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# THESIS

**APPLICATION OF THE INTELLIGENCE CYCLE TO PREVENT IMPACTS OF DISASTROUS WILDLAND FIRES**

by

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Wildland fires are an enduring homeland security threat that destroys lives, property, and the environment annually. This thesis explores the concept that the application of the intelligence cycle is a practical approach to addressing threats and minimizing wildland fire impacts. To determine how effective the intelligence cycle can be in decreasing the impacts of disastrous wildland fires, the research examined the wildland fire problem, fire service intelligence, and the intelligence cycle. Research affirmed there is no current application of a wildland fire intelligence cycle. A case study analysis concluded that components of the intelligence cycle currently take place in wildland fire incidents, but not in a formalized process. This thesis argues that the intelligence cycle is a valuable framework for re-evaluating how the fire service collects, analyzes, and disseminates information about wildland fire threats. As a result of research and analysis, several recommendations were identified that include policy adoption at the national level and enhanced wildland-fire intelligence integration. The intelligence cycle adoption will ultimately help the fire service better communicate with the communities it services, and the resulting enhanced communication will help the fire service be more successful in mitigating the effects of those fires that do occur.

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**APPLICATION OF THE INTELLIGENCE CYCLE TO PREVENT IMPACTS OF DISASTROUS WILDLAND FIRES**

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Submitted in partial fulfillment of the
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# ABSTRACT

Wildland fires are an enduring homeland security threat that destroys lives, property, and the environment annually. This thesis explores the concept that the application of the intelligence cycle is a practical approach to addressing threats and minimizing wildland fire impacts. To determine how effective the intelligence cycle can be in decreasing the impacts of disastrous wildland fires, the research examined the wildland fire problem, fire service intelligence, and the intelligence cycle. Research affirmed there is no current application of a wildland fire intelligence cycle. A case study analysis concluded that components of the intelligence cycle currently take place in wildland fire incidents, but not in a formalized process. This thesis argues that the intelligence cycle is a valuable framework for re-evaluating how the fire service collects, analyzes, and disseminates information about wildland fire threats. As a result of research and analysis, several recommendations were identified that include policy adoption at the national level and enhanced wildland-fire intelligence integration. The intelligence cycle adoption will ultimately help the fire service better communicate with the communities it services, and the resulting enhanced communication will help the fire service be more successful in mitigating the effects of those fires that do occur.

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## LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| 9/11 | September 11, 2001 |
| ASTER | advanced spaceborne thermal emission and reflection radiometer |
| AVL | automated vehicle locators |
| AWIS | airborne wildland intelligence system |
| BLM | Bureau of Land Management |
| CIA | Central Intelligence Agency |
| CIAC | Colorado Information and Analysis Center |
| CRS | Congressional Research Service |
| DHS | Department of Homeland Security |
| DOI | Department of Interior |
| EMR-ISAC | Emergency Management and Response-Information Sharing and Analysis Center |
| FAC | fire adapted communities |
| FACC | Fire Adapted Communities Coalition |
| FBAN | fire behavior analyst |
| FBI | Federal Bureau of Investigations |
| FDNY | Fire Department of the City of New York |
| FEMA | Federal Emergency Management Agency |
| FLAME | Federal Land Assistance, and Management and Enhancement Act |
| FMAG | fire management assistance grant |
| FOBS | field observers |
| FOUO | official use only intelligence |
| GACC | geographic area coordination center |
| GEOINT | geospatial intelligence |
| GIS | geographic information system |
| GPS | global positioning system |
| HPWREN | high performance wireless research and education |
| HUMINT | human intelligence |
| IAFC | International Association of Fire Chiefs |
| ICS | incident command system |

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|---|---|
| IMINT | imagery intelligence |
| IMT | incident management team |
| INT | intelligence |
| IPOE | intelligence preparation of the operating environment |
| IR | infrared |
| IRINT | infrared intelligence |
| IRWIN | integrated reporting of wildland fire information |
| ITACG | Interagency Threat Assessment and Coordination Group |
| JCAT | Joint Counterterrorism Assessment Team |
| JIC | joint information center |
| LiDAR | light detection and ranging |
| LTAN | long-term fire analyst |
| MASINT | measurements and signature intelligence |
| MISR | multi-angle imaging spectroradiometer |
| MODIS | moderate resolution imaging spectroradiometer |
| MCWP | Marine Corps Warfighting Publication |
| NASA | National Aeronautics and Space Administration |
| NCTC | National Counterterrorism Center |
| NFDRS | national fire danger rating system |
| NGO | non-governmental organization |
| NIST | National Institute of Standards and Research |
| NPG | National Preparedness Goal |
| NPS | National Park Service |
| NPSS | National Predictive Services Subcommittee |
| NRF | National Response Framework |
| NWCG | National Wildland Coordinating Group |
| NWS | National Weather Service |
| ODNI | Office of the Director of National Intelligence |
| OSINT | open source intelligence |
| PIG | probability of ignition |
| PPD | presidential policy directive |
| QFR | Quadrennial Fire Review |

| | |
|---|---|
| RADINT | radar intelligence |
| ROIC | Regional Operations and Intelligence Center |
| SAWTI | Santa Ana wind index threat |
| SIGINT | signals intelligence |
| SME | subject matter expert |
| S&T | scientific and technical intelligence |
| THSP | technical specialists |
| USDA | United States Department of Agriculture |
| USFS | United States Forest Service |
| USMC | United States Marine Corps |
| WFDSS | wildland fire decision support system |
| WFM | Wildland Fire Management |
| WUI | wildland urban interface |

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# EXECUTIVE SUMMARY

The threat of wildland fires is an issue of national security, as it relates to disaster management and the protection of U.S. citizens. Numerous wildfires, burned homes, environmental consequences, and the evacuation of thousands are problems that occur nearly every fire season. Tactical considerations are the primary focus of how the fire service deals with the wildland fire problem. However, having both a tactical and strategic approach allows fire service decision makers to make informed decisions that can minimize the impacts of wildland fires before, during, and after the fires. Given the limitations of current tactical approaches, other solutions that will complement them are worthy of consideration. Specifically, the application of the intelligence cycle has merit in combating wildland fires.

Providing a general overview of the intelligence cycle is not a simple task. Debates ensue about how to best describe it and its origination. Similarities in the core components, such as direction, collection, and processing of early versions of the intelligence cycle are evident in later iterations adopted by numerous intelligence agencies. Although fire services have not adopted a formalized intelligence cycle approach, advances in information sharing have been made.

The literature in this thesis demonstrated a gap in research and thinking about the application of the intelligence cycle to wildland firefighting. Little or no discussion appears in the firefighting literature about the use of the intelligence cycle or other intelligence principles. Despite the lack of defined research on a wildland fire intelligence cycle, some value is apparent in its use, which indicates the need to further evaluate its usefulness for the wildland fire problem. The Central Intelligence Agency (CIA) intelligence cycle model is evaluated for wildland fire application, due to the simplicity of the steps.

