Wildland Fire Management Science & Technology Coordination Workshop
Main Interior Building, Washington DC
June 17-19, 2014

Fire Science Applications
"How are agencies organized and resourced to conduct and deliver relevant science?"

Colin C. Hardy, Ph.D.

Program Manager — *Fire, Fuel, and Smoke Science*

RMRS, USDA Forest Service, Missoula, Montana

Fire Science Applications

Fire Science Applications

- Armillaria Response Tool (ART)
- BehavePlus
- BlueSky Smoke Forecast System (BlueSky)
- Comparative Risk Assessment in Fire and Fuels Planning (CRAFT)
- Consume 3.0
- Fire Area Spread Simulator (FARSITE 4.0.4)
- Fire Behavior Assessment Tool (FBAT)
- Fire Ecology Assessment Tool (FEAT)
- Fire Effects Information System (FEIS)
- Fire Effects Planning Framework (FEPF)
- Fire Effects Tradeoff Model (FETM)
- Fire Emission Production Simulator (FEPS)
- FireFamily Plus
- Fire and Fuels Extension–Forest Vegetation Simulator (FFE-FVS)
- Fire Regime Condition Class (FRCC)
- Fireshed Assessment: An Integrated Approach to Landscape Planning
- First Order Fire Effects Model 5.2 (FOFEM)
- FlamMap 3.0 Beta 6
- Forest Inventory and Analysis Biomass Summ. System (FIABioSum)
- Fuel Characteristic Classification System (FCCS)
- Fuel Characteristic Classification System (FCCS) Fuelbed Mapping

- Fuels Management Analyst Plus (FMA Plus)
- Gradient Nearest Neighbor (GNN)
- Gradient Nearest Neighbor (GNN) Vegetation and Fuel Maps, Including
- Guide to Fuel Treatment in Dry Forests of the Western United States
- Harvest Cost and Revenue Estimator (HCR Estimator)
- Integrated Forest Resource Management System (INFORMS)
- LANDFIRE
- LANDIS and LANDIS-II
- Landscape Simulator
- My Fuel Treatment Planner (MyFTP)
- NEXUS
- Optimizing Fuel Solutions and Ecological Values in Landscapes (FUEL
- Simulating Patterns and Processes at Landscape Scales (SIMPPLLE)
- Smoke Impact Spreadsheet (SIS)
- Stereo Photo Series for Quantifying Natural Fuels
- Tool for Exploratory Landscape Scenario Analysis (TELSA)
- Understory Response Model (URM)
- Valuation of Ecosystem Restoration Strategies (VERSTRA)
- Vegetation Dynamics Development Tool (VDDT)
- Water Erosion Prediction Project (WEPP) Fuel Mgt (FuMe) Tool
- Wildlife Habitat Response Model (WHRM)

Peterson, David L. and others. 2007.
A consumer guide: tools to manage vegetation and fuels.
[n=42]

USDA

Fire Science Applications

Peterson, David L. and others. 2007.
A consumer guide: tools to manage vegetation and fuels.

The variety of scientific software, simulation models, and decision support tools available for hazardous fuel treatment can be overwhelming, even for an experienced scientist or resource manager. Effective use of any given tool typically requires considerable time, training, and sometimes expense. Some tools have been effectively institutionalized and supported by federal agencies, whereas other potentially useful tools have not, and development of new tools is ongoing.

Surface Fire Spread Modeling

Sullivan, A. 2009. IJWF.
Wildland surface fire spread modeling, 1990-2007. (3 parts)

Type or Category	# Models
Physical	12
Quasi-physical	7
Empirical	15
Quasi-empirical	5
Simulation	14
Mathematical - anologue	22

Physical Models

Model	Author (year)	Origin
Weber	Weber (1991)	Australia
AIOLOS-F	Croba *et al.* (1994)	Greece
FIRETEC	Linn (1997)	USA
Forbes	Forbes (1997)	Australia
Grishin	Grishin *et al.* (1997)	Russia
IUSTI	Larini *et al.* (1998)	France
PIF97	Dupuy *et al.* (1999)	France
FIRESTAR	Morvan *et al.* (2001)	France
LEMTA	Séro-Guillaume *et al.* (2002)	France
UoS	Asensio *et al.* (2002)	Spain
UoC-R	Zhou *et al.* (2005)	USA
WFDS	Mell *et al.* (2007)	USA

