Decker Fire
Suppression Difficulty Index
Custom Fuel Moistures
10 MPH,
250 Azimuth
Gridded winds
October 5, 2019

Fire Perimeter 10/04/2019
Planning Area 9/11/2019
Roads
Wilderness
Supression Difficulty Index
0 - 0.1
0.1 - 0.2
0.2 - 0.4
0.4 - 0.7
0.7 - 1
> 1

Suppression difficulty index map, one of the risk management assessment tools used on the Decker Fire in fall 2019 in Colorado.

Data and Dialogue: Assessing Forest Service Risk Management Assistance

Chad Kooistra and Courtney Schultz

With an increase in wildland fire frequency, size, intensity, duration, and complexity, managing wildland fire has become increasingly challenging for the Forest Service and its cooperators. In 2016, Forest Service wildland fire leaders adopted an approach to help resolve ongoing concerns about protecting firefighter safety and values at risk while improving decision-making

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accountability, both internally and to Congress. The resulting risk management assistance (RMA) teams were tasked with supporting line officers through refined risk analytics and in-depth discussions to improve the quality of decision making and transparency on large wildfires.

Our goal was to help the Forest Service understand the efficacy of risk management assistance and options for expanding its use.

FOREST SERVICE RISK MANAGEMENT ASSISTANCE

The RMA teams consisted of experienced line officers, fire operations experts, researchers, and risk management specialists. The teams began traveling to fire events in 2017, but they were not meant to be a permanent structure. A long-term goal has been to explore decision support needs, apply emerging research tools, support ongoing learning through feedback, and institutionalize RMA best practices and tools so that line officers and their teams can use them on fire events throughout the agency. RMA support was provided exclusively through in-person teams in 2017 and through a combination of in-person teams and remote or virtual assistance in 2018.

One change initiated in 2019—and anticipated for the future—was to make RMA support primarily virtual; in fact, the "T" was dropped from the initial acronym (RMAT, for risk management assistance team) because teams no longer responded in person. The range of available RMA products (see the sidebar) reflects their overarching intent:

- To enhance decision making;
- To improve accountability and resource use; and
- To provide up-to-date information and predictions about the characteristics of a fire, forest and weather conditions, and other management considerations (see the RMA website at *https://wfmrda.nwcg. gov/RMAT.html* for more information about products and for examples).

Recognizing that feedback is an essential component of organizational learning, RMA leaders regularly evaluated their success in postevent summaries and internal discussions. They also requested a third-party assessment of RMA after its first 2 years to gain additional insights.

In response, our team from Colorado State University independently assessed RMA results in the summer and fall of 2019. Our goal was to help the Forest Service

Potential control locations map (left) and ground evacuation map (right), one of the risk management assessment tools used on the Decker Fire in fall 2019 in Colorado.

understand the efficacy of the RMA approach and options for expanding the use of RMA concepts going forward. This article presents the main findings from our assessment, including specific findings about RMA and general findings regarding risk-informed decision making on wildland fire events (see Schultz and others (2020) for more detailed findings).

INTERVIEWS WITH RMA DELIVERERS AND RECEIVERS

We started by reviewing background information on RMA and conducting preliminary informational interviews with RMA team members to help design our study. We then conducted 33 semistructured and confidential phone interviews in the summer of

2019 with both RMA "deliverers" (RMA team members who delivered products and support) and "receivers" (fire managers who received the support during an incident in 2017 or 2018). Receivers included line officers/agency administrators on fire incidents and a smaller number of analysts, incident commanders, operations chiefs, and other agency personnel.

Overall, we conducted 42 interviews averaging about 1 hour each. Our research team recorded, transcribed, and analyzed the confidential interviews using social science analysis techniques to identify key themes.

In the fall of 2019, we decided that a case study of RMA support on a recent fire would provide updated insights.

the use of different types of aircraft, including helicopters, large airtankers, and scoopers. The information displayed can track the use of retardant and help guide subsequent analysis of the associated environmental impacts.

SUPPRESSION DIFFICULTY INDEX (SDI) MAP

Displays how complex wildfire-related operations may be based on factors such as modeled fire behavior, responder mobility, available fuel breaks, and time to create line. Higher values on the SDI scale indicate more hazardous situations or areas.