Two intelligence dissemination platforms are examined, the wildfire centric geographic area coordinating centers (GACCs) and the all-risk or all-hazard focused national network of fusion centers. It appears that linking the GACCs and the national network of fusion centers may be critical in supporting wildland firefighting activities from the fire prevention level all the way down to the tactical level.

The research examines the role of intelligence and intelligence-collection methods in the current wildland fire environment. The fire service does not formally characterize the intelligence-collection methodologies as precursors to actionable intelligence. The robust nature of technology and its application to the wildland fire problem further supports the role of intelligence collection. The concepts of fire service intelligence, the intelligence collection types, and the technology component of intelligence collection as they relate to the CIA intelligence cycle are discussed.

Although the fire service does not use a formalized intelligence cycle, some current practices are consistent with the existing intelligence cycle models. When looking at the components parts and processes currently in use, information indicates a value in the application of the intelligence cycle for fire service decision makers. This thesis discusses the fire service's informal adoption of the five constituent components of the CIA intelligence cycle model, including the strengths and the gaps or problems of each in the way they currently are applied in the fire services.

Planning for large-scale wildland fires and their prevention is an enduring focus that depends on effective intelligence production. The collection and processing of information, such as weather indices and geographic areas at risk, support the planning portion of the cycle. Current analysis actions create finished fire intelligence that can be further enhanced in the future as technology evolves. Expanding dissemination can also support the adoption of the intelligence cycle

Analysis indicates various components or elements of the intelligence cycle were at play in the 2012 Waldo Canyon fire, even though a conscious effort may not have been made to use any formalized intelligence cycle model. Deconstructing the Waldo Canyon fire and examining the various parts of the intelligence cycle's relevance to the event provides a framework for application in the wildland fire environment to minimize wildfire impacts on communities. The use of the intelligence cycle to prevent and manage fires may evolve to help fire service and related agencies respond to external demands and societal implications in the wildland fire environment. An opportunity exists to formalize a well-defined wildland fire centric model.

This thesis draws conclusions about the intelligence cycle and its specific application to wildland fire prevention and management. Shortcomings and implementation issues are highlighted, and evidence from other fields that effectively utilize the intelligence cycle and scholarly research findings are used to generate related solutions that may lead to best practices in fire services. This paper posits that the intelligence cycle will be a practical approach to wildland fire prevention, response, and management.

Driven by the desire to minimize the impacts of disastrous wildland fires, the author provides recommendations for the future. To be implemented successfully, several recommendations will need significant high-level policy support. The support may be easier to garner as potential benefits are quantified as lives saved, property loss reduced, and environmental impacts minimized. Using a well-defined intelligence process focused on saving lives, protecting property, and reducing environmental impacts in a fiscally responsible manner is a prudent wildland fire policy. This thesis argues that the intelligence cycle is a valuable framework for thinking and re-evaluating how information about wildland fire threats is collected, analyzed, and disseminated. Its adoption will ultimately help the fire service better communicate with the communities it services, and the resulting enhanced communication will help the fire service be more successful in preventing wildland fires and mitigating the effects of those that do occur.

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# I. INTRODUCTION

Minimizing and mitigating the threat of wildland fires is an issue of national security, as it relates to disaster management and protection of U.S. citizens. Numerous wildfires, burned homes, environmental consequences, and the evacuation of thousands are problems that exist nearly every fire season. According to the National Interagency Fire Center, roughly 68,000 wildfires burned 10.1 million acres in 2015,[1] which exceeded the average of 6.6 million acres burned from 2000 to 2014.[2] Many experts who are troubled by ongoing disasters consider options for federal support to determine ways to prevent the severity of the impacts.[3]

Tactical considerations are the primary focus of how the fire service deals with the wildland fire problem. The operational nature of tactical considerations includes how to fight the fires and stop the ongoing impacts once the fires start. However, having both a tactical and strategic approach allows fire service decision makers to make informed decisions that can minimize the impacts of wildland fires before, during, and after wildland fires.

Given the limitations of current tactical approaches, other solutions that will complement them are worthy of consideration. Specifically, the application of the intelligence cycle may have merit in combating wildland fires. The intelligence cycle is a systematic means to process information to create actionable intelligence. With that in mind, using key core concepts from the intelligence community, such as ongoing intelligence collection, analysis of the acquired data, generating intelligence products, and identifying new issues and applying them to wildland fires may be beneficial. The basic model of the intelligence process is called the "intelligence cycle." When supported by the intelligence cycle, the intelligence analysis process of gathering information and

[1] "Fire Information," National Interagency Fire Center, accessed February 6, 2016, http://www.nifc.gov/fireInfo/fireInfo_stats_totalFires.html.

[2] National Interagency Fire Center.

[3] Katie Hoover, *Federal Assistance for Wildfire Response and Recovery*, CRS Report No. R41858 (Washington, DC: Congressional Research Service, 2015), 1–5, https://www.fas.org/sgp/crs/misc/R41858.pdf.

creating products can work towards preventing the destructive nature of these fires. The intelligence cycle can also contribute to tactical decision making by providing intelligence products that can aid incident commanders in making appropriate suppression and risk mitigation decisions. Natural disasters, including wildland fires, are similar to terrorist attacks because they often are not predictable, and they result in destruction and social upheaval.

This thesis used the concept that wildland fires are indeed a homeland security threat and the institutionalization of the intelligence cycle may be a practical approach to addressing their threat and minimizing their impacts on people, nature, and structures. The various iterations of the intelligence cycle provide an organized way to gather and analyze information in a streamlined way that will allow fire service officials to address the complexities of the wildland fire problem and overcome current difficulties in identifying effective solutions. Further, the resulting emergent data can serve as a foundation for future wildland fire prevention policy. A process is already in use in other fields that may be able to help with that problem, that of the intelligence cycle.

## A. BACKGROUND

Given the scale of wildland fires, the National Preparedness Goal (NPG) was created to provide a starting point for an overall strategy that includes the five key mission areas of prevention, protection, mitigation, response, and recovery.[4] The NPG is a vital element of the National Preparedness System mandated in the presidential policy directive (PPD) 8. The PPD 8 of 2011 "is aimed at strengthening the security and resilience of the United States through systematic preparation for the threats that pose the greatest risk to the security of the Nation."[5] This systematic preparation occurs as the five

[4] Department of Homeland Security, *National Preparedness Goal*, 2nd ed. (Washington, DC: Department of Homeland Security, 2015), https://www.fema.gov/media-library-data/1443799615171-2aae90be55041740f97e8532fc680d40/National_Preparedness_Goal_2nd_Edition.pdf.

