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Innovation to support wildfire risk-based decision-making: examining the incident strategic alignment process

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Abstract

Background In the face of increased complexity, the USDA Forest Service (Forest Service) is emphasizing the use of risk-based spatial analytics and expert coaching of fire managers through consistent processes and practices to inform safer, effective, and strategic decision-making during incident management. The Incident Strategic Alignment Process (ISAP) integrates collaborative dialogue with risk management assistance (RMA) and other spatial analytics to develop and deploy a consistent, science-based strategic planning model for incident management. An important challenge is understanding the impact of frameworks like the ISAP to track their efficacy over time and their impact on approaches to incident management. Using concepts from the implementation of innovation literature, we investigated the following questions: (1) What is the perceived value of the ISAP according to line officers and incident managers who have used it? and (2) What factors affected the adoption and use of the ISAP at different system levels (i.e., individual, organizational, and cultural)? We examined three case studies: the 2023 Elkhorn Fire (Case 1), San Juan fires (Quartz Ridge, Bear Creek, Mosca fires; Case 2), and the Six Rivers Forest Lightning (SRF) Complex (Case 3), utilizing participant observation and 30 semi-structured interviews with key informants.

Results We found that interviewees valued the ISAP because it helped provide a consistent approach when communicating risk and strategy, fit into existing workflows, and facilitated difficult but necessary conversations. Challenges included a lack of knowledge and technical skills to support use, communication between incident managers and administrators, and unit dynamics and culture that impeded the adoption of new approaches. Facilitating factors included clear leadership communication and buy-in, favorable biophysical conditions for considering different management approaches, collaborative history, and the capacity to support the ISAP implementation.

Conclusion Our findings revealed organizational factors that influenced the use and application of wildfire innovation. Across cases, there was a wide understanding of the application of the ISAP. In line with interviewee recommendations, we suggest that additional education will be needed to help increase knowledge and communication in the context of new federal expectations. Finally, we found that the ISAP helped facilitate multiparty risk communication, which will be invaluable during high-emergency wildfires and criticism of organizational legitimacy.

Keywords Incident strategic alignment process, ISAP, Risk-based decision-making, Communication, Alignment, Fire management, Innovation, Organizational change

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Resumen

Antecedentes De cara a una complejidad incremental, el Servicio Forestal de los EEUU (*USDA Forest Service*) está enfatizando el uso del Análisis Espacial basado en el Riesgo, y el uso de supervisores expertos (*expert coaching*) para gestores de incendios, para que, mediante procesos y prácticas consistentes, puedan informar sobre decisiones estratégicas, seguras y efectivas durante el manejo de incidentes. El proceso de alineamiento estratégico de incidentes (*Incident Strategic Alignment Process*, ISAP) integra diálogos colaborativos con Asistencia al Manejo de Riesgos (RMA) y otros análisis espaciales para desarrollar y desplegar un modelo estratégico consistente, basado en la ciencia, para el manejo de incidentes. Un desafío importante es el de conocer el impacto de procesos como el ISAP, para trazar su eficiencia en el tiempo y sus impactos sobre distintas aproximaciones en el manejo de incidentes. Usando conceptos de implementación de literatura innovadora, investigamos sobre las siguientes preguntas: 1) cuál fue el valor percibido de ISAP de acuerdo a oficiales de línea y de gestores de incidentes que lo usan?, y Qué factores afectan la adopción y uso del ISAP a diferentes niveles de los sistemas (i. e. individuales, organizacionales, y culturales?). Examinamos tres estudios de caso, el Incendio de Elkhorn de 2023 (Caso1), los incendios de San Juan (el de Quartz Ridge, el Bear Creek, y el Mosca, Caso 2), y el Complejo de Rayos de los seis Ríos (SRF, Caso 3), utilizando observaciones de los participantes y 30 entrevistas semi-estructuradas con informantes clave.

Resultados Encontramos que los entrevistados valoraron el ISAP dado que les ayudó a proveerse de una aproximación consistente cuando se comunicaba riesgo y estrategia, se ajustaba a los flujos de trabajo y facilitaba conversaciones dificultosas pero necesarias. Los desafíos incluyeron la falta de conocimiento y de las destrezas técnicas para poder usarlo, la comunicación entre los gestores de incidentes y los administradores, y la dinámica de la unidad y la cultura que impidieron la adopción de nuevas visiones. Los factores facilitadores incluyeron un claro liderazgo y participación, condiciones biofísicas favorables para considerar distintos visiones de manejo, historias colaborativas, y la capacidad de soporte en la implementación del ISAP.

Conclusion Nuestros hallazgos revelan factores organizacionales que influencian el uso y aplicación de innovaciones en incendios. A través de los casos, hubo un amplio entendimiento de la aplicación del ISAP. En la misma línea que las recomendaciones de los entrevistados, sugerimos que una educación adicional será necesaria para ayudar a incrementar el conocimiento y comunicación en el contexto de nuevas expectativas estructurales. Finalmente, encontramos que el ISAP ayudó a facilitar la comunicación del riesgo a las múltiples partes involucradas, lo que será invalorable durante las grandes emergencias en incendios y las críticas a la legitimidad de la organización.

Background

Wildland fire management is becoming increasingly complex. In the Western United States, this complexity is driven by an increase in fire activity, extended fire seasons, more extreme weather, continued development in the wildland-urban interface, and interactions between fire and other disturbances (Jolly et al. 2015; Holden et al. 2018; Radeloff et al. 2018; Cunningham et al. 2024). Furthermore, decades of wildfire suppression have removed the ecological benefits of fire and resulted in an accumulation of fuels, in turn leading to larger and more severe wildfires (Roos et al. 2020; Kreider et al. 2024). Managers and policymakers are now increasingly recognizing the importance of fire as a management tool to reduce fuel loads and reintroduce fire in fire-adapted ecosystems while maintaining the safety and effectiveness of response teams (Wildland Fire Leadership Council, 2014). However, fires are typically only managed for ecological benefit in remote wilderness locations that are relatively void of human assets (Iniguez et al. 2022; Young et al. 2020). In most landscapes, there are tendencies and incentives for fire managers to utilize more aggressive management tactics, which can protect values in the short term but lead to aggregated long-term risk (Calkin et al. 2015; Castellnou et al. 2019; Schultz et al. 2019). Fire management tactics inherently require consideration of tradeoffs among risks and values (i.e., critical infrastructure, areas of cultural significance, homes) that vary over time and space and from fire to fire. For example, protecting homes might reduce the risk of infrastructure loss but increase the risk to firefighters in the short term. Similarly, suppressing a fire immediately might lead to less short-term risk to habitats or infrastructure but create a greater risk of landscape-level fire with extreme behavior and consequences in the future (Calkin et al. 2015; Kreider et al. 2024; Furniss et al. 2024; Young et al. 2022; Young and Ager 2023). Furthermore, wildfires often burn across multiple landowner jurisdictions, dispersing decision-making authority across entities with different and sometimes conflicting management goals and priorities, further challenging decision-makers (Jones et al. 2024). Managing both short- and long-term goals is a significant challenge but one that requires increased attention for improved fire management and coordination

among those responding to disasters (Schultz et al. 2019; Thompson et al. 2023).

Globally, countries are developing unique tools to support the evaluation of wildfire risk and uncertainty (Thompson and Calkin 2011). The USDA Forest Service (Forest Service) and the Department of the Interior (DOI) agencies emphasize the use of innovative solutions to develop safe, effective, and strategic decision-making approaches (Schultz et al. 2019; Calkin et al. 2021; Greiner et al., 2020). These innovations include the development of potential operational delineations (PODs) and risk management assistance (RMA) frameworks intended to facilitate risk-informed decision-making. In 2022, the Incident Strategic Alignment Process (ISAP) was developed to create a common process by which incident managers and agency administrators (AAs, i.e., those who advocate on behalf of an agency and are the final decision-making authority) collaboratively discuss and develop strategy. The ISAP (formerly strategic risk assessment (SRA) and strategic operations) integrates RMA and other spatial analytics into collaborative discussions among AAs, Incident Management Team (IMT) members, and other cooperators (i.e., state land management agencies, collaboratives, stakeholders) to develop and deploy a consistent, science-based strategic planning model for incident management. The ISAP is an emergent platform and process for dealing with the complex fire management environment. Integrating these new processes, like the ISAP, requires updating leadership direction, incentives, and institutions to promote and sustain their adoption (Schultz et al. 2021). Understanding how innovations are adopted and how change occurs within an organization is needed to promote the longevity of a new process like the ISAP.