Sullivan, A. 2009. (Part 1)

Quasi-Physical Models

Model	Author (year)	Origin
ADFA I	de Mestre *et al.* (1989)	Australia
TRW	Carrier *et al.* (1991)	USA
Albini	Albini *et al.* (1996)	USA
UdC	Santoni *et al.* (1998)	France
ADFA II	Catchpole *et al.* (2002)	Australia; USA
Coimbra	Vaz *et al.* (2004)	Portugal
UoC-B	Koo *et al.* (2005)	USA

Sullivan, A. 2009. (Part 1)

USDA

Empirical Models

Model	Author (year)	Origin
CFS-accel	McAlpine and Wakimoto (1991)	Canada
CALM Spinifex	Burrows *et al.* (1991)	Australia
CFBP	FCFDG (1992)	Canada
PWSTas	Marsden-Smedley and Catchpole (1995)	Australia
CALM Mallee	McCaw (1997)	Australia
CSIRO	Grass Cheney *et al.* (1998)	Australia
Heath	Catchpole *et al.* (1998)	Australia
UdTM Shrub	Fernandes (2001)	Portugal
CALM Jarrah I	Burrows (1999)	Australia
CALM Jarrah II	Burrows (1999)	Australia
UdTM Pinaster	Fernandes *et al.* (2002)	Portugal
Gorse	Baeza *et al.* (2002)	Spain
Maquis	Bilgili and Saglam (2003)	Turkey
Helsinki	Tanskanen *et al.* (2007)	Finland
CSIRO Forest	Gould *et al.* (2007)	Australia

Quasi-Empirical Models

Model	Author (year)	Origin
TRW	Wolff *et al.* (1991)	USA
NBRU	Beer (1993)	Australia
USFS	Catchpole *et al.* (1998)	USA
Coimbra	Viegas (2002)	Spain
Nelson	Nelson (2002)	USA

Sullivan, A. 2009. (Part 2)

Simulation Models

Model	Author (year)	Origin
Ignite	Green *et al.* (1990)	Australia
CSU	Kalabokidis *et al.* (1991)	USA
Firemap	Vasconcelos and Guertin (1992)	Portugal
NCAR	Clark *et al.* (1996)	USA
SiroFire	Coleman and Sullivan (1996)	Australia
Thrace	Karafyllidis and Thanailakis (1997)	Greece
Prolif	Plourde *et al.* (1997)	France
Farsite	Finney (1998)	USA
Pyrocart	Perry *et al.* (1999)	New Zealand
Firemaster	Eklund (2001)	Australia
PdM	Guariso and Baracani (2002)	Italy
FireStation	Lopes *et al.* (2002)	Portugal
Prometheus	CWFGM Steering Committee (2004)	Canada
UWA	Johnston *et al.* (2006)	Australia

Sullivan, A. 2009. (Part 3)

Federal Scientists and the Research Grade Evaluation Guide (RGEG)

Six Type of Research Accomplishment:

1. Knowledge discovery
2. Knowledge Development
3. Knowledge synthesis and assessment
4. Modeling and systems integration
5. Special assignments and projects
6. Leadership

#4. Modeling and Systems Integration

- Accomplishments include scientific model building, methods development, and systems research, integration, and testing.