[5] "Presidential Policy Directive 8: National Preparedness," Department of Homeland Security, last published September 23, 2015, https://www.dhs.gov/presidential-policy-directive-8-national-prepared ness.

individual mission areas interact and linearly build upon each other.[6] The prevention mission area is focused on stopping or minimizing the impacts of homeland security threats prior to occurrence. The protection mission area is centered on safeguarding against threats and hazards. The mitigation mission area expects to reduce negative impacts and lessen ongoing results. The response mission is often highlighted due to the direct action needed to save lives, property and the environment immediately through incident stabilization. Lastly, the recovery mission area highlights actions to return to normal after a catastrophic event occurs. The core capabilities and mission areas directly align with the wildland fire problem as a homeland security concern. Many directly or indirectly relate to components of the intelligence cycle examined later.

On a more focused level, an indicator of a wildland fire's destructive significance and whether it is viewed as a homeland security issue is the approval of a Department of Homeland Security fire management assistance grant (FMAG) during the incident.[7] When a governor's authorized representative submits a FMAG application, several criteria must be met that include a threat to lives and property, high fire danger, lack of firefighting resources and potential for major economic impact.[8] Statistical analyses indicate that wildland fires are significant problems that impact lives, property, and the environment and do so with momentous financial costs. As a point of reference, during the 2013 fiscal year, 29 approved FMAG declarations affected nine western states at the cost of $109,070,405 with each on average costing $3,761,048.[9]

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[6] Department of Homeland Security, *National Response Framework*, 2nd ed. (Washington, DC: Department of Homeland Security, 2013), https://www.fema.gov/media-library-data/20130726-1914-25045-1246/final_national_response_framework_20130501.pdf.

[7] "The FMAG is authorized by the Stafford Act Grants and is provided to States, tribal and local governments. The FMAG is for the mitigation, management and control of any fire burning on publicly (non-federal) or privately-owned forest or grassland that threatens such destruction as would constitute a major disaster." Federal Emergency Management Agency, *Fire Management Assistance Grant Program Guide* (Washington, DC: Department of Homeland Security, 2014), 10.

[8] Federal Emergency Management Agency, 10.

[9] Federal Emergency Management Agency, *Disaster Relief Fund, Fiscal Year 2013 Congressional Justification* (Washington, DC: Department of Homeland Security, 2013), https://www.fema.gov/pdf/about/budget/11f_fema_disaster_relief_fund_dhs_fy13_cj.pdf.

Another sign that wildfire management is a significant homeland security issue is the annual wildfire management appropriations approved by Congress.[10] The Forest Service and the Department of the Interior (DOI) primary distributions fund the Wildland Fire Management (WFM) account and Federal Land Assistance, and Management and Enhancement Act (FLAME) account. The FY2017 budget identified a combined allocation of $4.18 billion.[11]

Recent governmental reports attempt to identify some of the challenges facing wildland fire management. The United States Department of Agriculture (USDA) and the DOI created the 2014 Quadrennial Fire Review (QFR), which is the result of a strategic risk assessment process. The QFR identified several problem areas and stated, "The wildland fire management community currently lacks an innovation agenda or a list of priorities."[12] Although several areas of weakness were found, the QFR identified the workforce as extremely technologically adept and indicated that it efficiently uses advanced analytics tools to process surveillance data.[13] A positive change that resulted from the recommendations of the 2014 QRF was the use of crowdsourcing that allowed stakeholders to provide input.[14] Crowdsourcing is also a form of intelligence collection, originated online to solicit feedback from governmental agencies, fire service professionals, industry experts, non-governmental organizations, and citizens on how best to improve wildland fire management. Focus groups were created to capture valuable input from those actively engaged in wildland fire intelligence. New priorities have not been determined for the 2018 QFR, but no evidence indicates that a new, innovative model, such as a wildland fire intelligence cycle will be included and adopted that may be

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[10] Kelsi Bracmort, *Wildfire Management: Federal Funding and Related Statistics*, CRS Report No. R43077 (Washington, DC: Congressional Research Service, 2013), 1–18, https://www.fas.org/sgp/crs/misc/R43077.pdf.

[11] Katie Hoover, *Wildfire Management Funding: Background, Issues, and FY2018 Appropriations*, CRS Report No. R45005 (Washington, DC: Congressional Research Service, 2017), 10, https://fas.org/sgp/crs/misc/R45005.pdf.

[12] Department of the Interior Office of Wildland Fire, *2014 Quadrennial Fire Review Final Report* (Washington, DC: U.S. Department of the Interior, 2015).

[13] Department of the Interior Office of Wildland Fire.

[14] Department of the Interior Office of Wildland Fire, *2014 Quadrennial Fire Review, Help Shape the Future of Wildland Fire Management* (Washington, DC: U.S. Department of the Interior, 2014), https://www.forestsandrangelands.gov/QFR/documents/2014QFR_Brochure_20140313.pdf.

supported by current and emerging technologies. A purpose of this this thesis research would be to provide a path for developing wildland fire intelligence techniques and procedures in support of wlldland fire management.

Identifying the issues of most concern for policymakers is the foundational phase of the intelligence process. According to the intelligence model, defining the answers essential to make educated decisions will outline the best route to a solution. The process involves laying out a plan for acquiring the desired information, followed by implementing the plan and acquiring the information, often in phases. Once the necessary information gathering is complete, the data are sorted and analyzed to create intelligence products. Finally, the intelligence recommendations are distributed to target audiences of fire service leadership and other public safety agencies. The activities of the intelligence cycle pull together information, convert it into intelligence, and make it available to end-users. The finished intelligence products often reveal additional issues, which lead to more inquiries; thus, as one cycle ends, the next one begins. Using this model to create actionable intelligence regarding wildland fires may reduce their negative impacts through improved early warning and more focused information compared to current implementation strategies. This intelligence can, in turn, facilitate firefighters' ability to make tactical and strategic decisions from a better-informed position.

The traditional characterization of the intelligence cycle is that the practitioners of the cycle provide decision makers with the necessary information to make educated choices. On a larger scale, the intelligence cycle is used to prevent or lessen the impact of unwanted events from occurring. In wildland fire arena, the intelligence cycle can equip fire leaders to make better-informed decisions that will lessen the destructive nature of fires. The application of the intelligence cycle to natural events, such as wildland fires, is reasonable, although its application to wildland fire management likely requires a national, strategic-level policy that may directly impact fire personnel at the tactical level. Using a non-traditional approach of the intelligence cycle for wildland fires will result in better coordination between public safety domains. While the impacts from wildland fires do not appear to be a transient problem, the non-typical use of the intelligence cycle may be the solution necessary to reduce the adverse effects of these fires.

## B. RESEARCH QUESTION

This thesis aims to provide recommendations that can help prevent and manage destructive wildland fires. The overarching research questions for this thesis are the following:

- How effective can the intelligence cycle be in decreasing the impacts of disastrous wildland fires?
- Assuming evidence suggests the intelligence cycle would be an effective approach, how might the cycle be best utilized by the fire service?