In this paper, we explore institutional innovation in the context of US wildland fire management. Through the lens of institutional innovation, we investigated how the ISAP is being adopted and deployed on the ground. We used participant observation and semi-structured interviews to answer the following questions: (1) *What was the perceived value of the ISAP according to line officers and incident managers who have used it?* and (2) *What factors affected the adoption and use of the ISAP at different levels?* Investigating the ISAP during its formative years is a timely issue; the National Wildfire Coordinating Group (NWCG) — the organization responsible for developing interagency training and standards for wildland firefighting in the USA — issued an internal task to standardize the ISAP, indicating that it will likely become a more commonly operated framework for developing incident strategy (NWCG 2023). The impacts of wildfires are felt worldwide, and it is becoming more important to create a shared understanding among wildfire responders while creating meaningful dialogue around risk and strategy.

Incident command and managing risk and strategy in the USA

Discussing and communicating risk in wildfire management has become increasingly challenging and ambiguous (Thompson et al. 2023). In the USA, IMTs and AAs often struggle to communicate and achieve alignment on when and how to balance short-term outputs (e.g., wildfire suppression) and long-term outcomes (e.g., ecosystem benefit) (Calkin et al. 2015). This is further challenged by conflicting Forest Service fire policy, which recognizes fire as both an ecological process and a threat to human values (Schultz et al. 2019). The need to communicate long-term goals, in some instances expanding the footprint of fire when appropriate, will be critical for safe and effective fire management in the future (Dunn et al. 2017; Schultz et al. 2019; Furniss et al. 2024). Nowell and Steelman (2019) suggest the need for consistent communication and better alignment across response teams, agencies, and cooperators to overcome these dynamics. Likewise, Thompson et al. (2015) proposed that "multiparty risk communication and prioritization of investments based on who can most efficiently mitigate risks" (p.920) should be a priority to address systematic challenges within wildfire response. Although standard communication and terminology are a cornerstone of the Incident Command System (ICS) (Hawkins 2007), standards do not prepare wildfire responders to effectively communicate risk and strategy during wildfire management (Pietruszka et al. 2025).

To understand how the Forest Service is responding to wildfire complexity, some background on incident command structure (ICS) is necessary. The ICS is composed of planning, finance, logistics, and operation functions organized hierarchically under an incident commander (IC; Nowell and Steelman 2019). This structure provides a standardized approach for disaster management in the USA. It is an organized system to reduce duplication of efforts and response-related expenditures, operationalize resources, and increase responder safety (Jensen and Waugh, 2014). When a wildfire occurs, an IMT is requested by the AA, who delegates to the IMT the authority to develop a strategy that balances risks to responders and protects values at risk. The IMT must also coordinate and communicate with partners and interested parties who may be affected by the fire, including state and local governments. They also often work with tribal governments in areas where Native American Tribes (henceforth Tribes) have government-to-government agreements and where they are rightsholders, neighboring land managers, or managing their ancestral

territories. If the fire's duration exceeds a team's typical assignment length — usually 14 days, but sometimes longer if necessary — the IMT will transition responsibilities to a new IMT. A transition will occur earlier if wildfire conditions begin to exhibit greater incident complexity, necessitating a team with greater qualifications to manage the fire. Conversely, the fire may become less complex, resulting in the team transferring command back to the local land management unit or a lower complexity IMT. Common terminology and integrated communication among IMT members and AAs are used to support quick and efficient communication, providing continuity during incident complexity and resource ordering (Hawkins 2007; Jensen and Waugh, 2014).

To further support effective communication, strategic planning, and risk-informed decision-making within the ICS, the Forest Service has developed several risk-based spatial analytics and tools. Among these tools is the potential operational delineations (PODs) spatial fire planning framework and decision support tool, which consists of grouping a landscape into polygon containers whose boundaries are defined by areas that are most suitable for fire containment (e.g., roads, rivers, and ridges) (Thompson et al. 2022). Potential control locations (PCLs) define POD boundaries and are typically developed during collaborative workshops between local fire managers, stakeholders, and other local land management personnel (O'Connor et al. 2017; Greiner et al., 2020). PODs can also summarize relevant information on ecological conditions, fire risks, management opportunities, and desired objectives in the event of a wildfire. Across the West, the use of PODs has become ubiquitous, and investment in the approach, through the Infrastructure Investment and Jobs Act (2021; H.R. 3684 §40803 (c)(7)), has provided organizational support and incentives to promote its use. PODs are now being used to plan and prioritize fuel treatments, providing more opportunities for fire and encouraging cross-boundary management (Thompson et al. 2022; Buettner et al. 2023). Similarly, in 2016, the Life First initiative was introduced, establishing a commitment to prioritize firefighter safety and minimize unnecessary exposure to wildfires (Schultz et al. 2021). In response, Risk Management Assistance Teams (RMAT) were created and traveled to select incidents to provide risk-based decision support to IMTs and AAs (Calkin et al. 2021; Schultz et al. 2021; Beeton et al. 2021). More recently, RMAT was dissolved, and support was transferred to an online application (see RMA Dashboard n.d.). RMA tools are expansive, but the primary tools include PODs, the snag hazard assessment, Suppression Difficulty Index (SDI), PCLs, and ground evacuation analyses (Beeton et al. 2021). Research on both PODs and RMA shows that they resulted in more proactive approaches to fire planning and management that can support risk-informed decision-making (Thompson et al. 2022).

The Incident Strategic Alignment Process (ISAP) was developed in 2022 to provide a more consistent process for assessing and communicating risk and strategy during incidents (NMAC 2017). Prior to the ISAP, strategy and risk were developed and assessed by individual teams through various approaches (i.e., there was no standard approach for assessing risk and developing strategy). The ISAP was designed for Type 1 and 2 teams (now referred to as complex incident management teams (CIMTs)) and local unit-managed fires, but it can also be utilized for other disaster types where resources must be prioritized to minimize impact to critical values (e.g., floods or hurricanes). An ISAP facilitator guides IMTs and AAs through four-pillar processes, which include 1) Critical Values at Risk, 2) Strategy and Strategic Actions, 3) Risk to Responders, and 4) Probability of Success. The pillars of the ISAP are built on a shared understanding, established through common terminology among incident responders at all levels, and supported by meaningful risk dialogue to help align priorities, focus efforts, and guide decision-making. The National Incident Management Organization (NIMO) supported the development of the ISAP as part of its organizational mission. Coaching teams, primarily consisting of NIMO staff, traveled to incidents to teach and introduce the process to IMTs and AAs at the request of Forests or ICs. Funding to support coaches was provided through the Wildland Fire Management Account. This coaching practice has largely diminished, leaving the responsibility of adopting and learning the process to individual IMTs.

Figure 1 illustrates the observed and reported timing, participating entities, resources consulted, and tools used for each pillar of the ISAP. The Critical Values at Risk (CVAR) pillar helps AAs identify the values and assets across a landscape that will drive strategy and may require responders to accept an elevated level of risk to protect. This should ideally be conducted as early in the command as possible, either immediately when a team is assigned to a fire or shortly after being briefed. The Strategy and Strategic Actions pillar is the process through which IMTs formulate strategies to protect CVAR. The AA primarily defines CVAR, but cooperators or Tribes may also identify them. Nuanced communication approaches may be needed during jurisdictionally complex fires (Steelman and Nowell 2025) or when other land managers or rightsholders, like Tribes, have their own problem-framing mechanisms (see, for example, Whyte 2013). During the Risk to Responders pillar, participants identify a shared understanding of the responder risk associated with a given strategy. This phase helps strike

