- The IST recommends renewed and even strengthened interactions between the development team and the science team as development work proceeds.
- There is a need to design/develop strategies to validate the component models that are being developed within the overall FPA system. The IST offered suggestions for what might be feasible.