The answer to the first overarching research question may be that the intelligence cycle may or may not be realistically or effectively applied, but at the very least, some of its components may be useful to address the wildfire problem. Hence, the research and analysis of this thesis tested the suggestion that the intelligence cycle may be a viable "fix" to the problem of disastrous wildland fires. This thesis also provides that the fire service can adapt or modify the intelligence cycle to fit the problem.

This research focuses on evaluating existing policy and determines whether viable policy recommendations or alternative options are available to the current challenges the nation faces in preventing and managing destructive wildfires. Due to the very nature of wildland fires, the managerial focus is primarily driven by the tactical response after the fire has started. Significant wildland fire suppression policies have been developed explicitly to focus on response, but those that relate to wildland fire prevention and risk reduction also exist. This thesis analyzes the value of those policies while concentrating on the application of the intelligence cycle to support actions aimed at reducing the impacts of wildland fires. The emphasis is on both the tactical and strategic level, which involves evaluating existing wildland fire policy, and examining how the intelligence cycle may potentially integrate with the current policy to create a best-practices approach in the future.

## C. METHODOLOGY

This thesis examines the intelligence cycle and its application to wildland fires. It uses a case study of the June–July 2012 Waldo Canyon fire in Pike National Forest near Colorado Springs to identify a relationship between wildland fire endeavors and the intelligence cycle. The Waldo Canyon fire was selected for evaluation because it was one of the most significant fires in Colorado history, and a significant amount of literature and data exist about it.

Eugene Bardach's eightfold path was used to conduct the analysis for this thesis. The steps of the eightfold path are the following.

- Step One: Define the problem
- Step Two: Assemble some evidence
- Step Three: Construct the alternatives
- Step Four: Select the criteria
- Step Five: Project the outcomes
- Step Six: Confront the trade-offs
- Step Seven: Decide
- Step Eight: Tell your story[15]

The primary objectives of this thesis are to work through the steps of the eightfold path and identify plausible solutions to address improvements to the wildland fire problem in the United States better. That process began with clearly describing the wildland fire problem, which entailed defining its scope, scale, and complexities. That foundational information was used to move through the remaining steps of the eightfold path, which identified several areas where components of the intelligence cycle were currently in use. The analysis of the Waldo Canyon fire included examining what

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15 Eugene Bardach, *A Practical Guide for Policy Analysis* (Los Angeles: Sage, 2012).

occurred at the fire and determining whether any intelligence processes or components of the intelligence cycle were employed. The components of intelligence collection, technological applications, and the intelligence cycle were carefully studied to determine correlations with the current wildland fire situation. Another aim of the study was to establish whether best practices were used to address the fire or whether the needed intelligence was lacking before, during, or after the historic fire.

The results of the research and analysis yield a set of recommendations to answer the research questions of whether the intelligence cycle can be effective in addressing the wildland fire problem, and if so, how the cycle can be used to decrease the impact of disastrous wildland fires.

## D. CHAPTER OUTLINE

Chapter II is the literature review and examines information sources that include the scope of the wildland fire problem, the intelligence cycle, the intelligence cycle application to wildland fires, fire service intelligence, and regional intelligence entities. Chapter III focuses on intelligence collection in support of the fire service and includes fire service intelligence, the relevance of intelligence collection, and technology role in intelligence collection. Chapter IV provides an overview of the intelligence cycle model and identifies correlation when applied to wildland fires. Chapter V focuses on a case study of the Waldo Canyon fire and how it relates to the components of the intelligence cycle, including planning, collection, processing, analysis, and dissemination. Lastly, Chapter VI ends with findings, limitations, recommendations, and conclusions.

# II. LITERATURE REVIEW

This literature review provides an analysis of a range of topics specific to the wildland fire problem and the intelligence cycle process and its role in public safety. The review is organized into five sections: analysis of the wildland fire problem, historical and current processes and practices of the intelligence cycle, existing fire service intelligence, regional intelligence practices, and policies, and the intelligence cycle's role in the fire service and its potential application to wildland fires. The wildland fire problem is examined from several different perspectives that include scientific positions based on scholarly research and policy perspectives in the fire safety field and related service areas. Scientific views and evidence are drawn from research in the fields of physical, life, and social sciences, and policy perspectives are considered from various governmental agencies and nongovernment organizations, including national environmental groups.

The data sources used in this literature review primarily consist of scholarly and field-specific books and manuals, scientific journals, and government documents. Subject matter experts (SMEs), commonly with doctorate degrees, and scientists provide much of the wildland fire academic information. As a contrast, practitioners from the intelligence community write much of the literature focused on intelligence. The current review provides an integrated approach that includes an academic discussion of key topics in addition to the practical application perspective.

## A. THE WILDLAND FIRE PROBLEM

The wildland fire problem is not easily solved and requires input from a variety of stakeholders. Evaluating the diverse perspectives and coupling that with the know and percieved limitations of current policies and practices provides a starting point.

### 1. Diverse Perspectives

Examining the totality of the wildland fire problem is complex, and various approaches can be used. Looking at the problem from multiple scientific perspectives and considering their policy implications provides a starting point. This section describes philosophical differences that exist among different scientific disciplines and related policy perspectives and analyzes their value in resolving the complexity of the current wildfire problem.

Wildland firefighting is a discipline unto itself that begins with primary firefighter education. Generally, the earliest courses are in the physical sciences, because they are focused on the physical and biochemical aspects of fire and the materials it burns. Many researchers whose work is examined in this thesis are deeply rooted in the physical science world, and their position on the wildland fire problem is often narrowly focused on topics specific to fire science growth and spread. For example, National Institute of Standards and Technology (NIST) researchers, who are largely grounded in the physical sciences, characterize their perspective by stating, "at its core, the wildland fire problem is a structure ignition problem and the best approach to reducing the severity of the problem is to lessen the potential for structure ignition."[16] This perspective suggests that altering the ignition potential will decrease the impacts of wildland fires. The perspective could be viewed as self-limiting due to its narrow focus on ignition principles. Its limited value is likely rooted in the institute's focus on the aftermath of wildland fires, which centers on the variable levels of damage and how structures either inhibit or enable the destruction.[17] Characterizing or quantifying a range of wildland fire ignition concepts is a relatively new science that is an essential component to describing and solving the problem.

The life science research perspective aligns with ecosystem studies and climatology. Much of the life science content related to wildland fires centers on managing ecosystems and mitigating risks to human and wildlife communities.[18] The ecosystems provide the vegetative fuels in wildland fires and managing these fuels

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[16] William Mell, "The Wildland–Urban Interface Fire Problem—Current Approaches and Research Needs," *International Journal of Wildland Fire Int. J. Wildland Fire* 19, no. 2 (2010): 238.