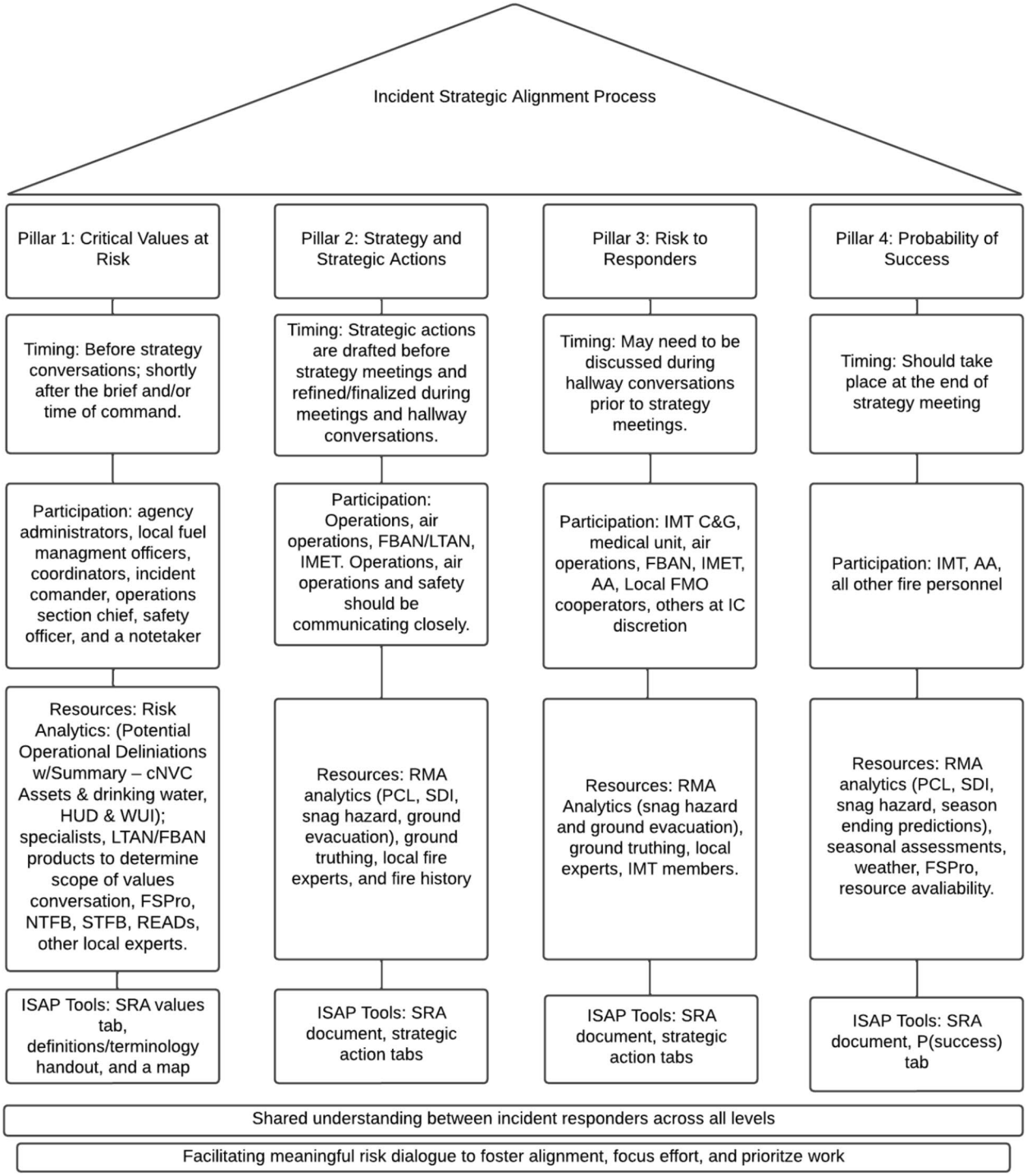

Fig. 1 Stylized depiction of timing, participation, resources, and the ISAP tools for each phase. This depiction was adapted from the diagram of the four pillars of the ISAP (see the ISAP Story Map (n.d.)) In practice, this may look different and vary in participation, resources used, and available technical capacity. The pillars of the ISAP are built upon a shared understanding between incident responders across all levels and on the facilitation of meaningful risk dialogue to foster alignment, focus efforts, and prioritize work. (AAs (Agency Administrators), FMO (Fire Management Officer), IC (Incident Commander), IMT (Incident Management Team), FBAN (Fire Behavior Analyst), LTAN (Long-Term Analyst), IMET (Incident Meteorologist), RMA (Risk Management Assistance), PODs (Potential Operational Delineations), cNVC (Conditional Net Value Change), HUD (Human Use Data), WUI (Wildland Urban Interface), FSPro (Fire Spread Probability), NTFB (Near-Term Fire Behavior), STFB (Short-Term Fire Behavior), READs (Resource Advisors), PCL (Potential Control Location), SDI (Suppression Difficulty Index), SRA (Strategic Risk Assessment)

a balance between actions to protect critical values and responder risks. Finally, during the Probability of Success pillar, AAs define what successful management of a fire will look like to help the IMT meet their expectations. In addition, the ISAP facilitator utilizes a probability of success to provide additional insights into decision-making. The developers of the ISAP define the probability of success as the "Likelihood of achieving strategic objectives given uncertainty in fire dynamics, resource production, resource availability and control line or point protection success. Control line and point protection success should be weighted based on consequences of failure for individual components" (Dunn et al. 2017, p.186). While quantitative measures, such as quality assurance and quality control datasets, or the probability of a fire line successfully stopping a fire under certain weather conditions and resource availability, are available and provide insights into successful management, these methods are not used during incidents (Arkowitz et al. 2025; Young et al. 2024). Instead, managers may use fire analytics (e.g., SDI, PCL, snag hazard, or ground evacuation) along with fire weather forecasts to consider the probability of success relative to risks. Therefore, in the context of the ISAP, a low probability of success will likely lead to a revaluation of the strategy unless the risks are low and the payoffs are high; however, disagreement over a strategy with a higher probability of success may invoke debate about strategic trade-offs. Throughout the ISAP, members of the IMT and AAs attend joint meetings and incorporate risk-based analytics, such as RMA tools, to help provide the best available science to guide discussions around decision-making. The ISAP is intended to fit within existing workflows; therefore, the ISAP meetings that adjourn may be completed through "hallway conversations," where relevant members of the IMT and AAs discuss decisions outside of formal ISAP meetings (i.e., in passing, during lunch). The ISAP meetings are generally supplemental and do not replace other meetings, such as command and general staff meetings (C&G), cooperators meetings, or end-of-day briefings — unless the IMT deems it prudent to integrate the ISAP into these gatherings. Once the initial ISAP has been conducted, decisions should be communicated to frontline firefighters, cooperators, and any other responders to convey the "why" behind the strategy. This is meant to ensure that the bias for action, which often drives responders to mitigate the negative impacts of wildfire (Thompson et al. 2018), is checked, that any actions align with the overall strategy, and that responders do not incur additional, unnecessary risk.

Conversation topics and decision-making rationale for each pillar are documented in the SRA to facilitate information transfer during team and personnel transitions. The SRA is an Excel spreadsheet that responders utilize to document each pillar of the ISAP and document their estimation of the probability that fire will negatively impact a value or responder. Except for the Probability of Success pillar, the ISAP results are generally qualitative and influenced by firefighter experience, as well as various organizational (e.g., budgets and funding availability, risk aversion, liability) and sociopolitical (e.g., community perception, land use patterns, leadership) pressures. The ISAP is intended to be an iterative process and can be revisited throughout an incident as environmental or social conditions change. Revisiting the SRA document will help responders track changes in risk to values and responders and indicate when a new strategy may be warranted. The ISAP is a novel approach and has not been a required process for incident management. In summary, the ISAP is both a process in which IMTs, AAs, and other relevant fire responders discuss risk and strategy, and a product that documents decisions across time and space, which can then be used to communicate with all other wildfire responders.