- Includes development of basic theories and the synthesis of this knowledge into organized modules and systems that help to give others an understanding of the mechanism.
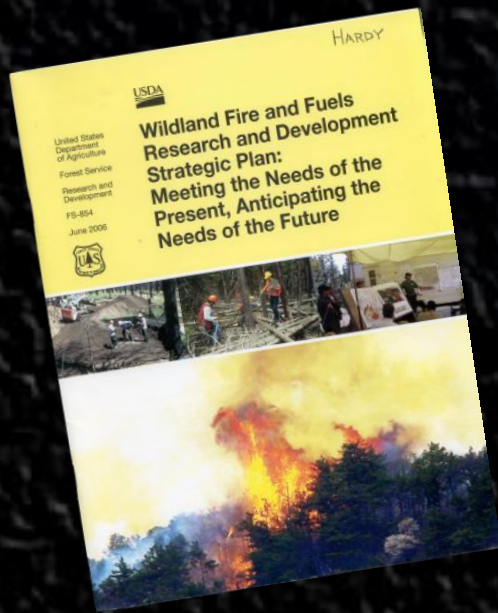
Strategic Plan for Wildland Fire and Fuels Research and Development

Wildland Fire and Fuels Research and Development Strategic Plan: Meeting the Needs of the Present, Anticipating the Needs of the Future

United States Department of Agriculture

Forest Service

Research and Development

FS-854

June 2006

HARDY

Fire Research and Development Portfolios:

A. Core Fire Science

B. Ecological and Environmental Fire Science

C. Social Fire Science

D. Integrated Fire and Fuels Management

E. Science Delivery
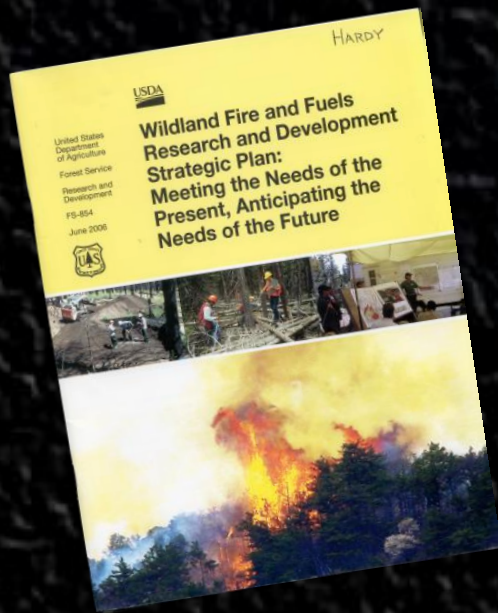
Strategic Goal 2 (Portfolio E):

Develop and deliver knowledge and tools to policymakers, wildland fire managers, and communities

- ELEMENT E1: SYNTHESIS AND TOOL DEVELOPMENT

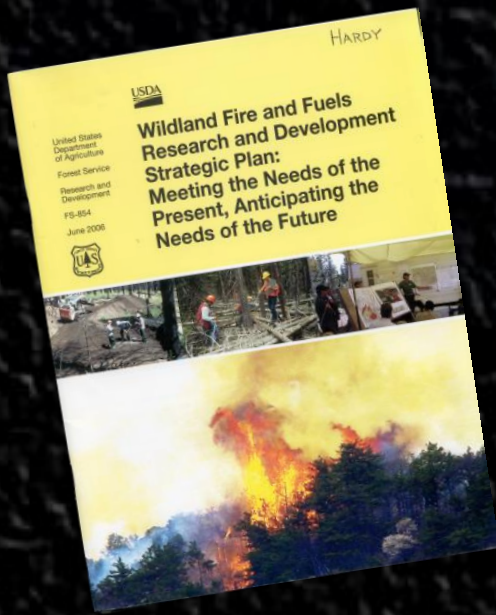- ELEMENT E2: SCIENCE APPLICATION STRATEGY
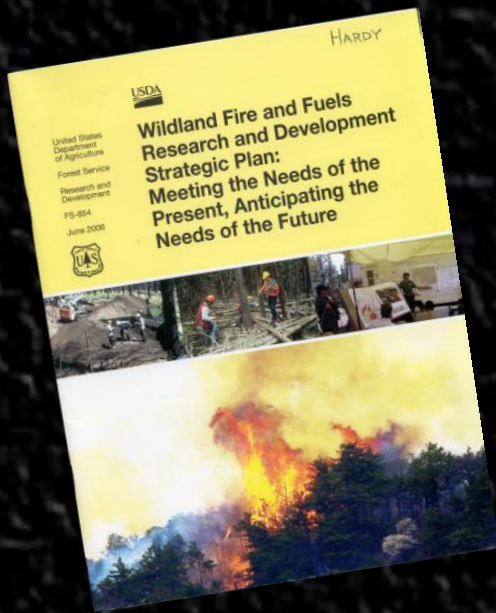
ELEMENT E1: SYNTHESIS AND TOOL DEVELOPMENT