[17] Joan L. Pellegrino, Nelson P. Bryner, and Erik L. Johnsson, *Wildland-Urban Interface Fire Research Needs—Workshop Summary Report*, NIST Special Publication 1150 (Gaithersburg, MD: National Institute of Standards and Technology, Department of Commerce, 2013), http://dx.doi.org/10.6028/NIST.SP.1150.

[18] Max A. Moritz et al., "Learning to Coexist with Wildfire," *Nature* 515, no. 7525 (2014): 58.

equates to a reduction of risk. As a life science researcher, Halsey argues that the current way of conducting business is ineffective from an ecological impact perspective.[19] A common theme throughout much of the life science aligned literature is the need to respond to climate change and this nation's continued development of fire-prone landscapes despite documented climate shifts. These studies suggest that the expansion into these areas will only compound the current wildland fire problems.[20] Warmer and drier conditions lead to longer fire seasons that result in more frequent and more destructive fires.[21]

Social science also provides insights into the wildland fire problem since human interaction is critical to the discussion. It is important that policymakers realize that social sciences experts support the creation of long-term policy decisions through community engagement to achieve success. It is equally important for policymakers to have a clear understanding of how the public living in high-risk areas interprets the wildland fire problem.[22] This understanding is realized by communicating and implementing policy and plans deemed acceptable to the public.[23] This community acceptance is accomplished when social science research examines societal values, beliefs, and mindsets.[24] Understanding how the community views the wildland problem helps establish what the needs of the community are.

The integration of physical, life, and social sciences is not easily accomplished due to the different focuses and perspectives among them in regard to both research and

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[19] Richard W. Halsey, *Fire, Chaparral, and Survival in Southern California* (San Diego: Sunbelt, 2008).

[20] Chad T. Hanson et al., "Setting the Stage for Mixed- and High-Severity Fire," in *The Ecological Importance of Mixed-Severity Fires: Nature's Phoenix*, ed. Dominick A. DellaSala and Chad T. Hanson (Amsterdam: Elsevier, 2015), 3–21.

[21] Jeremy S. Littell et al., "A Review of the Relationships between Drought and Forest Fire in the United States," *Global Change Biology* 22, no. 7 (2016): 2353–2369.

[22] Paul R. Lachapelle and Stephen F. McCool. "The Role of Trust in Community Wildland Fire Protection Planning," *Society & Natural Resources* 25, no. 4 (2012): 321–335.

[23] Michael Czaja, "Integrating Social Science Research into Wildland Fire Management," *Disaster Prevention and Management* 23, no. 4 (May 2014): 381–94.

[24] Jeffrey J. Brooks et al., "Collaborative Capacity, Problem Framing, and Mutual Trust in Addressing the Wildland Fire Social Problem: An Annotated Reading List," *The Bark Beetles, Fuels, and Fire Bibliography* (2006): 48.

practice. Ideally, the concepts of each science can be synthesized into a well-integrated best practices recommendation. Instead, the complex differences amongst the sciences have primarily led to incongruity due to philosophical disagreement; if synthesis is desired, it requires dialog between practitioners.[25] Difficulties arise when messaging and marketing wildland fire plans and policies to communities at risk. Each scientific viewpoint markets their own vision to the public. The undesired result of the marketing can be a biased perspective supportive of one science over another that can minimize a collaborative point of view. No single solution on how to deal the problem exists.

### 2. Limitations of Current Practices and Policies

Each year, Congress identifies the amount of wildfire management funding for relevant agencies, such as the United States Forest Service (USFS) through the DOI.[26] Should wildfire suppression funding become exhausted during any given year, agencies are authorized to transfer funds between accounts to pay for suppression activities. The practice of borrowing funds from the USFS and DOI accounts to pay for fire suppression undermines other land management programs, including those intended to decrease long-term wildfire risk and costs, such as fuel reduction.[27] Congressional Research Service (CRS) reports validate the pervasive, destructive nature of wildland and wildland-urban interface (WUI) fires, yet the funding for preventing and suppressing them is not adequate even though research data and CRS reports validate the argument that the wildland fire problem is of homeland security importance.[28]

Other policy level literature sources focus on life safety and environmental concerns, and some environmental policies may overlap with aspects of life science perspectives. For example, the USFS supports policies that use controlled and prescribed

[25] Halsey, *Fire, Chaparral, and Survival in Southern California.*

[26] Ross W. Gorte, *Federal Funding for Wildfire Control and Management,* CRS Report No. RL33990 (Washington, DC: Congressional Research Service, 2011), https://fas.org/sgp/crs/misc/RL33990.pdf.

[27] William L. Painter, *Department of Homeland Security: FY2015 Appropriations in the 114th Congress*, CRS Report No. R43884 (Washington, DC: Congressional Research Service, 2015), http://www.fas.org/sgp/crs/homesec/R43884.pdf.

[28] Bruce R. Lindsay and Francis X. McCarthy. *Stafford Act Declarations, 1953–2014 Trends and Analyses, and Implications for Congress,* CRS Report No. R42702 (Washington, DC: Congressional Research Service, 2015), https://www.fas.org/sgp/crs/homesec/R42702.pdf.

burning to minimize the threat of conflagration.[29] The principle is that over time, ecosystems become unhealthy, and the dead and dying plant life contributes to hazardous fuel loading, a concern among environmentalists. The USFS further defines management of wildland fires through prescribed burning by using the right fire at the right place at the right time, which is supported by intelligence and broad area surveillance and analysis: The USFS uses prescribed burning to do the following:

- Reduce hazardous fuels, protecting human communities from extreme fires
- Minimize the spread of pest insects and disease
- Remove unwanted species that threaten species native to an ecosystem
- Provide forage for game
- Improve habitat for threatened and endangered species
- Recycle nutrients back to the soil
- Promote the growth of trees, wildflowers, and other plants[30]

Not all life science researchers agree on the best approach to reducing the risk of a conflagration in this way. Chaparral researcher Halsey takes an opposing view to the controlled and prescribed burning policies of the USFS. He contends that field research fails to show that vegetation needs to burn every 20 to 30 years to renew and that prescribed burning timeframes should not depend solely on the age of the vegetation; the variable nature of vegetative types makes the policy faulty.[31] Halsey's argument provides an example of when environmental policy conflicts with the life safety policies of

[29] A. Sydney Johnson and Philip E. Hale, "The Historical Foundations of Prescribed Burning for Wildlife: A Southeastern Perspective," in *The Role of Fire in Nongame Wildlife Management and Community Restoration: Traditional Uses and New Directions Proceedings of a Special Workshop Nashville, Tennessee, September 15, 2000* (2002): 11–23, https://www.nrs.fs.fed.us/pubs/gtr/gtr_ne288/gtr_ne288.pdf#page=16.