POTENTIAL CONTROL LOCATION MAP

Shows the likelihood of fire stopping in a given area based on historical fire perimeters and other model drivers (such as fuel transitions, road networks, rate of spread, and suppression difficulty). Higher probabilities indicate better containment opportunities under current fire conditions.

SEASON-ENDING ANALYSIS

Describes the probability of a season-ending event, such as pulses of rain or snow, lower temperatures, and higher relative humidity.

SNAG HAZARD MAP

Estimates and displays the relative hazard from dead standing trees across the landscape using a mathematical relationship between Forest Inventory Analysis plot data and landscape characteristics.

GROUND EVACUATION MAP

Gives travel time estimates from different locations in the proximity of a fire to the nearest care facility, accounting for considerations such as road availability or conditions, slope, vegetation type, and driving speeds.

EXCEED PROBABILITY CURVES

Uses information from regional quantitative wildfire risk assessments and fire spread probability outputs to estimate the distribution of potential outcomes for highly valued resources and assets within a given timeframe.

We chose the Decker Fire in Colorado in fall 2019. We interviewed decision makers and the RMA delivery team, for a total of nine interviews related to the Decker Fire.

Below, we first present our main findings, followed by highlights from RMA on the Decker Fire. Then we discuss recommendations for future RMA efforts and for risk-informed decision making throughout the agency.

KEY FINDINGS
PERCEIVED VALUE OF RMA

People who received RMA support generally agreed that RMA products and specialists spurred valuable discussion about strategic alternatives for incident response and deliberation about risk-informed decision making among local political leaders, partners, and agency and fire management personnel. The discussions allowed for more structured and coordinated decisions. RMA offered evidence to support line officers' decisions, often providing validation for what already had been decided and, in most cases, increasing a line officer's confidence in those decisions.

As one line officer stated, "RMAT gives you a high degree of confidence that your decisions are sound. When you reach a decision, you are confident it's the right one given the circumstances."

We also heard that RMA provided tools to enhance transparency and accountability regarding decision-making rationale and procedures for resource use. The tradeoff analysis exercise in particular was called a useful tool and opportunity for considering different perspectives that may have been missed without a formal conversation. The exercise offered a structured format for discussing values at risk (such as firefighter safety, infrastructure, and water quality) across the landscape and how different fire management strategies might affect those values.

Interviewees consistently noted that one outcome of these discussions was clear, transparent communication about decision-making rationale among line officers when communicating with fire

In general, we heard a need for a more comprehensive and common understanding of risk.

staff, partners, cooperators, and the public. Some said that this allowed line officers who were new to communities to include cooperators, partners, and local officials in conversations and to build trust with them.

As one deliverer stated, "[RMA] gave [agency administrators] a lot of scientific data, and it provided them with concrete data to show partners and stakeholders why decisions were made."

FACTORS THAT AFFECTED RMA IMPLEMENTATION

We asked RMA deliverers and receivers about the factors that affected decision makers' receptivity to RMA during a fire. Line officers, agency administrators, and fire staff who were familiar with RMA, whether through preseason exposure or by engaging with it on a previous fire, were more comfortable with and open to RMA processes and tools than those who were unfamiliar with RMA.

For instance, some line officers expressed a feeling of being second guessed when RMA teams showed up on a fire offering additional insights and analysis. However, such feelings were less common if the line officer was aware of the intent of RMA to provide additional support, as opposed to challenging decisions or providing another layer of oversight.

Line officers and fire staff also received RMA support more positively when RMA teams arrived prior to key decision points. Some said that when the RMA team arrived, decision makers had to spend valuable time with the team repeating prior discussions in order to get the team up to speed. They suggested that receiving RMA support prior to or during Wildland Fire Decision Support System (WFDSS) decision inputs would be more efficient than getting support after decisions are entered in the WFDSS.