Conceptual framework

We situated our study in the organizational change, policy implementation, and diffusion of innovation literature, which together help explain the adoption of institutional innovations (Fernandez and Rainey 2006; Lemos 2008; Moseley and Charnley 2014). We rely on the integrative framework developed by Steelman (2010) in her conceptualization of the implementation of innovation. This framework identifies factors that might influence the direction and adoption of innovation at different institutional levels (i.e., culture, structures, and individuals, Table 1). Public organizations are more likely to pursue change at the cultural or broader institutional level when catalyzing events create windows of opportunity to reimagine possibilities (Steelman 2010). In wildfire management, such events may occur when there are undesirable outcomes, such as fire-related deaths or other losses, inefficient use of resources, or when there are infusions of new funding in response to fire events. Additionally, change may occur at this level if a new philosophy is set by leaders or if the change validates the broader institution in a meaningful way (Fernandez and Llamas-Sanchez 2008; Steelman 2010; Abrams 2019). Change may manifest at the structural or organizational level as new policies, incentives, funding, and training may influence change (Moseley and Charnley 2014). Additionally, the President and senior-level leaders, like Department Chiefs and Deputies, may provide new direction to agencies that can influence change. Steelman (2010) states that influence at this level should provide clear

Table 1 Factors that affect organizational change at different system levels

Organizational level	Actors at each level	Factors that affect organizational change from literature
Cultural or Broader Organizational Level	-Directives set by presidential administration -Catalyzing events (e.g., wildfire related losses) -Criticism to legitimacy	- Public organizations are more likely to promote change when catalyzing events create windows of opportunity to reimagine procedures (Steelman 2010). -For directives to be adopted they must address the problem (e.g., informal standards for risk and strategy development) and have the infrastructure (i.e., capacity) and institutional arrangements (e.g., rates of change) to support its use (Lemos 2008).
Structural or Organizational Level	-Forest Service/National Incident Management Organization -Department of Interior Agencies -National Interagency Fire Center -National Wildfire Coordination Group -Wildland Fire Leadership Counsel -Geographic Area Coordination Center - State Agencies (e.g., CalFire)	-Organizational factors (e.g., budgets and funding availability, risk aversion, and liability) are relevant for how new directives are developed and implemented (Fernandez and Llamas-Sanchez 2008; Cordner 2024). - Vested interests often seek to preserve the status quo and thus may challenge organizational change (Steelman 2010). -A culture that encourages risk taking may make adoption of new directives/innovation more likely (Lemos 2008). - Adequate staff and technical capacity to implement innovations (Dilling and Lemos 2011)
Individual or Local Level	-Incident Commander -Incident Management Team members -Agency Administrator -Front Line Firefighter	- Local level dynamics are influenced by the economic, biophysical (i.e., landscape characteristics and community dynamics (Cordner 2024)), and socio-political conditions (i.e., local buy in, land use patterns, leadership) (Moseley and Charnley 2014). -Other factors include the collaborative history of an agency or group, which may support or frustrate the use of alignment (Bergemann et al. 2019). - Past experiences of agency administrators and incident commanders influence the adoption of directives and innovations (Lemos 2008), with manager values, preferences, networks, and discretion playing key roles in implementation.

communication, incentives, buy-in, and intent to support compliance. Organizational mission, culture around risk-taking, and decision-making authority associated with organizational roles and capacity can influence the adoption of innovation, as can performance assessment incentives, leadership commitment, potential for integration with existing systems, and adequate staff and technical capacity to implement innovations (Fernandez and Rainey 2006; Dilling and Lemos 2011). At the local or individual level, local actor priorities, relationships, knowledge and training, risk tolerance, past experiences, and perceptions of innovations affect rates of adoption (Cash et al. 2003; Lemos 2008; Steelman 2010). Cordner (2024) found that demographic changes in the wildfire workforce and training standards have led to the agency adopting a 'safety culture' and more responders speaking up about leadership direction. Factors such as local ecology, economy, and social and political conditions are also relevant to how innovation is implemented because they can shape local support for change (Moseley and Charnley 2014; Cordner 2024). Bergemann et al. (2019) add that other local factors, like collaborative history, may be relevant for explaining how existing relationships influence change.

Research on wildfire decision-support tools can also provide insights into the institutional factors that have influenced the use and adoption of innovation. At the structural level, researchers have noticed that the wildfire culture and the failure to overcome short-term heuristics can frustrate the use of decision-support tools (Colavito 2020; Greiner et al. 2020). While investigating the use of PODs, Greiner et al. (2020) and Buettner et al. (2023) found that clear direction, incentives, and enabling legislation were needed to utilize the framework. Likewise, approaches need to fit within the existing decision-making framework, and there must be adequate capacity and technical expertise to support implementation (Colavito 2020; Greiner et al. 2020; Noble and Paveglio 2020; Buettner et al. 2023). Fernandez and Rainey (2006) note that innovation must fit within the existing institutional context of socio-technical processes to achieve a proper fit. Others have noted that individual-level buy-in is often overlooked before an organizational mandate to utilize the tool, resulting in improper fit (Colavito 2020). Rapp et al. (2020) add that buy-in from the operations chief

is often the deciding factor for decision-support tools used within a unit. Similarly, research on RMA showed that line officers' willingness to try new things, experience with the approach, and risk tolerances affected risk-based decision-making (Calkin et al. 2021; Schultz et al. 2021). Other local contexts like fire behavior and thus the perception of having time to use a decision-support tool may impact adoption (Noble and Paveglio 2020; Rapp et al. 2020). These factors do not influence the legitimacy of varying decision-support tools but highlight the social factors that have led to inconsistent use of these products.

Using this literature as a framework for the key factors influencing the implementation of innovations, we investigated the use of the ISAP as an innovation to support wildfire risk-based decision-making. We sought to understand the specific context of wildland fire management and how the ISAP, and by extension, risk-based decision-making, could be enhanced.

Methods

To answer our primary research questions, we used a mixed-methods exploratory case study approach, utilizing participant observation and semi-structured interviews (DeWalt and DeWalt 2011; Bernard 2017). We utilized a qualitative research design to allow for insights into "how" and "why" questions and to build contextual understanding (Creswell and Creswell, 2017). In this section, we begin with an overview of our case study approach and selection. We follow this with a section that explains our sampling, data collection, and data analysis procedures.

Case study selection

In partnership with the ISAP developers, we investigated the use of the ISAP on three different 2023 fires across the Western United States (see Table 2): the Elkhorn Fire (Region 4, Idaho); the Quartz Ridge, Bear Creek, Mosca fires (San Juan fires; Region 2, Colorado); and the Six Rivers Forest Lightning Complex (SRF Complex; Region 5, CA, USA). We selected these case studies based on the ability to shadow coaching teams and where our research team received prior approval to observe the ISAP meetings.

The 2023 Elkhorn Fire burned along the Salmon River corridor in the Payette National Forest (Payette NF) near the border of the Nez Perce-Clearwater National Forest (Nez Perce-Clearwater NF). Burning approximately 26,000 acres, the fire threatened the National Forest System (NFS) Lands, including wilderness land and private inholdings along the Salmon River (InciWeb 2023a). The 2023 San Juan fires started through lighting strikes on the San Juan National Forest and primarily threatened Forest assets. While these three fires were managed by a single Type 1 Incident Management Team (now referred to as a Complex Incident Management Team; see IWDG, 2023),

Table 2 Development of risk and strategy across incident command (Aldworth et al. (2024b);(2024c); 2024 d)

Elkhorn Fire:
The extreme fire behavior and rapid-fire expansion prompted the Payette National Forest to request a Type 1 IMT to manage the incident. The incoming team, in partnership with the Payette and Nez Perce-Clearwater NFs, invited two ISAP coaches to help facilitate the ISAP. The Salmon-Challis and Bitterroot National Forests were included in the ISAP due to the potential for fire spread. The IMT, AAs, and two ISAP coaches discussed risk and strategy using the ISAP. When a new IMT assumed control of the fire, the incoming team and AAs used the ISAP to re-evaluate the strategy. The decision was made to halt construction of indirect fuel breaks to the north of the fire area due to moderating weather and fuel moistures that had reduced the threat to the identified CVAR. The new team retained the structure protection and observational activities that had been implemented by the previous team.
San Juan fires:
The first ICT to assume control was a Type 3 team from the San Juan National Forest. San Juan AAs and the Type 3 team discussed risk and strategy using the ISAP, before transferring command to a Complex Incident Management (CIM) National Incident Management Organization (NIMO) team. AAs were interested in taking advantage of the favorable weather to suppress the Mosca Fire directly. While other actions were being deployed on the Quartz Ridge and Bear Creek fires, AA's and the CIM-NIMO team met with the assigned Interagency Hotshot Crew (IHC) to discuss the risks to responders and potential mitigations associated with inserting a crew to suppress the Mosca Fire. Leaders from this IHC explained the tactics they would use, risk mitigation actions they would take, and voiced confidence in their crew's ability to suppress the fire. After debate, the AAs and the CIM-NIMO team decided to insert the crew to suppress the Mosca Fire.
SRF Complex:
The SRF Complex was managed by two successive Type 1 IMTs, followed by two successive Type 2 IMTs. The Pearch Fire posed an immediate near-term risk to CVAR due to its proximity to the town of Orleans. Bluff #1, Mosquito, Blue Creek #2, Marlow and Copper fires posed potential longer-term risks to the Yurok Reservation in the event of continued warming and drying and a significant east wind event. The first Type 1 IMT conducted a defensive firing operation along the western edge of the Pearch Fire to protect the town of Orleans and began to construct indirect line around the main group of fires to the west utilizing POD boundaries. During an IMT transition, a rainstorm significantly reduced potential fire behavior in the area. This rain event provided an opportunity to re-introduce culturally significant and ecologically beneficial fire onto the landscape, despite the fires being classified as full suppression. This was accomplished by transitioning a strategy that aimed to minimize short-term risks, to managing long-term risk. The Forest, IMT, and local Tribal fire managers initiated a second, strategic firing operation on September 12 using the improved POD boundaries to link the main group of fires together to achieve desired goals. Throughout the incident and across team transitions, the ISAP was used to discuss risk and strategy between the Six Rivers Forest, each IMT, local partners, and members of the Hoopa, Yurok, and Karuk Nations.