[30] "Prescribed Fire," U.S. Fire Service, accessed December 15, 2016, https://www.fs.fed.us/managing-land/fire/resilient-landscapes/prescribed-fire.

[31] Halsey, *Fire, Chaparral, and Survival in Southern California*, 28.

agencies, such as the USFS. Specifically, Halsey questions the effectiveness or appropriateness of many of the policies that the USFS or other fire agencies use to contain that problem. Validating the intelligence provided by life science experts with fire service professionals can help with the inconstancies in policy.

Some prevention policies conflict with what research and science indicate may be most useful in protecting life, property, and the environment. Sabrina Drill examines several myths focused on wildfire resistance and environmental health. She argues that environmentally sound preventative actions, such as drought-tolerant landscaping may conflict with the belief that fire safe landscaping requires significant amounts of water.[32] Another myth identified by Drill supports Halsey's contention that it is false to believe that California native plants require regular burning to maintain health.[33] Instead, she argues for funding and policies that would bridge the gap between life science and social science through the regulation or support of homeowners in hardening their homes with a primary focus on effective vegetation and landscape management.[34] Another perspective concentrates on the concept of letting current fires burn to minimize or prevent future events, although not to the point where life safety is an immediate threat. Similarly, researchers Ingalsbee and Raja call for "ecological fire use, [focused on] working with wildland fire rather than fighting against them."[35] The authors characterize the wildland fire problem as being socioenvironmental, which is a combination of some of the societal and environmental topics previously discussed. The researchers argue that the wildfire problem results from three compounding factors: fuel accumulation from historical fire suppression activities, global warming, and consistent residential growth in the urban-wildland interface.[36] Each of these issues independently creates the need for extensive policy evaluation and development.

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32 Sabrina Drill, "Achieving Wildfire Resistance and Environmental Health in the Wildland-Urban Interface," *Fremontia: A Journal of the California Native Plant Society* 38, no. 2 (July 2010): 37–42.

33 Drill, 37.

34 Drill, 39.

35 Timothy Ingalsbee and Urooj Raja, "The Rising Costs of Wildfire Suppression and the Case for Ecological Fire Use," in *The Ecological Importance of Mixed-Severity Fires: Nature's Phoenix*, ed. Dominick A. DellaSala and Chad T. Hanson (Amsterdam: Elsevier, 2015), 367.

36 Ingalsbee and Raja, 353–5.

## B. FIRE SERVICE INTELLIGENCE

The concept of fire service intelligence continues to evolve with the needs of society and public safety agencies. The intelligence operations take place at the larger national level and are reinforced at the regional level. Both levels improve situational awareness for first responders.

### 1. National Level

Although fire services have not adopted a formalized intelligence cycle approach, recent advances have been made in information sharing. Before September 11, 2001 (9/11), the term "all-hazards" intelligence did not exist, nor did the concept of fire service involvement in the intelligence process. Much has changed since then; the U.S. government and the fire service have increasingly embraced the idea of information sharing and dissemination. In the years following 9/11, the Fire Department of the City of New York (FDNY) was instrumental in this change. In 2007, the FDNY developed a terrorism and disaster preparedness strategy that included the fire services' first consideration of information-sharing, which included timely intelligence and information dissemination to enhance situational awareness for the fire service.[37] One of the pillars of this strategy was the creation of the weekly intelligence product *Watchline*, which provides recent incident reports, threat evaluations, and intelligence assessments focused on firefighters as the end user. This intelligence product has been in use for nearly a decade and provides timely information to approximately 40,000 response personnel weekly.[38] While *Watchline* is not considered a tactical intelligence product it is useful for situational awareness.

In addition to the local New York efforts to improve interagency communication post-9/11, the *9/11 Commission Report* provided recommendations at a national level. In response to the report, the Interagency Threat Assessment and Coordination Group

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[37] Michael R. Bloomberg, Nicholas Scoppetta, and Salvatore J. Cassano, *Fire Department City of New York, Terrorism and Disaster Preparedness Strategy* (New York: Fire Department of the City of New York, 2007), 20, http://www.nyc.gov/html/fdny/pdf/events/2007/tdps/terrorism%20strategy_complete.pdf.

[38] Michael R. Bloomberg, Salvatore J. Cassano, and Edward S. Kilduff, *FDNY New York Counterterrorism and Risk Management Strategy* (New York: Fire Department of the City of New York, 2011), 10, https://www1.nyc.gov/assets/fdny/downloads/pdf/FDNY_ct_strategy_2011_12.pdf.

(ITACG) was established by the National Counterterrorism Center (NCTC) to improve information sharing throughout public safety disciplines. In 2013, ITACG was replaced by the Joint Counterterrorism Assessment Team (JCAT) to "improve information sharing and enhance public safety" through collaboration with multidisciplinary stakeholders.[39] The ITACG, Federal Bureau of Investigations (FBI), and Department of Homeland Security (DHS) collaboratively produced the intelligence product *Roll Call Release* that provides timely and relevant information to first responders. Additionally, the multi-disciplinary 37 agencies represented at JCAT produce 50,000 print copies of the *Intelligence Guide for First Responders* as a primer for intelligence-related topics and is readily available on multiple sites online.[40] First responders also have online access to the guide. The *Guide* was first produced in 2011 and updated in 2015. It is unknown what the readership is for the estimated 1,160,000 professional and volunteer firefighters in the United States.[41] The *Guide* is a tool for public safety agencies to recognize and report suspicious activity or respond to and mitigate incidents after they have occurred.

The desire for fire integration with the intelligence community remains a focus at the national level. In a 2017 testimony to the U.S. House of Representatives Subcommittee on Emergency Preparedness, Response, and Communication, Fire Chief John Sinclair, President of International Association of Fire Chiefs (IAFC) identified recommendations that included an enduring need for information sharing. Sinclair's testimony also argued for continued support for the current network of intelligence fusion centers. He also shared the desire to receive actionable intelligence that assists in tactical and procedural decision making to best protect lives and property.[42] He suggested that

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[39] "Joint Counterterrorism Assessment Team (JCAT)," Office of the Director of National Intelligence, accessed June 15, 2016, https://www.dni.gov/index.php/nctc-how-we-work/joint-ct-assessment-team.

[40] Joint Counterterrorism Assessment Team, *JCAT Intelligence Guide for First Responders* (Washington, DC: National Counterterrorism Center, 2015), https://www.nctc.gov/jcat/docs/Intelligence_Guide_for_First_Responders.pdf.

[41] "U.S. Fire Department Profile," National Fire Protection Association, 2015, http://www.nfpa.org/news-and-research/fire-statistics-and-reports/fire-statistics/the-fire-service/administration/us-fire-department-profile.

