Performance-Based Interagency Fire Program Analysis System

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Blueprint for Fire Planning

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ABSTRACT

A new fire management paradigm reflects broadening goals, increased responsibilities, the need for interagency systems, and heightened performance accountability. Current program analysis models developed in a previous era can no longer support the expanded responsibilities and expectations for this new paradigm. We outline and discuss principles and major components of a new strategy-level, interagency program analysis system. The principles and system components are presented, not as a solution, but as a point of departure in stimulating professional dialogue toward a new system for fire management and planning.

Keywords: policy; wildland fire

A new paradigm of fire management has arrived that has potentially profound implications for the future of our fire program analysis systems. The new paradigm carries broader responsibilities, heightened expectations, and increased costs, and it almost certainly will increase public expectations for program performance and accountability. A new programmatic foundation is required to support the central role of fire on our nation's public lands and address wildland fire within the context of broad land management goals.

This article outlines how a performance-based system could be tailored to national fire management planning. We provide the historical context for where we are today in fire management planning, review the foundations of performance-based systems and their potential relationships to the national fire situation, and introduce a "conceptual blueprint" for such an approach as a way to begin constructive discussion.

Teetering on an Old Foundation

Some 20 years have passed since the first federal fire management program analysis models were introduced. Although these models have seen many upgrades, they have consistently relied

Above: **A performance-based system would link the treatment of fuels to the protection of resources.**

on their original structural and philosophical foundations—aggressive suppression, multiple use, and limited prescribed burning. These models were designed primarily to minimize the total cost of suppressing wildland fires that threatened commercial timber and other monetized resource values. Although the models evolved, the broadening fire management responsibilities widened the gap between what is expected under the new paradigm and what is possible using the old foundation.

With rising fire program expenditures and increasing values at risk from wildland fire, national fire planning and appropriation programs have been the subject of intense public scrutiny. The National Fire Plan, investigations by the US Government Accounting Office (GAO), and concerns expressed by the US Office of Management and Budget (OMB) and Congress have questioned the accountability of current practices while calling for new approaches to national fire program analysis.

Based on these and other criticisms, new interagency fire management policies were introduced in 1988 and 1995 and updated in 2001. These policies recognized common issues facing the federal fire management agencies and called on each agency to forge a cohesive and integrated approach to fire management. The 2001 policy document (Interagency Working Group 2001) highlights deficiencies where interagency solutions would be appropriate. The federal fire agencies recognized that successfully implementing the 2001 policy will require a bold new approach across traditional boundaries.

While the policies reflect a philosophical shift and the need to reform national fire planning, bringing such change to fruition will require a major overhaul in how the nation's wildland fire management business is performed. For example, an extraordinary effort will be required to overcome decades of autonomy fostered by diverse bureau missions and separate budgets. This reformation is unlikely without a comprehensive interagency fire management program analysis system to replace the current, decades-old approaches tailored to the individual bureaus.

Under the new paradigm, the fire management community has been handed a larger role in resource management with expanded responsibilities. Stakeholders seek intensive fuels treatments in the wildland-urban interface along with expansive efforts to restore and maintain fire as a natural ecosystem process. The change in fire management ethos reflects the realization that fire plays an integral role in ecosystem function and is often viewed as a central tool for accomplishing land management and ecosystem objectives.

Broader fire management responsibilities come with increased expectations and costs. Although this combination has invited public scrutiny, it should be noted that these costs have risen because much more is now asked of our fire management community. When today's fire management expenditures are compared with historical patterns, it is clear that demands on the fire planning and management systems have vastly expanded.

In addition, heavy fuels accumulation and aggressive suppression under the old paradigm left many federal lands at increased risk of catastrophic wildfire while changing cultural values shifted the nation's priorities. The interagency policies of 1995 and 2001 attempt to reflect the new priorities by addressing a broader range of concerns. Today's fire management challenges increasingly reflect the protection of valuable properties, restoration and management of sensitive ecosystems, protection of national treasures, and management of the wildland-urban interface. These challenges have become increasingly expensive and complex in ways that could not have been anticipated when the current models were developed.

Engineering a Performance-Based System

We characterize our blueprint as a Performance-Based Interagency Fire Program Analysis System. The system reflects contemporary program requirements and the need for an interagency initiative. It focuses on performance-based goals conforming to requirements of the Government Performance and Results Act (GPRA) of 1993 and addresses issues of appropriation and accountability in ways that tie budget levels to levels of performance.