these fires were not given a "complex" status (i.e., two or more incidents managed by a single IMT; see NVDEM, 2011). The Quartz Ridge Fire was contained to 2800 acres, Bear Creek to 1000 acres, and Mosca to 8 acres (InciWeb 2023b; 2023c). Lastly, the 2023 Six Rivers Forest Lighting Complex (SRF Complex) started and burnt a total of 50,000 acres (InciWeb 2023d). Collaboration with cooperators and Tribal Nations led to managing some of the fires for ecosystem benefit (see Karuk Media 2023). For each fire, there were no noted issues of resource scarcity, and IMTs had sufficient workforce capacity to support the ISAP.

Data collection and analysis

We employed a mixed-methods exploratory approach, utilizing both participant observation and semi-structured interviews. We utilized participant observation, i.e., a method in which the researchers traveled to the Incident Command Post for a select duration during each incident to observe daily activities, interactions, and events to learn the explicit and tacit aspects of routines and culture (DeWalt and DeWalt 2011). Participant observation was critical for understanding how IMTs and AAs interact within the ISAP. During each incident, we observed the ISAP coaches, IMT leaders and members, AAs, and cooperators who engaged with the ISAP. Wildfire incident command is fast-paced and high stakes; therefore, we primarily shadowed the ISAP coaches to understand factors that support and frustrate the process rather than intrude on daily operations. We attended morning briefings, dedicated ISAP meetings, command and general staff meetings (C&G), cooperators meetings, and end-of-day briefings. In addition, we spoke with individuals who held roles within the IMT and to AAs about their perceptions of different risks and how the ISAP was used when executing their responsibilities. We took detailed field notes to capture meetings and conversations throughout participant observation. At the end of each day, we summarized our observations, which allowed us to reference our observations by day, key findings, and reflections. Participant observation was used to inform and refine our interview protocol and provide additional context to interview findings.

Semi-structured key informant interviews were primarily administered after the 2023 wildfire season (nine interviews were conducted during observation of the SRF Complex). We interviewed 30 individuals, allowing interviewees to reflect on their use of the ISAP. We conducted initial outreach purposively with connections made during participant observation (Bernard 2017). We spoke with IMT members, the ISAP coaches, AAs, cooperators, and frontline firefighters (Table 3). Interviewee questions focused on the individual and structural factors that influenced the use of the ISAP: (1) How the ISAP was used to discuss strategic actions and trade-offs, (2) the components of the ISAP that were useful for communicating and documenting risk and strategy, (3) factors that frustrated and supported the use of the ISAP, and (4) the recommendations that would support greater use of the ISAP. Interviews and participant observations were conducted according to our institution's approved human subject research protocol (2652).

Table 3 Number of interviewees across each case study

Wildfire	Number of Interviewees
Elkhorn Fire	8
San Juan fires	10
SRF Lightning Complex	12
Total	30

We reached data saturation and concluded data collection when we did not hear new themes or variability within themes related to our primary research objectives (Guest et al. 2006). We recorded and transcribed interviews and then coded the transcripts and participant observation notes in the Atlas.ti qualitative analysis software. We utilized a modified grounded theory approach that prioritized coding for emergent findings and then linked findings to concepts in theory (Thornberg 2012; Mills et al. 2006). This approach was not purely inductive nor deductive (Charmaz 2006). We developed and applied codes through an intercoder agreement process to ensure consistent application across each interview (Campbell et al. 2013; Hemmler et al. 2022). Codes were developed collaboratively, applied by the second author, and analyzed by the lead author. We also used the data to develop practitioner-oriented reports and asked our interviewees to review them to ensure their insights were accurately reported (see Aldworth et al. 2024a; 2024b; 2024c; 2024d). We include selected quotes from our interviewees in the results and include the fire the interviewee served on and a general role assigned to add context to the quote while also preserving confidentiality. In addition to in-text quotes, supplemental quotes can be found in Tables 4, 5, and 6, which provide additional insights into our findings.

Results

What was the perceived value of the ISAP according to line officers and incident managers who used it?

Most interviewees said the ISAP was a helpful tool to find common ground across different perceptions of risk and provided a common language to determine the "why" behind the strategy. These interviewees said that

Table 4 Factors that facilitated the use of the ISAP

Individual Level
I thought [the facilitator] did a really good job in explaining the risks. But he was the only one that did a job at that level.
- SRF Complex Cooperator
If the IC isn't buying-in, the team won't. Something that inherently supports it is people are social and they like to talk and they like to be in groups and they like to see their thoughts be heard. And I think that when you bring people together and you start talking about the problem, magic can happen.
- San Juan fires IMT Member
These incidents in particular, the real important pieces, were the partners in the room; our county sheriff was involved in all those ISAP processes, which made it pretty beneficial. And then we had people leading us through the process who knew the process well.
- San Juan fires AA
Structural Level
The tools that were most useful, and we had the capacity with an LTAN and a SOPL that were able to produce the near-term fire behavior. Potentially identifying that time and space, knowing if our lines were viable or not.
-Elkhorn IMT Member

Table 5 Factors that challenged the use of the ISAP

Individual Level
[Tribes] don't prioritize stuff. It's all a circle. Everything's important. It's just somewhere in here. We were really ineffective and knew it, but couldn't figure out why, because of the cultural part of this. [Tribes] start from a place where it's all important.
-SRF Complex IMT Member
Structural Level
They don't teach ISAP until S-520, which is your advanced C&G type-one, which is now complex. So, when you got people who have never heard of it, always been suppression oriented and never working in the gray where you can use multiple strategies to meet the agency administrator's intent. They're lost.
-Elkhorn IMT Member
You know, it takes extra people. If you have a full-blown fire that is burning homes, or ripping through a watershed or threatening a power infrastructure, everybody's very busy. And so when you have incidents like that, I don't want to say there isn't time for ISAP. But I think that conversation or that process looks something completely different.
Organizational Level
-Elkhorn IMT Member
I don't think it was the products themselves, but the culture around using the products. What I mean by that is firefighting, there's a lot of intuition in firefighting and we've leaned on that for many years. I think there's a hesitancy to dive into these toolboxes and believe that on face value, and there's also a danger in doing that. I think the challenge of this process is more a slight culture shift of being open to look at this information ahead of time.
- San Juan fires AA

the shared terminology used throughout the ISAP helped establish common ground to discuss risk and strategy while acknowledging varying familiarity and tolerances of the topics. Others said the ISAP created time and space for open communication across IMTs, AAs, and cooperators. One interviewee said about the ISAP, "These are the same challenges I wrestled with for 35 years in my career, but it's a step-by-step process, it's like we're all using the same set of slides to look at these outcomes. Maybe it's not perfect, but it gives you something to compare" (Elkhorn AA).

Most interviewees said the ISAP was an intuitive, straightforward process and helped create consistent communication. Interviewees in the operations section thought the ISAP incorporated into their existing processes and helped ground decisions in values and risk. Some explained how fire analytics and models (e.g., RMA products and PODs) were seamlessly incorporated throughout the ISAP process and helped visualize trade-offs. According to these interviewees, this helped IMTs and AAs better communicate risks related to current wildfire behavior. Others thought the ISAP dialogues helped leverage local knowledge and individual past experiences. For instance, on the SRF Complex and San Juan fires, subject matter experts and Interagency Hotshot crew members attended some of the ISAP meetings and helped IMTs and AAs better understand field conditions. Some interviewees said the ISAP helped facilitate difficult conversations and communicate the priority of values to IMTs. When discussing the value of ISAP meetings, one interviewee said, "For the forests to have that [CVAR] conversation out in the open was probably one of the first times that had ever occurred. And the ISAP discussion is what allowed that transparent discussion to occur" (Elkhorn AA). Likewise, local emergency managers said using the ISAP across all wildfire incidents would help outside cooperators and local emergency management engage in a consistent framework. Ultimately, as one interviewee said, "[The ISAP] is a consistent framework that helps us all walk through risk and strategy" (Elkhorn AA).