[42] International Association of Fire Chiefs, *The Future of FEMA: Stakeholder Recommendations for the Next Administrator* (Fairfax, VA: International Association of Fire Chiefs, 2017), 3, http://docs.house.gov/meetings/HM/HM12/20170214/105563/HHRG-115-HM12-Wstate-SinclairJ-20170214.pdf.

the fire service can contribute to counterterrorism efforts as intelligence collectors and intelligence consumers. Equally import, intelligence can be enhanced when the fire service develops of community networks and proactively engages these networks through planning, preparation, and education.[43]

### 2. Regional

Although no research has been conducted on the effectiveness of the intelligence cycle for wildland firefighting, fire service professionals do make ample use of intelligence and information gathering and dissemination systems, particularly at the regional level. This section first reviews the current literature on one of the most prominent regional fire service intelligence systems, the Geographic Area Coordination Centers (GACCs), which disseminate fire intelligence on a regional basis. Next, this section reviews the national network of fusion centers, which is a network of state and local intelligence centers established after the 9/11 terrorist attacks. Both systems are designed to deploy relevant intelligence to stakeholders; the GACCs are more single focused and wildland fire-centric while the national network of fusion centers is frequently characterized as "all-risk" or "all hazard." Most fusion centers do not focus on any one type of hazard; instead, they are interested in all public safety threats, including terrorism. The current processes in place for intelligence product distribution and alternatives that may be feasible are discussed.

The GACCs are overseen by the USFS, the DOI, the United States National Park Service (NPS), the United States Fish & Wildlife Service, and the United States Bureau of Land Management (BLM). The 10 regional GACCs service areas are Alaska, Eastern Area, Great Basin, Northern California, Northern Rockies, Northwest, Rocky Mountains, Southern Area, Southern California, and the Southwest (Figure 1). These GACCs provide

[43] Daveed Gartenstein-Ross and Kyle Dabruzzi, *Firefighters' Developing Role in Counterterrorism* (New York: Manhattan Institute, 2008), https://www.manhattan-institute.org/html/firefighters-developing-role-counterterrorism-5955.html.

a geospatial-centered view of the wildland fire threats by dividing the country into the specific regions.[44]

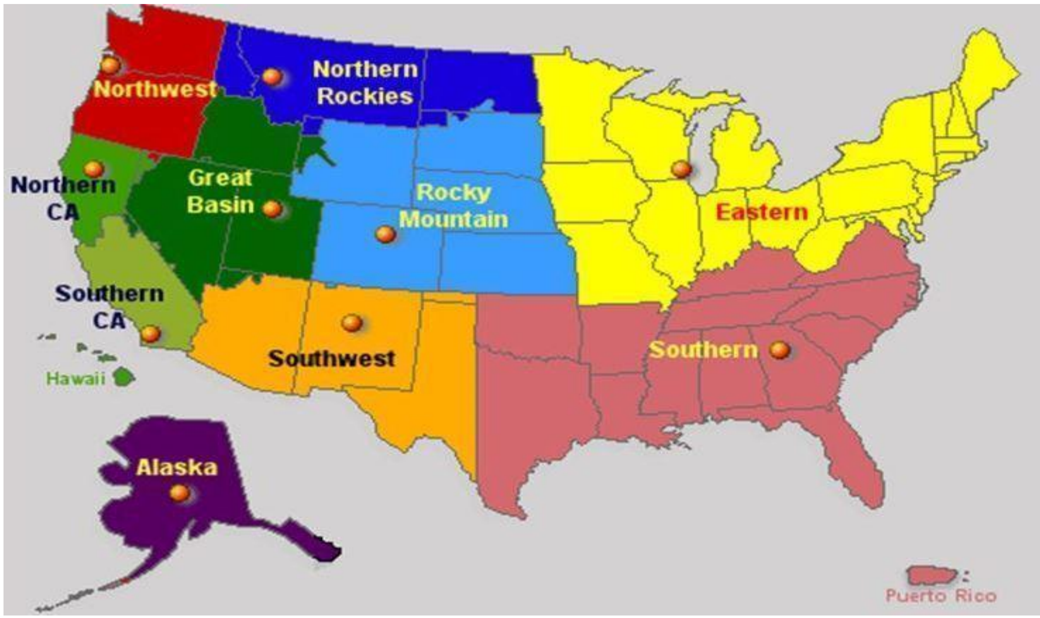


Figure 1. Geographic Area Coordination Centers.[45]

One of the GACC's primary missions is to develop predictive intelligence products that provide decision support information to help agencies act proactively in the prevention of fires. The Predictive Services section at the GACCs consists of three primary functional areas—weather, fire danger, and fuel conditions—and focus on intelligence and analytic outlook products. Predictive Services function under the guidance of the National Predictive Services Subcommittee (NPSS), which is chartered under the National Wildland Coordinating Group (NWCG) to "provide leadership and direction for the program with the goal to promote safe, efficient and cost-effective fire

44 Thomas W. Corringham, Anthony L. Westerling, and Barbara J. Morehouse, "Exploring Use of Climate Information in Wildland Fire Management: A Decision Calendar Study," *Journal of Forestry* 106, no. 2 (2008): 71–77.

45 Source: "About Us," Geographic Area Coordination Centers, accessed October 4, 2016, http://gacc.nifc.gov/admin/about_us/about_us.htm.

management practices."[46] Intelligence and predictive services-related products are to be used by the greater wildland firefighting community for wildland fire and incident management decision making at the regional level.

Much of Predictive Services intelligence results from the national fire danger rating system (NFDRS), a system that culminated from nearly a century of theoretical, experimental, and applied wildland fire science.[47] The scientific basis of this type of early warning takes numerous collection types into account and produces actionable intelligence for fire incidents.

> At the core of the NFDRS is a computational process that inputs fuels, weather and topographic variables and outputs a suite of related indices that reflect the potential for a fire to ignite, spread and resist control. Rather than providing site-specific fire behavior predictions, the NFDRS is designed to provide indices that indicate the worst-case burning conditions averaged across large fire danger rating areas.[48]

Focusing on large fire danger rating areas leaves vulnerabilities when attempting to provide actionable intelligence to targeted communities at risk. The large area focus considers entire portions of a state or county that lacks the needed attention to specific neighborhoods or individual streets.

The available research information about GACCs focuses on organizational capabilities and service delivery. No identified literature indicates the GACC system utilizes the intelligence cycle, and little evaluative research has been done to measure the effectiveness of GACCs. In *Climate in Context: Science and Society Partnering for Adaptation*, Parris and others identified past and future areas of improvement for predictive services. As early as 2000, an "information push" was targeted at identifying shortcomings in wildland fire predictive services.[49] A byproduct of these actions

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[46] "Welcome to the National Interagency Coordination Center," National Interagency Coordination Center, accessed October 13, 2016, https://www.nifc.gov/nicc/index.htm.