By defining the scope of fire performance-based goals for each agency and by modeling and tracking their achievement, a performance-based system has the potential to provide agencies with a way to:

- Incorporate fuels treatment (including prescribed fire) into wildland fire management.
- Link appropriations to performance.
- Integrate state and private fire and fuels programs.
- Model ecosystem-related performance goals.
- Address the wildland-urban interface.
- Account for fire management expenditures and appropriations including suppression spending, fuels treatment, ecosystem management restoration and protection, and rehabilitation of lands burned by unwanted wildland fire.

Defining and Managing Performance

Establishing measures of performance is critical and challenging in the design of performance-based systems (GAO 1997; NAPA 1999). Defining the metrics of performance that allow for comparisons of treatment alternatives and of alternative budget levels will be central to the success of the performance-based system.

Although the roots of today's performance-based systems can be traced to the evaluation of defense expenditures during the cold war (Goldman 1967), applications in the post-GPRA era have focused on defining and measuring performance. Osborne and Plastrik (2000) identify five components of performance. These components, or levels of analysis, include the policy level, the program or strategy level, physical outputs, processes, and inputs. The strategy level is addressed in the blueprint we present.

Comprehensive Interagency System Analysis

The 1995 and 2001 federal wildland fire management policies (USDI–USDA 1995; Interagency Working Group 2001) identified the urgency for developing a comprehensive interagency approach to fire management and fire program analysis. With the five major federal land management agencies using at least three different fire management models, and with growing interest in integrating state and private interactions, a comprehensive approach to the national fire management situation is needed and called for by federal oversight agencies and recommended by the National Academy of Public Administration (NAPA 2000). Based on a common wildland fire management policy, fire program analysis can be addressed from a common philosophical foundation and a system that integrates the unique agency missions.

Accountability and Appropriation

With increasing expenditures on wildfire suppression and fuels treatment, congressional interest in the financial integrity of fire programs is acute. The GAO's Barry Hill stated that accountability must now be a priority and that the Forest Service and the Department of Interior will need to "clearly identify not only how they spend funds appropriated to reduce hazardous fuels but also what they accomplish with these funds" (Hill 2000).

Converging events in the early 1990s changed how public land management agencies would be viewed by the public and by their oversight agencies. The publication of *Reinventing Government* (Osborne and Gaebler 1993) provided a vision for performance-based government and spawned many subsequent publications. Passage of the GPRA in 1993 required government agencies to formulate quantifiable performance standards related to their strategic planning processes, goals, and appropriations. This set the stage for establishing rigorous and consistent measures of performance throughout the federal government, including fire management, planning, and appropriation.

A performance-based system could identify key indicators of performance related to strategy-level goals and simulate how goal accomplishment is related to budget level. The ability to model changes through time would provide a powerful tool for land managers who must document the use of scarce budgeted dollars.

Advances in technology also have enabled spatial and temporal displays to allow managers to better understand and evaluate program performance. For example, the system could show how and where a 20 percent change in appropriation would affect performance-based outcomes. Such outcomes could include the expected number of catastrophic wildfires; expected property damage in the wildland-urban interface; and the extent that hazardous fuels were reduced, ecosystems restored, and national treasures protected. Simulation through annual time steps would allay the misconception that variation from the model in a single year represents a failure to achieve goals.

Current fire program analysis models have not allowed lay personnel to establish a working knowledge of model implementation. The initial "attack-based" models were sometimes called "black boxes," terminology that reflects the frustrations of program evaluators and outsiders. Relating changes in appropriations to potential changes in program performance and displaying outcomes in a graphical interface is an essential ingredient in fostering confidence and accountability in appropriations.

By costing fire program management scenarios and tracking the effectiveness and performance of alternatives, budgets can be tailored to the five federal land management agencies. The inclusion of spatial and temporal analysis makes for effective reporting of expected accomplishment by management alternative and by alternative funding level. In this way, federal oversight agencies and Congress can be given an estimate of what alternative budget levels will purchase in fuels treatment, ecosystem restoration, and in the protection of national resources and property, including the wildland-urban interface.