Interviewees said that line officer personality, such as being open to mentoring and incorporating scientific analysis, also affected receptivity to RMA. Years of fire experience did not necessarily relate to RMA receptivity, although most interviewees perceived RMA as more beneficial for line officers with less fire experience. Local agency leaders clearly played an important role in communicating the benefits of RMA support, encouraging requests for RMA support and integrating RMA support with other information and decisions.

Any set of analytical tools carries a degree of uncertainty. A few fire staff expressed concerns about the reliability of some of the RMA products, such as an evacuation

The early timing of risk management assistance support on the Decker Fire improved the ability to more effectively integrate it into other processes and decision points.

map suggesting a potential evacuation route on a washed-out road that was impassable. Others found the tradeoff analysis exercise to be subjective and redundant with other risk assessment processes.

People generally agreed, however, that any of these types of information and processes need to be complemented with both local knowledge and experiential knowledge in incident management. One suggestion was that local and regional fire staff, who have local knowledge and relationships, obtain more knowledge of RMA tools and approaches; this would require increased education, training, and capacity among local and regional staff for implementing RMA approaches.

Integrating any decision support system such as RMA requires balancing existing organizational structures, processes, and experiences against the increased use of analytics. As a recent article in *Harvard Business Review* emphasized, "Investments in analytics can be useless, even harmful, unless employees can incorporate that data into complex decision making" (Shah and others 2012).

BROADER CHALLENGES AND CONSIDERATIONS

We also sought to understand broader challenges and considerations regarding Forest Service fire management and the implications for RMA. In general, we heard a need for a more comprehensive and common understanding of risk among RMA deliverers, line officers, and fire staff, both within the agency and among partners.

The concept of operational risk is ingrained in firefighters' everyday practice from the first day on the job. Firefighters draw on their experience and training to help them mitigate risk. Over the past decade, improved analytical tools, such as the WFDSS, potential operational delineations, and now RMA, have supplemented experience and training in making risk-informed fire response decisions. The intent of such analytical tools is to move beyond mitigating operational risk into the realm of strategic risk management.

Interviewees said that aligning a broader understanding of risk management with on-the-ground decision making requires leaders and staff to step back in order to discuss the bigger picture of risk-informed decision making and how it plays out for different kinds of decisions and decision makers, essentially moving from operational to strategic risk management. As one RMA deliverer explained, there is a need for "a deeper, basic understanding of what risk really is and what [risk-informed] decision making might look like." A lack of alignment between how agency leaders and fire personnel perceive risk and approach risk management is a potential barrier to applying new tools and information.

Some people we spoke to thought that RMA has helped develop a common understanding and approach to assessing risk and informing decisions across all spectrums of risk (such as risk to firefighters, individual and organizational risk, short-term and long-term risk, and so forth). In discussing risk, several informants referred to the Forest Service's four-level risk diagram (enterprise, strategic, operational, and real-time risk management). One line officer pointed out how "RMAT helps people understand those various levels of risk. If applied well and communicated well to firefighters, you can connect those levels of risk to firefighters." The RMA process can be an important opportunity to create shared understanding about risk management among different personnel and across various situations.

Interviewees also discussed tensions connected to the notion of risk sharing in relation to roles and responsibilities in wildland fire management across the agency. Firefighters risk their own safety and lives on the ground. Line officers we spoke to universally took responsibility for decision making and outcomes on a fire because they often represent the agency in public, especially after a fire event. They agreed that RMA was only "providing support [because] you can't really share responsibility."

However, one deliverer explained that the agency as a whole bears responsibility for decisions by training and equipping line officers to make good decisions: "You happen to have delegated responsibilities. But at the end of the day, we are all responsible as an organization. We're all in the same boat." Nevertheless, interviewees generally thought that there is not a broad sense of shared risk across the hierarchy of the agency. Ultimately, RMA can help improve and support decision-making processes, but discussions about decision-making responsibility highlight the need to evaluate how and where organizational culture affects responsibility and risk sharing and where decision support tools fit into the complex relationship between organizational culture, decision making, and risk sharing.

Several line officers noted differing opinions in the community as to acceptable levels of risk to firefighters in protecting homes or other values.

Smoke from the Decker Fire in fall 2019, seen from Poncha Pass near Salida, CO. Photo: Chad Kooistra.