Most interviewees said the ISAP helped them be proactive by getting "in front" of strategy and anticipating future needs. These interviewees said understanding the proposed strategy and how it will be implemented helped adjust the resources needed before a plan was

Table 6 Factors that affect organizational change at different system levels aligned with our findings

Organizational Level	Factors that affect organizational change from literature	Factors that affected organizational change from our findings
Cultural or Broader Organizational Level	- Public organizations are more likely to promote change when catalyzing events create windows of opportunity to reimagine procedures. - Change must fit within larger social and political goals.	-The broader firefighter culture challenged the use of the ISAP through perception that the process was created to question operational experience and lived experiences.
Structural or Organizational Level	-Organizational factors (e.g., budgets and funding availability, risk aversion, liability, and public perception) are relevant for how new directives are developed and implemented. - Vested interests often seek to preserve the status quo and thus may challenge organizational change. -A culture that encourages risk taking may make adoption of new directives/innovation more likely. - Adequate staff and technical capacity to implement innovations.	- Organizational direction was provided to standardize the implementation of the ISAP (NWCG 2023). -Resource (e.g., facilitators) and technical capacity (e.g., LTAN and SPOL) was needed to support the ISAP. -Varying use and understanding around the ISAP created inconsistent buy-in. - Training courses reinforced the use and application of the ISAP.
Individual or Local Level	- Local level dynamics are influenced by the economic, biophysical (i.e., landscape characteristics and community dynamics) and socio-political conditions (i.e., local buy in, land use patterns, leadership). -Other factors include the collaborative history of an agency or group, which may support or frustrate the use of alignment. - Past experiences of agency administrators and incident commanders influence the adoption of directives and innovations, with manager values, preferences, networks, and discretion playing key roles in implementation.	- Buy-in and leaders' intent from ICs and operation staff members provided clear direction for the use of the ISAP. - Uncertainty **existed** around how to address socio-political risks in the ISAP. -Favorable biophysical conditions (i.e., fire behavior and weather conditions) provided time to engage with the ISAP. -The ISAP integrated into existing workflows. -The ISAP was used for coordination with cooperators and Tribes. -There was poor communication and documentation of decisions made during the ISAP meetings.

operationalized. For example, extended evacuation times on the San Juan fires posed an increased risk to responders; the ISAP dialogues helped the liaison, safety, and medical officers order additional evacuation resources (i.e., ambulances and air evacuation) to mitigate risks. Likewise, AAs discussed the value of understanding planned strategies to help keep forest leadership informed before making decisions.

Some interviewees thought the ISAP could be used as a tool to help facilitate effective team transitions during a wildfire incident. Strategy can and does change after team transition, often due to changes in resource availability, weather, and more, but strategy should not change just because of a transition. Many interviewees said the ISAP could facilitate team transitions by capturing key decisions such as trade-offs, challenges, concerns, and successes throughout wildfire management, which are needed for incoming teams to understand the current strategic direction. These decisions are recorded within the SRA document, which interviewees said must be standalone so that anyone can understand why decisions were made. Interviewees acknowledged that the longevity of strategy, which persists through team transitions, is difficult because the decision-making context behind strategic decisions was often not relayed effectively in the ISAP documentation.

What factors affected the adoption and use of the ISAP at different levels?

At the individual/local level, most interviewees discussed how ecological factors like fire conditions and the perception of having time for the ISAP meetings affected adoption. For each case study, lower fire activity allowed IMTs and AAs to devote more time to the ISAP meetings and learn the process. Many interviewees said that taking time and making space for the ISAP allowed teams to get ahead of the fire and plan proactively rather than reacting to changing conditions. Others spoke about how fire behavior helped guide CVAR discussions because it helped provide clearer prioritization. Timing is important, and interviewees said that if CVARs are not provided quickly enough, it causes the Operations Section to backpedal or proceed with their initial strategy. Most interviewees said extreme fire activity does not provide the time for risk and strategy discussion through the ISAP. In this case, some interviewees said CVAR conversations should be conducted during the preseason to streamline the ISAP implementation during an incident.

Most interviewees attributed buy-in and leader intent as factors facilitating successful ISAP implementation. During participant observation, teams told us that buy-in from the operations section and the IC was a strong sign for a successful ISAP. ICs who provide clear leader intent around the ISAP helped create the buy-in necessary to facilitate risk-informed and strategic decision-making. As one interviewee said, "[Our IC] has been super engaged [with the ISAP] since the start, and we've been really blessed to have several people on our team who understand it, embrace it, coach others, and are bringing us along with them" (SRF Complex IMT Member). These interviewees also said that having personnel who understand the value of the ISAP and have a culture around continuous improvement helped promote the use of the process. One interviewee said:

It's just seeking continuous improvement. Everything changes, this is a completely different fire ecosystem than when I first started, and to think we can manage and suppress fires the way we did 20 years ago is not doing anyone justice. So, we need to be changing with it. And I think that comes from a leader's intent. We can either help steer the ship, or we can just wait for it to go by and then follow whatever process is there (SRF Complex IMT Member).

Ultimately, interviewees thought buy-in for ISAP should continue to come from bottom-up adoption but also acknowledged that mandating and standardizing the process is likely needed for broader and consistent use.

On the SRF Complex, three Tribal Nations were engaged in the ISAP process and found that the CVAR conversations did not align with their practices. SRF Complex interviewees explained that the history of extractive practices resulted in the Tribes' hesitance to map and share CVAR. Tribal hesitancy to share CVAR carried over into prioritizing CVARs, which, according to interviewees, was not something Tribes were willing to do in large coordination meetings. For instance, one interviewee said, "The matrix is designed with this assumption that values are something that people will want to prioritize, which, as we saw, is something that Tribes may not want to share or prioritize" (SRF Complex IMT Member). Interviewees said additional one-on-one coordination with Tribes may be needed to ensure CVAR are represented and protected in a way that acknowledges and promotes Tribal sovereignty.

Some interviewees said short-term values, such as local sociopolitical pressures, are projected onto the ISAP without a clear understanding of how they should be prioritized. They said AAs should be transparent about sociopolitical risks so that IMTs can understand the entire operating picture and tailor strategy around those values, if appropriate. Despite the management outcomes of the SRF Complex (Table 2), there remains a need to clarify how local-/individual-level managers should incorporate long-term considerations, like the Wildfire Crisis Landscapes, into the ISAP.

At the structural/organizational level, some interviewees said it was important that individuals outside of the IMT (e.g., interagency hotshot crew members, forest personnel, cooperators) should be incorporated into the ISAP to ensure there is cohesive alignment across all responders. Others added that teams must ensure they have appropriate resource capacity, like long-term fire analysts (LTAN) and strategic operational planners (SOPL), on their roster to guide conversations and interpret analytics. Most interviews said that AAs who understand their role (i.e., conveying values at risk and other desired management outcomes) and the value of daily conversations helped facilitate successful ISAP implementation.

In addition to who should be involved in the ISAP meetings, many interviewees agreed that the individual who facilitates the ISAP should create an inclusive space. Interviewees did not agree on what staff members should facilitate the ISAP. However, many interviewees said the facilitator should be the individual on each team or local unit with the best facilitation skills and could create an inclusive space to discuss risk and strategy. Many interviewees said the facilitator should not be biased or appear to favor input from any IMT member or AA. During participant observation, we noticed that a strong facilitator helped implement the ISAP. Many interviewees agreed that each team should be flexible and adaptable to varying facilitation styles, but that individuals should be trained on the ISAP facilitation skills. Therefore, interviewees were clear that appropriate resource capacity (e.g., an LTAN, SOPL, and facilitator) was needed to support the ISAP implementation.