Staffing analysis. Staffing the personnel and equipment for the fire year is a complex process; resources are needed for long-term planning, fire year deployment, prevention, suppression, and much more. Although budgets are formed by agency, resources are often shared at critical times during the fire year, thus adding another layer of complexity to the process. Staffing analysis is a critical component in the operation of a comprehensive performance-based system.

Fuels treatment linked to wildland fire management and initial attack. The interaction of fuels treatment with initial attack of unwanted wildland fires is now recognized as an integral element of wildland fire management. Reducing hazardous fuels reduces the risk profile of the resource base and diminishes the required level of initial attack resources. Rising expenditures in fuels treatments are often regarded as reducing the threat of wildfire to public and private properties. Conversely, successful initial attack affects fuels accumulation and may have long-term implications.

The crucial link between initial attack and fuels treatment is missing from current fire management models. With effective simulations of ecosystems that include fire effects with spatial and temporal resolution, a performance-based system could effectively link the treatment of fuels to the protection of resources.

Fire in ecosystem and landscape management. Treating fuels mechanically and through prescribed fire can affect initial attack success while helping to restore and maintain healthy ecosystems. By incorporating information about fire effects on various vegetation types, a performance-based system can simulate changes in key indicators of ecosystem health based on various treatments through time. The interagency focus of such an approach could enable fuels managers to focus on landscape-level planning and treatments. With different agencies and ownerships, barriers to participation and cooperation should be recognized, and approaches toward partnerships and

cooperation may need to be considered (Williams and Ellefson 1997). A performance-based system would be a powerful tool to help managers design the best fuels management strategies for achieving long-term land management goals.

Urban interface analysis. With steadily increasing property values and the continuing influx of homes, the wildland-urban interface poses a complex challenge for fire managers. Protection of property and human life pose challenges beyond the traditional wildland fire management paradigm. A new system would analyze the values to be protected, alternative treatments, and the cost of protection. Spatial and temporal resolution of the wildland-urban interface and displaying the effects of wildland and prescribed fire management strategies over broad landscapes would facilitate the analysis.

Economic theory and analysis. The economic theory and application of benefit-cost analysis in conformance with OMB Circular A-94 (OMB 1992) could be reviewed for application to the new fire management model. In traditional fire management program analysis, quantifiable objectives tend to be associated with measured levels of benefit where dollar values are attached. For example, fire management of commercial timber stands can be well-suited to quantified measures of dollar benefit such as net value change. Although many of these applications were developed and applied under the previous paradigm, they should be reassessed, as there is growing evidence that they have involved questionable practices (Donovan et al. 1999).

Fire management problems increasingly involve the protection and management of resources where valuation is less and less practical. The increasing role of fire in the functioning of critical ecosystems or in the protection of natural treasures, such as archeological sites and other historic properties, provides just two examples where evaluation in physical units may be more appropriate. Protection of property and life in the wildland-urban interface can push traditional valuation techniques beyond their capabilities and thus re-