Accelerate and coordinate the development of science syntheses and decision-support and predictive tools that build on Strategic Goal 1 [portfolios A-thru-D] research.

a. Decision Support for Appropriate Management Response and Programmatic Fire Planning

b. Fuel Management, Postfire Rehabilitation, and Ecosystem Restoration

Element E2: Science Application Strategy

Develop and implement a comprehensive national strategy for moving science into application, supporting and maintaining tools and models resulting from wildland fire and fuels R&D, and for evaluating success.

a. Implement a corporate, interagency decision process to evaluate and select models and decision-support tools for further development, and recommend adoption.
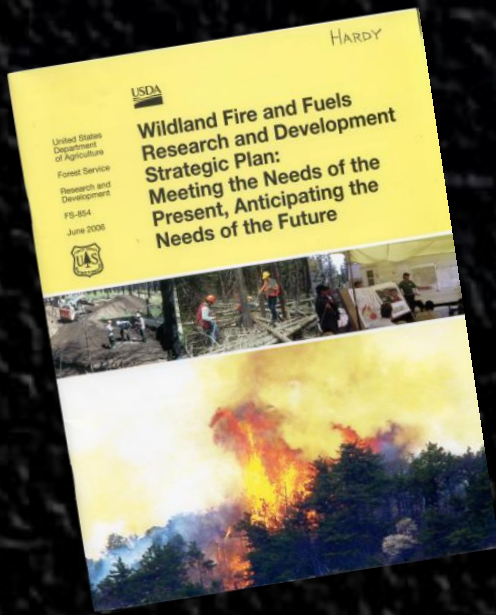
ELEMENT E2: SCIENCE APPLICATION STRATEGY
(continued) ......

b. Develop a corporate approach within the USDA Forest Service to ensure effective application of research results to management problems

1. Define and implement a dedicated infrastructure for science application and technology transfer.

2. Develop a stable funding structure to ensure adequate staffing and longterm commitment.

"… we now have a "system" of independently developed, linked models that were never intended to work together, are sometimes based on very limited data, and may propagate errors beyond acceptable limits"

U.S. FS R&D 2006

" The…challenge is to balance the efforts to develop a new, more flexible physics-based approach while at the same time providing a moderate level of support for the existing systems without resorting to a major overhaul to extend the life of their usefulness. "
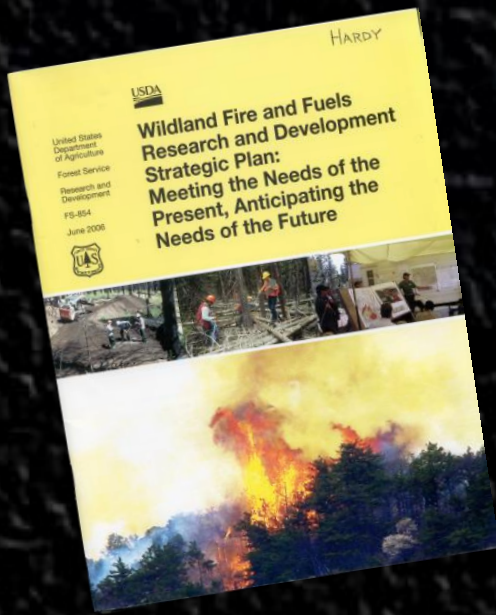
External Peer Review 2007
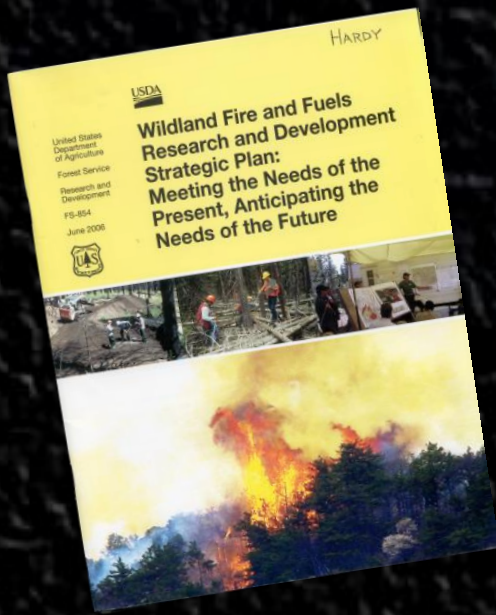
Element E2: Science Application Strategy