Aggressiveness in attacking a fire varies among firefighters, depending on the agency; on the team; and on condition-dependent factors such as weather, fire behavior, and fire history, among other considerations. One line officer questioned how to legitimately assess risk before ordering firefighters to engage a fire, citing such cultural factors as "the intense fear of humiliation and ridicule if we don't fulfill a mission [and] the biased can-do reaction [of firefighters]." Although interviewees noted disagreement about acceptable levels of risk, they agreed that firefighter safety is their top priority.

Broader debates about the values at risk and the responsibility for them are intertwined with diverging perspectives on the role of fire on the landscape.

Interviewees said that there is a bias on incidents towards aggressive fire response rather than accepting the need and taking responsibility for a variety of fire management decisions. Agency personnel have disparate perceptions of fire's role on the landscape, interpretations of how to integrate fire as a resource management tool, and perspectives on how to consider a wide range of response options. As one deliverer said:

> We are very well split in the agency. Some fire folks see themselves as a fire organization, meaning they do suppression. They go every time the fire bell rings. They're in for war. … Then there's another group of people in the fire organization that see

themselves as resource managers, in a way, and their job, it's an art. How much fire do you introduce in order to make a sustainable ecosystem? It's a lot different.

The ability to consider a variety of management response options also depends on local social and political pressure and local relationships. Local biophysical conditions, fire history, and social and political pressure can leave agency administrators with limited space to consider anything other than aggressive attack, according to some line officers. Such broader considerations will be important for the Forest Service to continue grappling with as new challenges related to fire management emerge and efforts such as RMA are made.

2019 DECKER FIRE CASE STUDY

Leaders of the RMA effort sought to enhance the efficacy of RMA support during the 2019 fire season. One event in particular exemplified how RMA can succeed in the future.

Lightning ignited the Decker Fire in September 2019 in the Sangre de Cristo Wilderness in southern Colorado. The fire burned approximately 9,000 acres (3,600 ha) until the area received a significant snowfall 7 weeks after ignition. RMA support was requested and provided within the first 4 days of ignition and several times later during the fire.