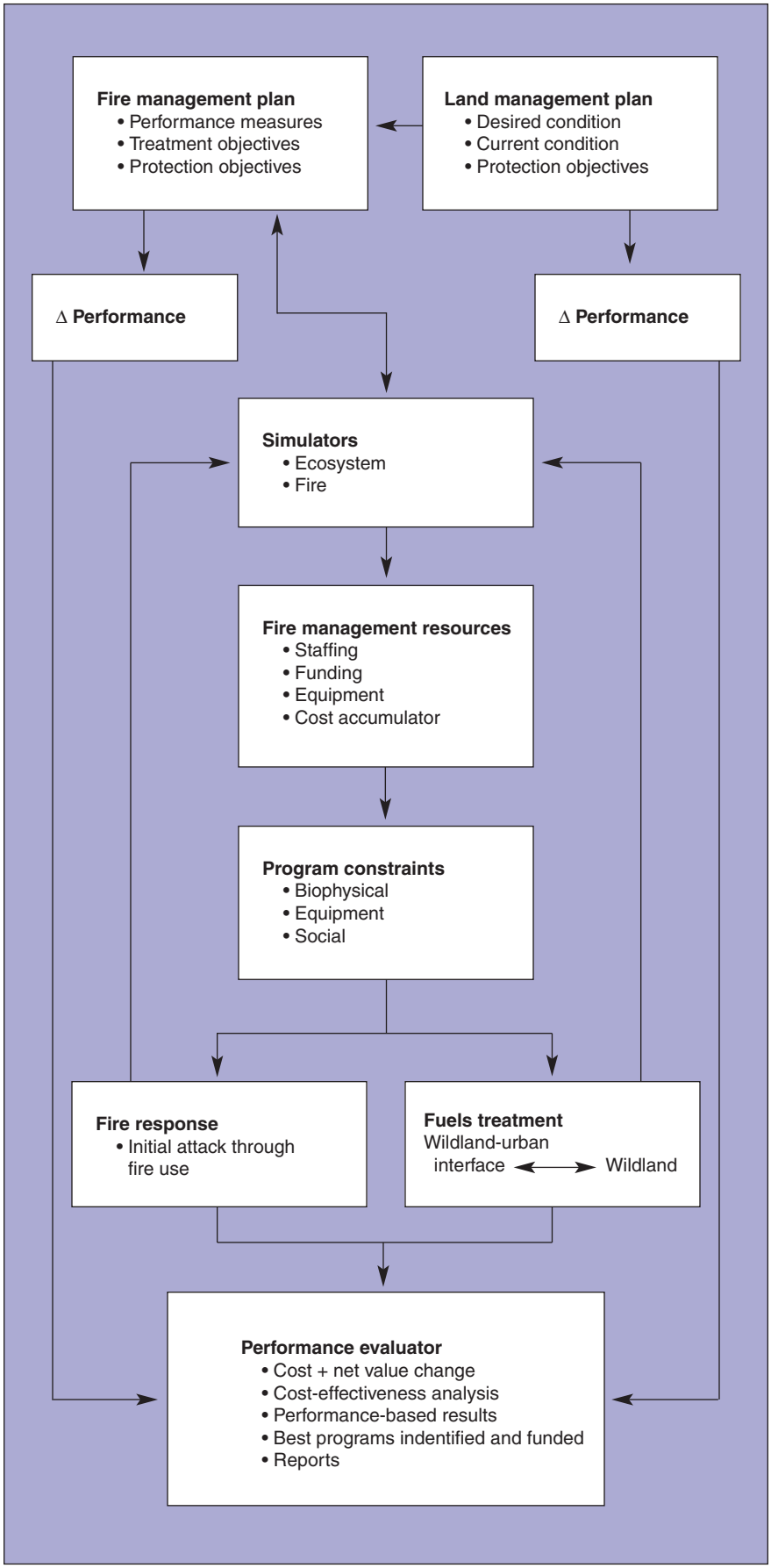

Figure 1. **Performance-based program analysis schematic.**

quire broader analysis tools. The economic principles and applications of cost-effectiveness analysis and investment analysis are intended to address problems of nonmonetized resources and the critical relationship between fuels treatment and the risk profile of hazardous fuels. Increasing requirements for a sound operational and reporting system, conformance with GPRA, and the challenges of nonmonetized results suggest that cost-effectiveness analysis would be an integral part of a performance-based system.

Conceptual Blueprint

The strategic operating elements of a performance-based system appear in *figure 1.* These elements are defined below to launch dialogue. Details of each element would require considerable specification of detail and protocol beyond the scope of this article.

Fire and land management plans. Goals and objectives of the land management plan form the basis for strategic measures of performance and provide direction to the fire management plan. Land management plans should provide an assessment of the current condition, define the desired future condition, and then identify the current difference between the two. This difference provides a basis for goal definition and performance assessment. Fire and land management plans can be synthesized for measures of accomplishment over relevant time periods, and the fire management plan can obtain programmatic goals and objectives from the land management plan.

The fire management plan would specify program elements or tools for managing wildland fire and hazardous fuels. It may also specify fire management units for tactical implementation at the project level. Examples of measurable objectives potentially related to the fire plan could include indicators of acceptable social impacts, resource protection or the degree to which fuels and vegetation, have varied from the natural or desired state (condition classes). Fire management planning can be much more effective if it is expanded on an interagency basis to include broad geographic areas. This is especially relevant to planning and assessing ecosystem fire impacts.

