FPA Preparedness Module
Initial Attack Model Evaluation

A White Paper

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Introduction / Background

Determine which, if any, of the existing strategic fire planning system models will meet the business requirements of the Fire Program Analysis System Preparedness Module (FPA-PM). The purpose of FPA-PM is strategic, not tactical, to assist managers in planning for cost effective and efficient fire management programs. Due to the number of fire planning systems that are in existence today as well as those under development an evaluation of these systems was conducted so that a recommendation could be made for the model and/or its attributes that should be included in the FPA Preparedness module.

Abstract / Business Case

This paper evaluates the existing Fire Planning Systems and describes their ability to meet the criteria designated by the Core Team as needed for the FPA Preparedness Module and its integration with the remainder of the FPA modules. A comparison of known fire planning systems was completed to determine if they met the criteria deemed necessary to have a viable, robust strategic fire planning system for use within FPA. Systems presented in the "Proceedings of the Symposium on Fire Economics, Planning and Policy: Bottom Lines", were included in the analysis. The Rideout/Kirsch prototype and Wiitala's Wildfire Initial Response Assessment System were also assessed.

Problem Statement / Introduction

The importance of selecting an existing model or concepts from existing models for incorporation within the FPA design should not be overlooked. While its contribution for determining the optimal organization and associated budget for the initial attack organization of a Fire Planning Unit is extremely important additional priority needs to be given to its ability for analyzing proposed fuel treatments, their geographic placement in relation to minimizing the size of large fires should initial attack actions fail.

The Federal Fire Aviation Leadership Council Planning and Budget Team, has provided direction to the Core Team, "ensure that the Preparedness, initial attack module incorporates an optimization routine". The "Hubbard Report" specifies that the FPA system be objective driven and performance based, the ability to model different strategies over time, identify fire management resources, contain a cost-effectiveness analysis and provide analysis at a range of scales.

Additional attributes desired for the FPA-PM include multiple fires, fireline/perimeter interaction, identification of fire season, multiple fire seasons, deployment, dispatch, initial attack suppression, fire exceeding the capabilities of intial attack forces, spatial fire occurrence, fire occurrence, resource tracking, and provide for budget request and allocation.

Proposed Solution(s)

Evaluate existing and proposed models against the attributes that have been identified for the FPA System, specifically the Preparedness Module. Identify which, if any of the existing and proposed models address the identified attributes.

Select from any of the existing models, developed processes that address the attributes so they can be incorporated into the FPA Preparedness Module.

Models that have been evaluated and their results are found in Appendix A, they are: Level of Protection Analysis System (Leopards), Forest Fire Management Decision Support Systems (FFMDSS), KITRAL, California Fire Economics Simulation model (FPPS/CFES), FirePro, ARMS/ADFF, NFMAS/IIAA, ARCAR41, Rideout model and the Wildfire Initial Response Assessment System (WIRAS).

Results (See Appendix A: Models Evaluated): The only models that met the optimization criteria were Leopards, FFMDSS and the Rideout formulation. Leopards and FFMDSS are closely related. In fact, it appears that Leopards may be the fire planning system embedded in the FFMDSS. Dennis Boychuck, one of the primary authors of Leopards recommends not using Leopards (personal communication with Howard Roose) and thusly FFMDS.

The Rideout formulation incorporates optimization but lacks multiple fire, fireline/perimeter interaction, identification of fire season and multiple fire seasons.

Future Direction / Long-Term Focus

The Core Team should continue to work on business requirements and include those items that are necessary to develop a robust, strategic fire planning system. A contractor with a strong background in optimization, fire growth and containment modeling should be selected through the Request For Proposal (RFP) process and will then be asked for a recommendation on systems that would meet the business requirements. The Missoula Fire Sciences Laboratory is tasked with providing information and algorithms for fire growth and containment. The RFP selection criteria should include demonstrated knowledge and experience in wildland fire growth and containment modeling as well as optimization.

Integration of future modules must be considered in any decisions relating to the FPA-PM.

Appendices

Appendix A – Models Evaluated

FPA Desired	**Attributes:**	Leopards	FFMDSS	Kitral	FPPS/CFES	FirePro	ARMS/ADFF	NFMAS/IIAA	ARCAR41	Rideout	WIRAS
	Planning levels:										
	(multiple seasons)	X	X		X	X	X	X			X
	(season)		X	X	X	X	X	X			
	(daily)		X	X					X		X
	(incident)			X					X		X
	Budgeting process		X		X	X		X		X	
	Modeled program components										
	deployment	X		X	X		X		X	X	X
	dispatch	X	X	X	X		X	X	X	?	X
	initial attack suppression	X	X	X	X		X	X	X	X	X
	ignition prevention	X							X		
	detection	X	X	X					X		
	fuels management								X		
	escaped fire		X	X				X?	X	X	X
	Methodological features										
	deterministic simulation	X		X	X			X	X	X	
	stochastic simulation		X		X		X				X
	optimization	X	X		X?					X	
	subjective ranking		X	X		X					
	clock driven/event driven	X	X	X	X		X		X		X