c. Foster partnerships for science application and delivery.

Wherever possible we recommend joint planning with agency, university, and other partners outside the USDA Forest Service for science application.

ELEMENT E2: SCIENCE APPLICATION STRATEGY

d. Develop improved approaches for effective science delivery and application.
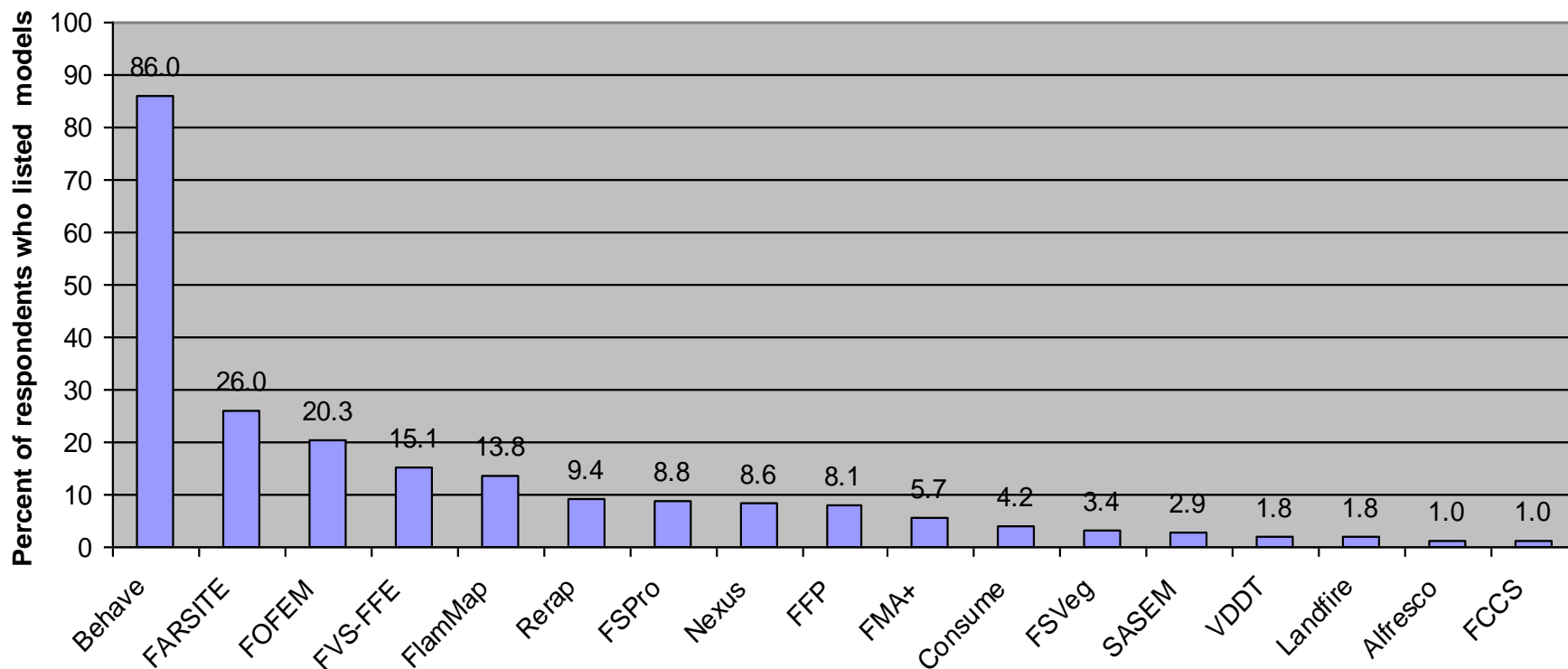
Improving the effectiveness of science delivery requires us to identify and evaluate existing approaches to science delivery and learning within target audiences.