Partners, cooperators, agency administrators, and fire management team leaders review conditions and strategies during an evening briefing on the Decker Fire in fall 2019. Photo: Chad Kooistra.
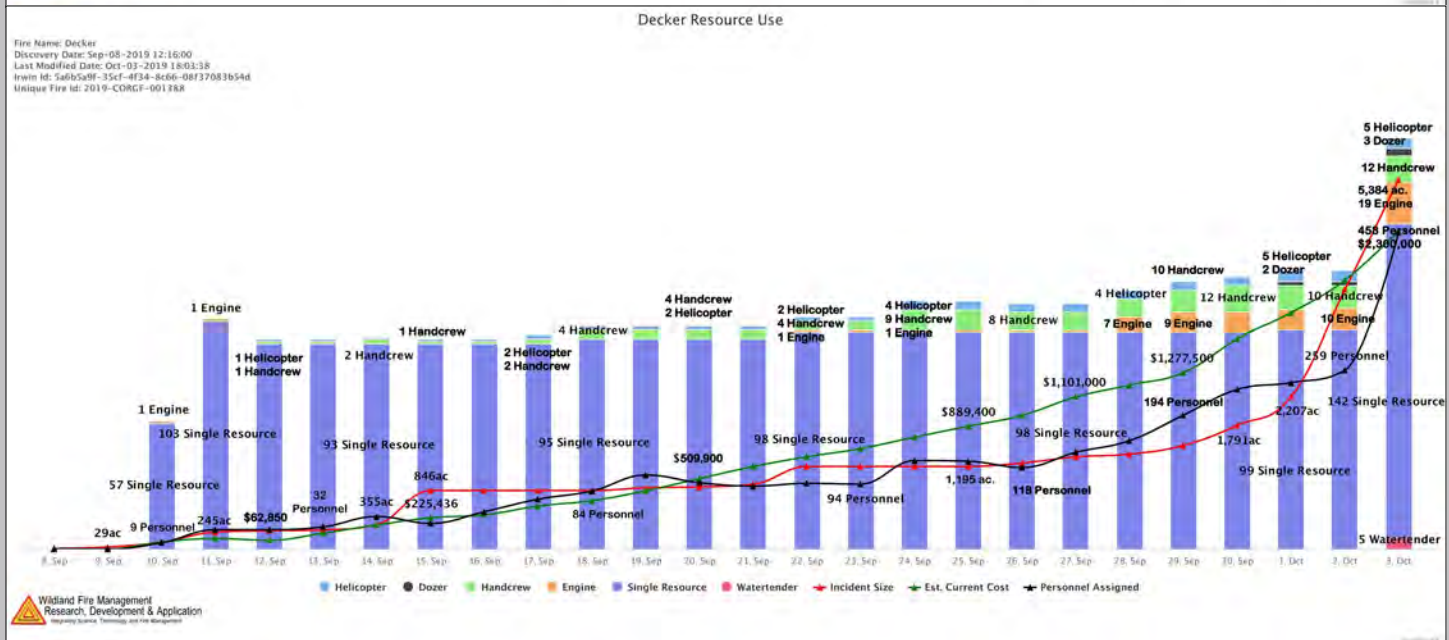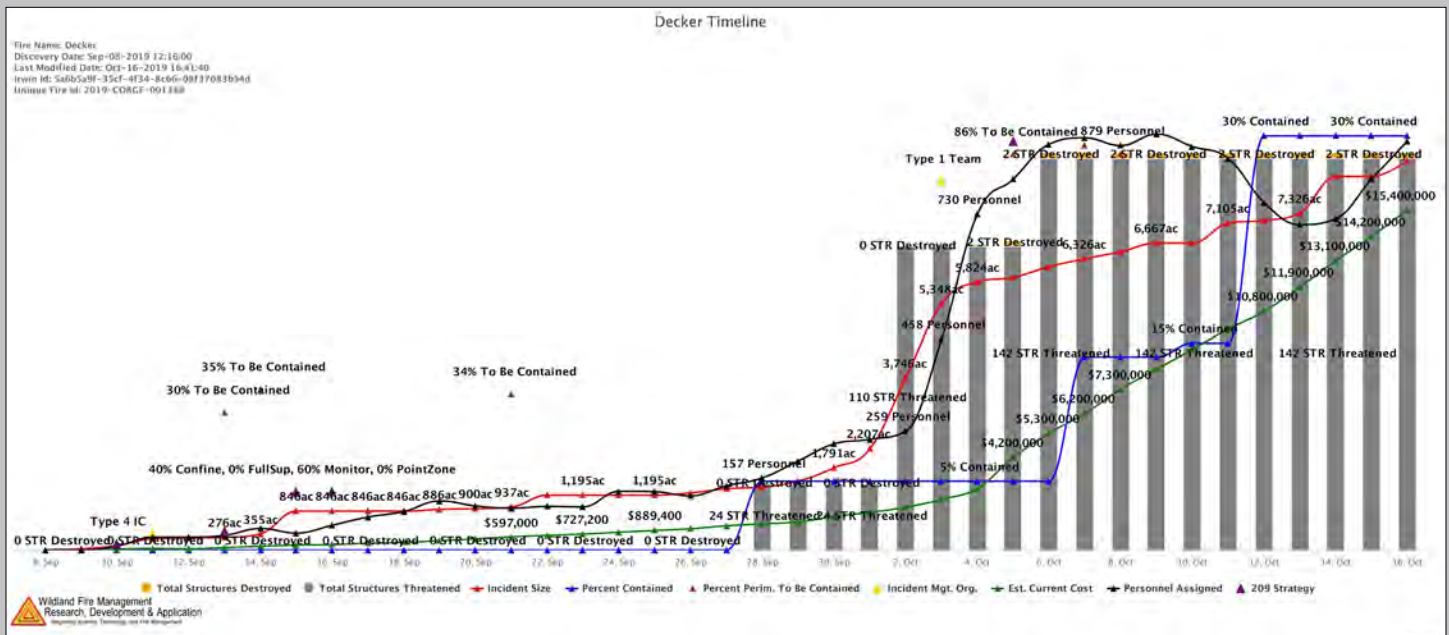
Incident timeline (top) and resource timeline (bottom) from the Decker Fire in fall 2019, some of the risk management assessment tools used on the fire.