	spatial fire occurrence	X	X	X	X?		X	X?	X	X	X
?	spatial fire growth			X					X		
	Process features										
	multiple fires	X	X	X	X		X				X
	fire occurrence										
?	statistical distribution		X		X		X				X
?	historical patterns	X	X	X			X				
?	historical averages			X		X		X		X	
	diurnal fire behavior	X		X	X			X?	X		
	fireline/perimeter interaction	X	X	X	X				X		X
	capacity tracking	X			X		X				
	resource tracking				X	X	X?		X	X	X
	structural protection				X						
	Dynamic interaction scope										
	national	X?	X	X?			X			X	X
	provincial/regional	X	X	X	X?		X		X		X
	administrative unit		X	X	X	X		X	X		X
	fire level			X					X		X
	Economic/system analysis										
	resource valuation		X	X	X	X		X	X		X
	cost efficiency	X	X		X			X			
	cost effectiveness	X	X		X	X		X		X	
	system effectiveness	X	X	X	X		X	X			
	Budgeting										
	program budget		X?		X	X		X		X	
	program allocation			X	X	X		X			

Appendix B

ATTRIBUTES OF FIRE PLANNING SYSTEMS

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During the 1997 Strategic Fire Management Planning Models workshop held at the PSW Research Station, Forest Fire Laboratory, Riverside, CA several models were presented and discussed. The intent of the workshop was to identify the characteristics or attributes of the models and to try to find out a core set of attributes necessary for a successful strategic fire planning model. We identified the attributes of all the models presented but did not go into selecting a set of core attributes. However, the list of attributes below, and their definitions, provides a good indication of the desirable elements of a good model depending on the purpose of the model being developed.

Attribute	**Definition**
Planning level	Level of fire activity modeled.
Multiple seasons	More than one fire season
Season	One individual or average fire season
Daily	Every day
Fire	A single fire
Budgeting process	Results are use for budgeting purposes
Modeled program components	Activities of a fire management program modeled.
Deployment	Distribution of resources over the territory
Dispatch	Rules to send resources to the incidents
Initial attack suppression	Simulation of first response to an incident
Ignition prevention	Rules & simulation of prevention activities
Detection	Rules for the detection of fires
Fuels management	Rules & simulation of forest fuels manipulations

Escaped fires	Treatment of fires escaping initial attack suppression: simulation, tables or other approach
Methodological features	How is the model constructed
Deterministic simulation	No uncertainty attached to model components
Stochastic simulation	Uncertainty and probabilities of inputs, processes, and results are incorporated in the model
Optimization	Model uses optimization to seek best possible allocation of resources or some other facet of the model
Subjective ranking	
Clock driven/Event driven	Internal tracking of the model focuses on system processes and events over time
Spatial fire occurrence	Distribution of the events over the landscape
Spatial fire growth	Fire physically grown over the terrain
Process features	Characteristics of different processes
Multiple fires	Can handle simultaneous and or sequential fire events
Fire occurrence	How the occurrence of fires is handled
Statistical distributions	Estimated statistical distributions represent historical spatial and or temporal patterns of fire history
Historical patterns	Actual historical records are used to represent spatial and temporal patterns of fire occurrence
Historical averages	Average number of fires based on historical distribution
Diurnal fire behavior	Variation in fire behavior over 24 hour period
Fire line/perimeter interaction	The effect of line production on perimeter growth during suppression
Capacity tracking	Record fire line building capacity of organization
Resource tracking	Record the use of individual resources being used
Structural	Models protection of structures
Dynamic interaction scope	Administrative level at which it applies
National	Countrywide application
Provincial/Regional	Province- or region-wide application
Administrative unit	Organizational level at which it is applied, e.g.,

	national forest, national park, etc.
Fire level	Individual fires
Economic/System analysis	Level at which economic analysis is done
Resource valuation	Economic impact at the resource level
Cost efficiency	How well inputs have been used to achieved desired outputs
Cost efficiency	How well inputs have been used to achieved a determined set of outputs
System effectiveness	How the overall system achieved its desired goals
Budgeting	Model results used for budget development
Program budget	Results use for fire program budget determination
Program allocation	Results use for distributing budget between program components

Appendix C – References

Gonzalez-Caban, Armando; Omi, Philip N., technical coordinators. 1999. Proceedings of the symposium on fire economics, planning and policy: bottom lines; 1999 April 5-9; San Diego CA. General Technical Report PSW – GTR – 173. Albany CA; Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture; 332 p.