Some interviewees discussed challenges with the ISAP being used as a tactical rather than a strategic tool and how it can be used to sway outcomes. These interviewees said that the current fire culture incentivizes the ISAP to be used as a tactical tool (e.g., to plan locations to place fire line), and there are still perceptions that having resources encourages action on the ground without a long-term strategy. On the Elkhorn Fire, the AAs wanted the IMT to use the ISAP to plan long-term strategy once initial point protection around critical values was in place (see Table 2). As one interviewee said, “My vision was more on the strategic side, and where we ended, it was more of a tactical conversation. If you are not looking at each alternative equally to understand the hazards and the probabilities, how do you make an informed decision on which is the best alternative?” (Elkhorn AA). Some interviewees also perceived that the ISAP focused conversations on hypotheticals, which encouraged indirect wildfire tactics. For example, one interviewee said, “to avoid all the future hypotheticals, [ISAP] needs to be more grounded in the current management decisions of the unit. Do you want [the fire] out or not? Let’s not talk about what it could do two, three, or four weeks from now” (San Juan fires IHC Member).

At the culture/broader organizational level, the ISAP was built on the assumption that IMT members, AAs, and local fire staff needed a consistent process for alignment when discussing risk and strategy. However, most interviewees held perceptions on who was entitled to contribute to these discussions, which challenged broader adoption. Some interviewees explained that IMT members have expertise across multiple roles, which warranted full participation in the process. One interviewee explained this: “I’ll ask different folks about their background. They weren’t born a finance chief, so what have they done? And that’s when I start encouraging people to participate. If I see the ISAP going on, I get to interact with all the different sections” (San Juan fires IMT Member). However, other interviewees viewed individuals speaking on topics outside of their specialty as “stepping out of their lane” and providing perceptions of risk and strategy they are not qualified to give. These same interviewees perceive the ISAP as a tool to question the years of training they worked hard to receive. One interviewee explained this by saying the following:

We’ve got to be trusted because it is a sleight of hand or a slap in the face to say, "We’ve invested millions of dollars in you over the years and trained and made you what you are, but we’re not going to trust what you have to say about this." And that’s where it’s a little bit of a rub. And that’s where some of the superintendents just say they are done with this process and with people degrading the amount of commitment I’ve given in my life to be good at this (San Juan fires IHC Member).

Furthermore, this interviewee said they believed that their discretion in the field has been limited by processes such as the ISAP. For instance, they said, “Unless [IMTs] are going to live out here with us, they don’t see the moment-to-moment opportunities that exist. We’ve got to take advantage of very smart firefighting, and that’s what we’ve always been trusted to do” (San Juan fires IHC Member). Our findings reveal conflicting perceptions of the ISAP, with some believing it is a tool for greater collaboration, while others perceive it as a means of questioning or removing expert opinions.

Interviewees attributed agency and firefighting culture as the primary barriers to buy-in for the ISAP. Interviewees explained that there can be some hesitancy within the agency and among firefighters to adopt new approaches. While most interviewees understood the value of alignment, collaboration, and relaying decision-making rationale to frontline firefighters, we observed poor communication of strategy with cooperators and frontline firefighters. Cooperators told us they were confused

about what communication methods to expect during the observed incidents and how this would impact communication standards moving forward. In addition, some interviewees noted that crews lacked the buy-in needed for the ISAP alignment to occur. We observed that frontline firefighters were unaware of the ISAP, and decision-making rationale did not diffuse down the chain of command. Finally, interviewees attributed the challenges of the ISAP documentation (i.e., filling out the SRA document) and notetaking to internal firefighting culture. Some interviewees explained a perception that risk and strategy conversations should stay internal to fire management and not become available to personnel outside of the decision-making context. We observed this in one example when an IMT did not send the SRA document to AAs and cooperators in advance of an ISAP meeting; coaches said this prevented AAs and cooperators from reviewing proposed strategies before meetings and being informed before discussions.

Discussion

We investigated how responders perceive the value of the ISAP during wildfire incidents and the factors that facilitated and challenged its implementation and use. In summary, we found that most interviewees valued the ISAP because it helped provide a consistent approach to communicate risk and strategy, fit into existing workflows, and facilitated difficult but necessary conversations (e.g., when discussing how political pressures influence CVAR). Challenges for adopting the ISAP included a lack of knowledge and technical skills to support use, lack of communication between incident managers and administrators, and various unit dynamics and culture that impeded the adoption of new approaches. Facilitating factors included clear leadership direction and buy-in from the IC, favorable biophysical conditions for considering different management approaches, collaborative history, and the capacity to support the ISAP implementation. To improve the ISAP, interviewees recommended greater education on the process and suggested incorporating ISAP into preseason discussions. Interviewees advocated against an organizational mandate to use the ISAP and instead suggested that the process continue to build support at the local level. Using the implementation of innovation theory (Steelman 2010), we explored the ISAP as an institutional innovation and the factors that supported and challenged its adoption at different levels. In the paragraphs that follow, we first examine our findings through the lens of institutional innovation to shed insights on opportunities to improve the ISAP and factors that challenged its implementation and use (see Table 7). We then include a short section on the implications of our work for policy and practice and conclude with a reflection on our research process and avenues for future research.

Theory indicates that an innovation will be adopted at the individual and local level if it fits with the manager's priorities (Lemos 2008). On the fires we studied, the ISAP coaching was requested on behalf of the AA or IC and, therefore, was implicitly a manager priority. Additionally, interviewees said AAs and ICs established clear direction needed for fire personnel to participate and engage willingly in the ISAP. We also observed and recorded noticeable buy-in from the operations section of IMTs, which interviewees indicated was a strong signal for successful ISAP implementation, as predicted by Rapp et al. (2020). Others have noted that to support change within organizations, leaders must create internal support for innovations and reduce opposition through widespread participation and clear communication of rationale for change (Fernandez and Rainey 2006).

Other local factors like social-political, ecology, and collaborative history influence the implementation of innovations (Moseley and Charnley 2014; Bergemann et al. 2019). Some interviewees shared their uncertainty on how social-political components of wildfire management, such as political pressures to prioritize asset protection, should be incorporated into the ISAP. Uncertainty around political pressures is partly due to the elusive policy direction around wildfire management (Schultz et al. 2019; Franz et al. 2024), but it may also be a result of minimal education on communicating risks through the context of the ISAP. Many interviewees also said that favorable fire conditions and, thus, the perception of having adequate time for the ISAP meetings helped create space for risk and strategy discussions. Congruent with other studies on decision-support tools, the perception of time impacted the ability of individuals to engage with an innovation (Colavito 2020; Noble and Paveglio 2020). Even with the perception of time for ISAP meetings, CVARs need to be provided early in an IMTs command. Interviewees recommended that CVAR could be developed in the preseason to expedite this process (Aldworth and Beeton 2025). We also suspect that collaborative history in the locations surrounding the fire's location influenced the use of the ISAP (see Bergemann et al. 2019). For example, in the context of the San Juan fires, local collaboratives were exposed to the ISAP as an effort to set expectations on communication and a local commitment to the process (i.e., the ISAP will become the standard for communicating with cooperators; FACO 2023). Likewise, on the SRF Complex, external communication with Tribes highlighted a gap in the identification of critical values through the ISAP but ultimately resulted in productive outcomes where fire was reintroduced on some Indigenous lands (Harling 2024).

Many interviewees said there was poor communication regarding risk and strategy across all levels of wildfire management. This might be explained by a broader wildfire culture that normalized communication on a need-to-know basis (Hawkins 2007). The finding suggests that, particularly for ISAP to be utilized, teams need to be better prepared to share information (e.g., through notes and the SRA document) within and across IMTs and with partners and to tailor communication to case-specific needs (e.g., when coordinating with Tribes). Steelman and Nowell (2019, p.6) note that communication is typically directive, focused on "informing and acknowledging" practices, rather than on intentions of collaborating and coordinating. Tailored, improved approaches to communication will allow IMTs to better engage with local governments and Tribes as partners and rightsholders (Steelman and Nowell 2019). For example, AAs may need to utilize alternative valuation methods that take a holistic approach to social valuation (Woinarski et al. 2024). Other local-level factors that challenged the use of the ISAP included poor ISAP documentation and a lack of notetakers available during risk and strategy meetings. Interviewees said the SRA should be a living document that can facilitate information sharing and greater alignment across IMTs, AAs, and cooperators. The ISAP required many teams to incorporate aspects of coordination/communication that may not have been common prior to the ISAP. Ultimately, our research showed that local context matters with regard to wildfire management, and the ISAP is a tool to help create transparency around local contexts and across IMT members and AAs.