One person noted, "When I think back to all these different RMA fires, I like this [approach used on the Decker Fire] because it was used by multiple people at multiple times throughout the whole life cycle of the fire. This is the ideal example of how this could work on other fires."

Several line officers connected with the Decker Fire had extensive background in RMA and initiated early discussions about requesting RMA support. Agency administrators for the Decker Fire initially selected a strategy other than aggressive

suppression due to the remoteness of the fire and predictions about growth. They requested RMA support within 2 days after ignition because they recognized the potential complexity of the fire. It was burning in an area surrounded by dense beetle-killed trees, abundant snags, and steep terrain, with the potential to move towards communities if weather patterns and fire behavior aligned. Line officers understood the potential for a complex and long-term event and wanted RMA support to help them thoroughly consider their short- and long-term options.

This type of leadership commitment, background knowledge, and training is essential for successfully integrating new systems and analytics into the fire management decision-making process.

Interviewees viewed the timing of initial RMA support on the Decker Fire as ideal because the support was available before major decisions were made. The early timing of RMA support also improved the ability to more effectively integrate RMA into other processes and decision points. As one person noted, "[RMA support]

also really helped formulate some of the WFDSS decision making and objectives. It was really interesting because [the tradeoff analysis] also helped facilitate WFDSS, and WFDSS helped facilitate the tradeoff analysis."

Line officers and fire staff on the Decker Fire consistently mentioned the value of the tradeoff analysis exercise. They conducted three different tradeoff analysis exercises during the Decker Fire. Participants said that they walked away with the clearest understanding they had ever had of what the fire management team needed to do to succeed in a manner consistent with the agency administrator's strategy. For example, one participant told us the following:

> We thought that would be useful, and it was, for a sitdown with the type 3 team that we ordered and the agency administrators to really home in on what the values at risk were. … They changed their decision during the course of the risk assessment and the tradeoff analysis. They all had a mental outcome in mind, and then, when they went through the risk assessment and the tradeoff analysis, that actually changed.

Participants said that the tradeoff analysis exercises also created a structured opportunity to consider perspectives across different agencies and jurisdictions. Decision makers discussed and prioritized values at risk on two national forests, Bureau of Land Management (BLM) districts, and other lands and aligned the strategic approach accordingly. BLM partners identified important values at risk, such as impacts on sage grouse habitat, cultural considerations, and the effects of road closures on the hunting community. Recognizing these issues helped the team formulate decisions and consistently communicate the rationale for these decisions to the public and various stakeholder groups.

Those discussions also led to more efficient transitions between the multiple management teams throughout the fire because teams did not need to engage in that entire process to get the necessary

Risk management assessment teams consisted of experienced line officers, fire operations experts, researchers, and risk management specialists.

information. The suite of RMA products was included in the packet of information provided to incoming teams and helped facilitate transitions between management teams.

As one member of an incident management team stated, "[The tradeoff analysis exercise] was fantastic. Because of the stuff that [an agency staff member] preloaded … instead of us getting up to speed in the first 3 to 4 days, we [were] up to speed in the first day or two."

Those involved with the Decker Fire were optimistic about the prospect of RMA remote support, especially with the availability of virtual, real-time assistance and well-trained local staff to interpret information and facilitate discussions. For instance, since RMA no longer includes in-person teams who can facilitate the tradeoff analysis exercise, participants recognized that designating a local expert to facilitate the process was ideal. Local agency staff familiar with RMA products and risk-informed decision-making principles systematically guided the team through the mechanics of the exercise, such as when and how to weigh different values and assign categories of risk. Having this type of local expertise across the agency—or at least having immediate access to trained experts—will be necessary for accurately interpreting other RMA analytics as well.

Agency administrators, line officers, and RMA deliverers said that multiple

Interviewees pointed to a need for a stronger agencywide commitment to and leadership for risk-informed decision making.

requests for RMA support throughout the duration of the Decker Fire improved the ability to integrate RMA products into key decisions by providing up-to-date and relevant information as fire conditions changed. At times, RMA deliverers also proactively provided additional information or suggested types of information that might be helpful. This kind of back-and-forth dialogue worked well for receivers and deliverers.