Technical and Social Influences on the Success of Fire Science Delivery
V. Wright, 4/10/09 (JFSP Project #04-4-2-01)

All Agencies (n = 385)
USFS, NPS, BLM, USFWS, BIA, State, TNC

Percent of respondents who listed models

Model	Percent
Behave	86.0
FARSITE	26.0
FOFEM	20.3
FVS-FFE	15.1
FlamMap	13.8
Rerap	9.4
FSPro	8.8
Nexus	8.6
FFP	8.1
FMA+	5.7
Consume	4.2
FSVeg	3.4
SASEM	2.9
VDDT	1.8
Landfire	1.8
Alfresco	1.0
FCCS	1.0

Results are shown for 17 applications; another 33 were listed by <1% of respondents

Influences to the Success of Fire Science Delivery: Perspectives of Potential Fire / Fuels Science Users
V. Wright, 2010 – JFSP Final Report #04-4-2-01

Influences to Research Use

Beliefs about research usefulness & ease of use

Individual willingness to try new approaches

Position responsibilities → **Research Use** ← Education, history with scientists

Organizational culture: Support, time for reflection, experimentation, communication, appreciation of alternate viewpoints

Public values, acceptance

Recommendations for Scientists:

1. Expect a time lag to diffusion.

2. Target delivery to early adopters.

3. Target delivery to positions responsible for research use and communication.

4. With managers, experiment with boundary spanner positions to facilitate application.

5. When it's relevant, show research relevance (including models) to FBANS.

6. Explicitly demonstrate objectivity, in both study design and communication.
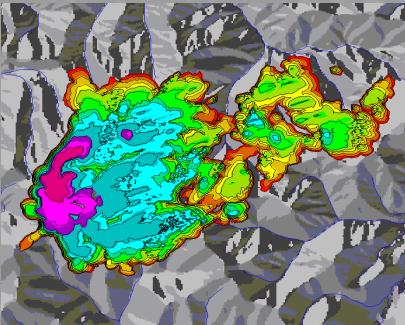
Experiments and Data

Data and Models

$$R = \frac{I_R \xi (1 + \phi_w + \phi_s)}{\rho_b \varepsilon\, Q_{ig}}$$

Models and Modeling Systems

Fire Management
- Physical processes
- Social
- Ecological
- Fuel
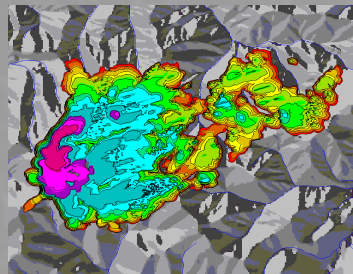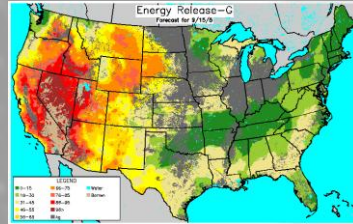- Risk assessment
- Applications

Research   Development   Application

R   D   A

$$R = \frac{I_R \xi (1 + \phi_w + \phi_s)}{\rho_b \varepsilon Q_{ig}}$$
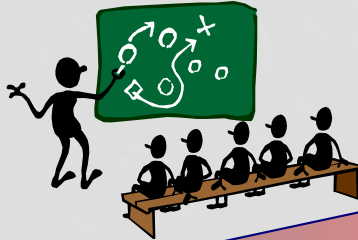
Research | Development | Application