At the organizational level, change is influenced by the structures that support or frustrate the use of an innovation, including incentives and organizational support or opposition to adopt an innovation (Fernandez and Llamas-Sanchez, 2008; Steelman 2010). Directions to standardize the ISAP and require its use on incidents have already occurred (NWCG, 2023). In alignment with other research, most interviewees said that as a new process, the ISAP should continue to gain local support before there is an organizational mandate (Colavito 2020; Buettner et al. 2023). Nevertheless, these interviewees still valued other organizational factors like NWCG courses that can introduce and reinforce risk-informed decision-making and strategy development coaching teams introduced on incidents. Organizations must also provide tangible support for innovations to be adopted, such as through funding or capacity building (Fernandez and Rainey 2006). Some interviewees said that technical capacity, supported by strong SOPLs and LTANs, is a sign that the ISAP can be successfully implemented. Conversely, it may be a barrier for units without these resources. Scholars have noted that a lack of technical capacity is generally a barrier to adoption of wildfire innovations (Lemos 2008; Greiner et al. 2020; Noble and Paveglio 2020). Similarly, interviewees said the ISAP facilitator is also important and may become a barrier for teams who do not have a roster of facilitators to utilize throughout the wildfire season.

We found that interviewees' understanding, buy-in, and application of the ISAP varied across incidents. For instance, some participants struggled to use the ISAP as a long-term planning tool. On the Elkhorn Fire, interviewees said they were not able to frame discussions around strategic applications of the ISAP. Rather, interviewees said the ISAP was used as a tactical tool where multiple strategic alternatives were not openly discussed during the ISAP meetings. Despite this challenge, responders on the SRF Complex were able to look beyond the tactical applications of the ISAP, considering multiple alternatives to minimize long-term risks to responders, which ultimately led the IMT and AAs to select more indirect tactics. Additional training focused on the ISAP implementation may be needed to create consistency in its use and ensure wildfire responders are prepared to discuss short- and long-term goals on their forest. Education should concentrate on how the ISAP as a process could help managers achieve region-specific operational needs, for instance, to communicate with larger cooperator groups, Tribes, or the public. While NWCG training is ideal for individuals coming through the wildfire response system, it does not address tenured or entry-level professionals who are not receiving new qualifications. Needed is early risk-based and structured decision-making training to increase alignment from incident command to frontline firefighters.

Change is more likely to be accepted at the cultural or broader organizational level when it fits within larger social and political goals (Steelman 2010). The ISAP was created to provide a consistent process for discussing risk and strategy (NMAC, 2017). Organizations embedded within cultures are rarely questioned, and catalyzing events or new framing create windows of opportunity for innovation (Steelman 2010). We found that the broader-level firefighting culture within the Forest Service created challenges for the implementation of the ISAP. For instance, some interviewees felt that the use of the ISAP undermined their firefighting experience, was leveraged to justify indirect suppression tactics, or enabled individuals to comment on topics outside their area of expertise. However, expert knowledge may be defined differently by different individuals and can be widely held, as many IMT members have served in multiple sections across their careers and likely have knowledge that would provide value across functional areas. The ISAP facilitator plays a crucial role in balancing expert opinion

across positions and managing influence across sections. Furthermore, the ISAP required a level of communication and coordination that may not have existed within wildland fire management before, as seen with a lack of notetakers and communication with frontline firefighters. However, despite challenges at this level, representing a tension between tacit knowledge and structured processes involving people with different types and levels of experience, we found considerable buy-in and support for the ISAP at the individual and structural levels. This indicates that additional framing, training, and communication may be required to depart from traditional viewpoints and engage with new decision-making paradigms (Steelman 2010).

Changes within the broader social context have occurred since data collection and could affect how ISAP is used during wildfire response. Recent fires, like the Marshall Fire, Palisades fires, and Attica fires, have gained increased attention because of their wind-fueled spread rates that devastated communities and tested responses to wildfire (Bassler 2024, 2025; NOAA 2024). Many of our interviewees imagined that ISAP would not be as effective during fast-moving dynamic wildfires, such as these. Conducting full ISAP meetings with corporations, administrators, and wildfire responders would not be practical, desirable, or acceptable during these conditions and would leave the agency's legitimacy at risk. Additionally, under the current operating framework, CVARs could not be provided at the appropriate time in incident response. However, even if the ISAP is not appropriate for these types of fires, it may still provide value for coordinating immediate post-wildfire response efforts across actors where there are still values at risk (i.e., from flooding, debris flows, or other hazardous materials on the landscape), hazard mitigation strategies needed, and responders at risk.

Furthermore, new framing is another factor that can cultivate changes in a worldview (Steelman 2010). Wildfire management can be influenced by new problem framing set by a presidential administration. For instance, goals proposed by the Trump administration seek to suppress wildfires at their smallest footprint (Schultz 2025). While this has not materialized into directives or policies, it will begin to invoke change at lower levels as agencies face increasing pressures. This suggests that wildfire responders will need to take aggressive direct suppression tactics, which could significantly increase the risks to firefighters depending on the terrain and conditions. However, there have been developments to consolidate federal wildfire efforts into one organization and to increase the development and use of technology to support decision-making (EO 14308). In combination with budget and staff cuts to the USFS and DOI agencies, resulting in the loss of more than 10% of their workforce (see OPM, 2025), the wildfire system is being asked to do more with fewer resources and in new ways under unprecedented conditions (Thompson et al. 2023). These changes will have unintended and relatively unknown impacts on wildfire management. The ISAP may become a valuable process to help prioritize efforts while maintaining wildfire safety and protecting critical values at risk. While our case studies highlighted how dialogue across IMTs, AAs, and cooperators can facilitate opportunities for other than full suppression strategies, this may subside with the change in federal leadership direction. It is important to note that research has highlighted the value that risk-based and structured decision-making frameworks bring to fire planning and management (Thompson et al., 2021), highlighting the need to maintain investment in approaches like the ISAP.

Limitations and future research

Our research captures how the ISAP is being used to manage and communicate risk and strategy during incident management. Our case study locations exhibited similar fire behavior across all cases, and there were no noted issues of resource scarcity, which limited our understanding of how the ISAP is used during extreme fire behavior and times of resource scarcity. Additional research is needed to understand the utility of the ISAP during these conditions. This will help us understand how time availability influences the ISAP implementation. In addition, during participant observation, we primarily shadowed the ISAP coaching team and learned the process through their perspectives and through conversations with IMT members and AAs. While we did have conversations with individuals without the coaching team present, observing ISAP from the perspective of AAs or key IMT positions would still be valuable for future work. Furthermore, most participants were early adopters and were generally very positive towards the ISAP; our sample may have skewed our data to suggest more buy-in than exists. Interviewees thought the ISAP had a utility to facilitate team and personnel transitions; however, it was not a part of our research objectives to observe team transitions during data collection. Further research would benefit from studying the ISAP's utility as a tool to facilitate team transitions. We found that risk perceptions influence the ISAP implementation, but relatively little is understood about how different fire personnel perceive and evaluate risk. Research should be conducted to better parse the different factors that influence decision-making at the AA and IC levels, which could lead to insights to better align competing objectives and interests in fire management.

Conclusion

In this paper, we explored institutional innovation in the context of US wildland fire management. The impacts of wildfire are felt worldwide, and it is becoming more important to create a shared understanding of risks across scales and strategies that more fully consider risks among wildfire responders. We found that interviewees valued the ISAP because it helped provide a consistent approach to communicate risk and strategy, fit into existing workflows, and facilitate difficult but necessary conversations. Factors that challenged the ISAP revealed there is still a broader need to educate responders on how best to communicate and engage through the process. Our findings add to an existing body of literature focused on managing uncertainty through risk-based decision-making. When used in the right context, the ISAP can facilitate multiparty coordination that considers a full accounting of risks and strategy. This will be increasingly important as wildfire complexity continues to grow.

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Authors' contributions

WCB, conceptualization, methodology, investigation, formal analysis, writing, review, and editing. TA, conceptualization, methodology, investigation, formal analysis, writing, review, and editing. MG, conceptualization, investigation, methodology, and review. TB, conceptualization, writing, review, and editing. CS, conceptualization, writing, review, and editing.

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Data availability

The datasets generated and/or analyzed during the current study are not publicly available due to participant confidentiality. The interview guide and codebook are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

Our research was approved by the Institutional Review Board at Colorado State University. All study participants provided verbal consent to participate in this study.

Consent for publication

All authors whose names appear on the submission approve the version to be published. Availability of data and materials. The interview guide and codebook are available from the corresponding author on reasonable request.

Competing interests

None.

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