Participants also said that RMA products from the Decker Fire will have utility after the fire for assessing fire impacts and shaping future planning efforts. Several interviewees pointed out how RMA risk assessment information could help the postfire burned area emergency response teams decide where to focus their efforts. Someone also discussed plans to use RMA products from the Decker Fire in future planning meetings on fuels mitigation to allow for fire to promote resource benefits. As one person said, "[RMA products] can be utilized in prescribed fire planning, treatment, public outreach, and communication." Such considerations could help the Forest Service communicate and embrace RMA approaches across the agency in the future.

RECOMMENDATIONS FOR RMA

A key question in our work was how to diffuse RMA principles throughout the Forest Service. Interviewees offered several observations and suggestions.

First, they pointed to a need for a stronger agencywide commitment to and leadership for risk-informed decision making. RMA deliverers in particular maintained that the approach was unlikely to succeed without communication from agency leaders about the importance of using improved analytics for decision making and a corresponding national commitment. Multiple interviewees added that RMA principles may not be widely

adopted without performance measures, incentives, and rewards for line officers, along with clear communication to line officers about expectations.

The agency can help resolve broader risk-related issues through clearer leadership direction, incentives, and expectations to:

- Utilize strategic risk management approaches;
- Empower line officers to play the central role in decision making on fire incidents; and
- Employ a range of fire response tactics that might be desirable, depending on conditions and values at risk.

Second, increasing awareness of RMA and enhancing accessibility of the corresponding analytical tools are important next steps. Many interviewees mentioned a need to spread knowledge about RMA, noting that many line officers and fire staff remain unaware of the process for requesting RMA support and the range of RMA products available.

Continuing to diffuse knowledge of risk management principles among agency leaders, staff, and line officers through training and clear expectations would improve the effectiveness of future RMA implementation. Embedding RMA skills and tools at the region, forest, and district level would improve capacity to deliver RMA and minimize any resistance to accepting outside support. Preseason integration, exploration, and training in RMA principles may increase RMA incorporation into bigger picture discussions about risk management. Pursuing more interagency dialogue around risk-informed decision making will also encourage consistent approaches

Risk management assistance supported line officer decisions, often providing validation for what already had been decided.

across agencies and enhance the range of application for efforts such as RMA.

Third, carefully developing and articulating the wider potential benefits and uses of RMA products can make RMA a prominent component of strategic wildland fire management, integrating it into preseason, fire season, and postseason tools and systems (Stratton 2020). Line officers, agency administrators, and fire managers said that RMA should be better integrated into existing decision-making systems and products so it can be used more broadly and efficiently.

Some interviewees wanted the ability to request RMA products and support directly through WFDSS or other easily accessible interfaces or websites. As one line officer said, "The game changer [would be] if those RMA products are integrated into WFDSS. So that when you bring in a fire, you have a point of ignition, you drop it in, [and] it starts to build the RMA products."

We heard that developing certain RMA products in advance, such as information about snag hazards and potential control locations, and having that information readily available before the fire season would allow RMA analytics to be immediately available when a fire starts or for prescribed fire planning efforts. These types of RMA analytics and processes, along with the discussions around them, would also align particularly well with ongoing efforts to engage partners in collaborative planning efforts such as potential operational delineations, where analytics and experience are combined with diverse stakeholder inputs to improve the efficacy of planning and incident response.

POTENTIAL ROLE IN THE FUTURE

The growing complexity of fire management requires new approaches, roles, and mindsets, which will take time to establish. RMA can serve an important role across the Forest Service. Successfully integrating support systems such as RMA requires giving clear leadership direction, communicating consistently about RMA and giving it widespread exposure, and

carefully articulating expectations for planning and decision making among the different roles in the agency. Regularly monitoring how different forms of support are being perceived and applied across the agency and partners will help agency leaders evaluate the effectiveness of RMA and similar analytics in expanding the decision space in an increasingly complex wildland fire system.

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