R D A

Corporate
adoption

Distributed
w/O&M
& help

Special use
w/limited
O&M

Peer-to-peer
research
platform

Personal
research
tool / bench

The Basic-to-Applied Science Continuum: Who is RESPONSIBLE for WHAT ?
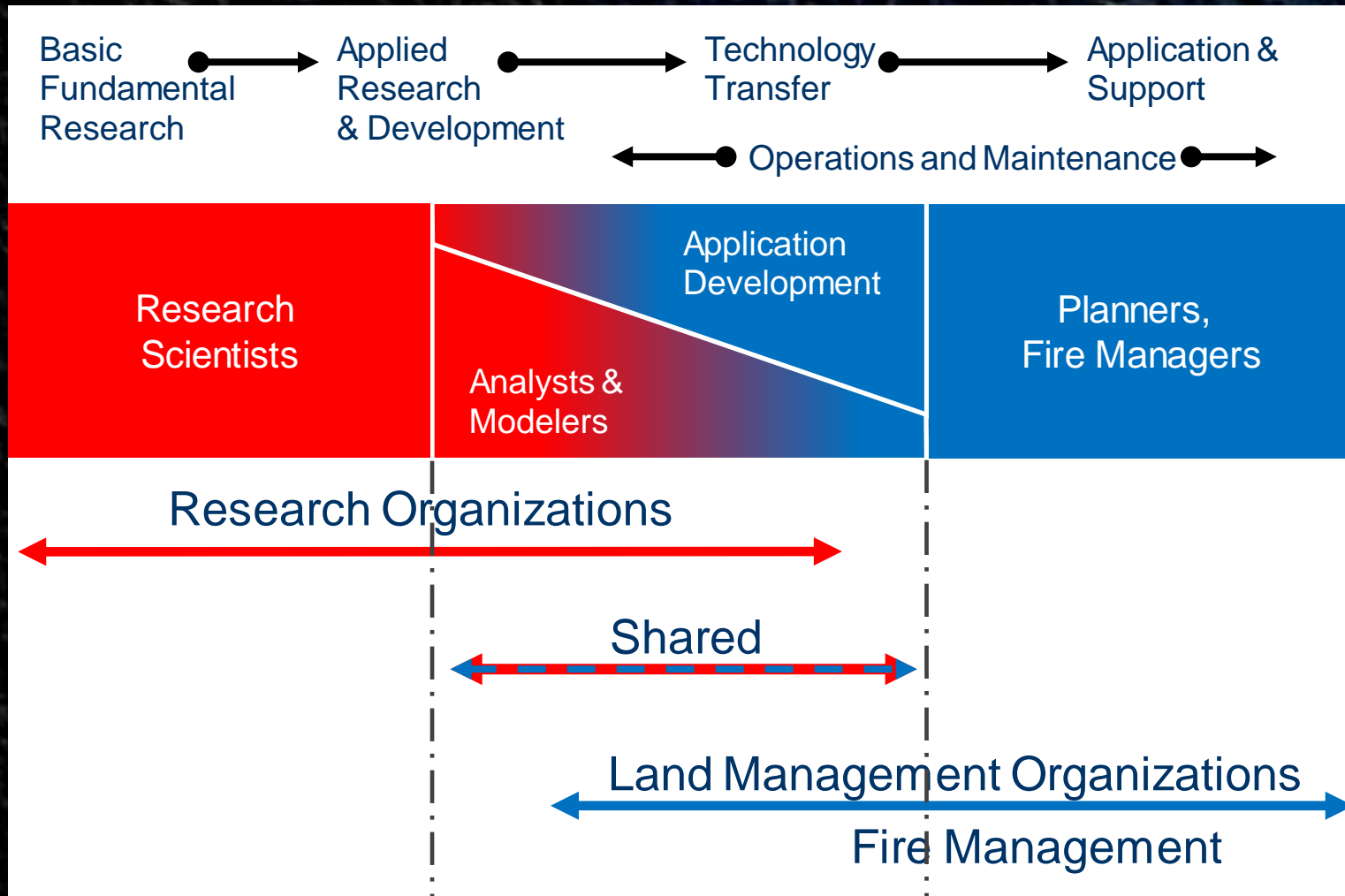
How are agencies organized and resourced to DELIVER SCIENCE?

FS R&D Nationally

R&D Fire SPA:

E. Science Delivery

JFSP

Knowledge Exchange Consortia: Connect to Local Experts

FS R&D Station(s)

FS R&D
Station(s)