Ecosystem and fire simulators. Ecosystem simulators would model physical changes through time. Clear specification of the spatial and temporal resolution is therefore essential to overall functioning of a performance-based system. As shown in *figure 1,* fire management, including fire response and fuels treatment, affects the ecosystem elements as modeled through space and time. The system would enable managers to model alternative fire responses and fuels management scenarios and track their short- and long-term impacts on the ecosystem. This type of modeling can become a powerful decision tool with which fire management objectives are quantified on an interagency basis over broad geographic areas. Because the ecosystem and fire simulators are related to the set of performance measures from the plans and to the performance evaluator (discussed below), managers and planners could identify how alternative fire management strategies would affect ecosystem performance. Tracking the relationship between ecosystem changes through time and fire management objectives through physical measures related to the landscape is a major feature of the new model.

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Fire management resources. The menu of fire management resources, from ground crews through strategically placed aircraft, could be modeled for potential deployment in response to the full range of fire management activities, from wildland fire response to fuels management. Because these key program elements often share management resources, an integrated management resource element is an important consideration. In addition, the major fire management agencies often "share" resources, making interagency modeling and cost identification advantageous. The fire management resource module would also compute staffing requirements for fire response and fuels treatment activities. Optimization routines can specify cost-effective resource deployment. In addition, by performing sensitivity analysis, cost-effective staffing and equipment levels can be identified by management scenario.

Program constraints or filters. Many potential management activities are constrained by legal or political requirements or realities. For example, fall burnings may be delayed by smoke disturbances to local communities or by federal and state air quality standards. Other potential activities may be curtailed by the Endangered Species Act or by injunction or the potential for injunction. In addition, although certain equipment may seem best for meeting a management objective, it may be infeasible to deploy in certain situations, or it may violate land management requirements for impact of machinery. Further, some operationally feasible alternatives may not be socially desirable or acceptable. Filtering out physically and socially infeasible activities and equipment would provide an important check on the viability of the system and the accuracy of the overall analysis.

Fire response. Recognizing that wildland fire can play an important role in ecosystem functioning, restoration, and overall management, wildland fires can be managed through the full spectrum, from aggressive suppression to the use of natural ignitions to attain a desired condition. Once land management goals are quantified for specific zones, a performance-based system could simulate wildland fires managed under the full range of response strategies.

Fuels treatment. All treatment alter-

natives must be carefully modeled and related to the fire and ecosystem simulators. In addition, special consideration in modeling must be given to social values in the wildland-urban interface. Modeling the benefits and impacts of alternative fuels management strategies in the interface will help managers evaluate program performance.

Performance evaluator and reporter. Driven by sound principles of benefit-cost and cost-effectiveness analysis, this module will accumulate measured changes in performance and link them with appropriate cost elements from the fire management and staffing modules. By comparing measures of performance with cost, programs can be evaluated and displayed to show how well they have met the land and fire management goals. Tradeoffs between ecosystem restoration goals and protection of life and property goals will be more easily understood, allowing land managers to develop a sound and defensible program. The theory of "cost plus net value change" (C+NVC), when properly applied, provides an important measure of program efficiency consistent with the principles of benefit-cost analysis. The NVC function requires that all resources to be managed and protected are "monetized" (assigned dollar values). With vastly more complex analysis and objectives involving the management of critical ecosystems, the protection of life, and the protection of national treasures, such dollar-value-driven valuation is unlikely to provide the kind of analysis appropriate for addressing fire management under the new paradigm. Indicators of performance are increasingly becoming accepted as nonmonetized. That is, physical measures (including qualitative measures) of performance or management effectiveness are increasingly required of the analysis.

Conclusion

Land management in the United States has evolved to include a much broader spectrum of fire management goals than existed under the simple wildland fire suppression paradigm. Broader goals have brought increased responsibilities to fire management organizations and increased demands for accountability and documented performance. We now ask much more of our fire management programs. Today's fire programs must help provide for the maintenance, protection, and restoration of critical ecosystems, whereas only a short time ago the focus was on fire suppression and initial attack. So it is no surprise that the vastly broader range of services required of the fire management agencies has come with an increasing cost in personnel, equipment, and social impact.

Requiring so much more of fire management programs has taxed fire program analysis systems beyond the capabilities of their 20-year-old foundations. Unfortunately, simply adding and upgrading the old foundations is no longer a viable option. Under the new paradigm, where fire plays a central role in land management and protection, a new program analysis and planning model is required. Regaining the public trust in public lands management and providing the groundwork for socially acceptable fire management programs implies higher standards of accountability and disclosure. Because of advances in the design of performance-based systems, in concert with rapid technological advances, such a system can be created to address these critical concerns.

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