[47] Patrick H. Freeborn, Mark A. Cochrane, and William Matthew Jolly, "Relationships between Fire Danger and the Daily Number and Daily Growth of Active Incidents Burning in the Northern Rocky Mountains, USA," *International Journal of Wildland Fire* 24, no. 7 (2015): 900.

[48] Freeborn, Jolly, and Cochrane, 900.

[49] Adam S. Parris et al., ed. *Climate in Context: Science and Society Partnering for Adaptation* (Chichester, West Sussex: John Wiley & Sons, 2016), 149.

included increased staffing at the GACCs and the creation of enhanced intelligence products, such as daily situation reports, and monthly or seasonal outlooks. The authors suggest that the GACCs are a "gap bridging solution that verifies quantitative inputs to the [climate] outlooks thus creating actionable intelligence products.[50] The GACCs are working to improve communication to determine whether predictive service products are meeting the needs of fire service leadership.

The national network of fusion centers has also moved toward improved intelligence messaging. Several years ago, the *Global Justice Information Sharing Initiative* recommended fire service integration into fusion centers.[51] Existing literature indicates that the focus of fusion centers on wildland firefighting is very restricted even though proponents of fire service integration see overall value in the concept.[52] Adding a wildland fire component to the fire service integration at fusion centers can enhance overall life safety for the major urban areas serviced by the centers. The National Fusion Center Association has emphasized the need to integrate the fire service in the multi-disciplinary approach to national security:

> The vision of the National Network of Fusion Centers is to be a multidisciplinary, all-crimes, all-threats, all-hazards information sharing network that protects our nation's security and the privacy, civil rights, and civil liberties of our citizens.[53]

Improving information-sharing initiatives by linking the thousands of federal, state, and local public safety agencies is a crucial component of the *National Strategy for the National Network of Fusion Centers*.[54]

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[50] Parris et al., 160.

[51] Department of Justice, *Global Justice Information Sharing Initiative, and Department of Homeland Security, Fire Service Integration for Fusion Centers: An Appendix to the Baseline Capabilities for State and Major Urban Area Fusion Centers* (Washington, DC: Department of Homeland Security, 2010).

[52] Department of Justice.

[53] National Fusion Center Association, *2014–2017 National Strategy for the National Network of Fusion Centers* (Arlington, VA: National Fusion Center Association, 2014), 7, https://nfcausa.org/html/National%20Strategy%20for%20the%20National%20Network%20of%20Fusion%20Centers.pdf.

[54] National Fusion Center Association, iv.

Some of the national level changes involving the integration of fusion centers have been linked to presidential strategies. For example, as early as 2007, President Bush identified the desire to create fusion centers and stated that "the threats to our national security are constantly evolving, so our policies to ensure this information is used and protected as intended must evolve as well."[55] The historic creation of the fusion centers provides a springboard for homeland security intelligence evolution. In a 2012 investigative report, Senator Carl Levin stated, "Fusion centers may provide valuable services in fields other than terrorism, such as contributions to traditional criminal investigations, public safety, or disaster response and recovery efforts."[56] In as early as 2008, John Rollins indicated that less than 15 percent of fusion centers exclusively self-identify as counterterrorist centric.[57] The remainder of the fusion centers focused on an "all-crime" or "all-hazard" approach.

Not all experts share the same views regarding the value of integrated fusion centers. Monahan and Palmer disagree with the all-hazard concept of fusion centers. They contend that the concept moves away from the core focus of counter-terrorism and results in a weakening of centers' ability to prevent and respond to terrorist attacks.[58] Vanderbilt University Professor Manahan also opines the counterterrorism expansion to all-hazards is primarily to justify the fusion centers' existence in the face of increased irrelevance.[59] Despite some experts' dismissal of the value of all-hazard fusion centers, the size and geographic reach of the national network of fusion centers has not been altered. With an existing network of 79 fusion centers nationwide, the ability to institutionalize change is improving. More significant numbers of fusion centers are

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55 White House, *National Strategy for Information Sharing and Safeguarding* (Washington, DC: White House, 2012), https://www.whitehouse.gov/sites/default/files/docs/2012sharingstrategy_1.pdf.

56 U.S. Senate, *Federal Support for and Involvement in State and Local Fusion Centers* (Washington DC: Government Printing Office, 2012).

57 John Rollins, *Fusion Centers: Issues and Options for Congress*, CRS Order Code RL34070 (Washington, DC: Congressional Research Service, 2008).

58 Torin Monahan and Neal A. Palmer, "The Emerging Politics of DHS Fusion Centers," *Security Dialog* 40, no. 6 (2009): 617–636.

59 Torin Monahan, "The Murky World of 'Fusion Centers' Torin Monahan Critiques the Emergence of Data-Sharing 'Fusion Centers' Intended to Reduce Crime and Prevent Terrorism," *Criminal Justice Matters* 75, no. 1 (2009): 21.

supporting fire service integration. Of the 79 fusion centers, fire service involvement is variable (Table 1).

Table 1. Fire Service Fusion Center Roles.[60]

| Number of fusion centers | Fusion center role |
|---|---|
| 79 | Total fusion centers |
| 46 | Fire service identified as a specific mission area |
| 52 | Fire service participation in liaison programs |
| 39 | Fire service participation in governance |

No apparent reason has been advanced as to why some centers choose to have fire service involvement. Participation in the fusion center governance process is likely a contributing factor to the level of involvement.

One example of the effective integration of fire and other services into an all-hazard fusion center involved Hurricane Sandy in 2012. The New Jersey fusion center, the Regional Operations and Intelligence Center (ROIC), supported the needs of the public, as well as public safety agencies by providing real-time situational updates to a wide variety of customers before, during, and after the storm.[61] The ability to provide intelligence to a variety of stakeholders is an example of the all-hazards approach. The ROIC handling of Hurricane Sandy emphasizes the need for the fusion center network to continue to evolve and possibly include wildland fire threat, and this thesis provides the first examination of that idea.

## C. INTELLIGENCE CYCLE

This section provides an overview of the intelligence cycle and how the U.S. intelligence community uses it. The final output of the intelligence cycle is finished

[60] Department of Homeland Security, *2015 National Network of Fusion Centers Final Report* (Washington, DC: Department of Homeland Security, 2015), 10, https://www.dhs.gov/sites/default/files/publications/2014%20National%20Network%20of%20Fusion%20Centers%20Final%20Report_1.pdf.

[61] "Fusion Center Coordinates New Jersey Hurricane Sandy Disaster Response," Information Sharing Environment, accessed March 3, 2017, https://www.ise.gov/blog/col-rick-fuentes/fusion-center-coordinates-new-jersey-hurricane-sandy-disaster-response.

intelligence. Mark Lowenthal, former Director of Analysis and Production at the Central Intelligence Agency (CIA) and recognized national security affairs expert, provides a sound basis for understanding when he stated, "Intelligence is a subset of the broader category of information."[62] Lowenthal further provides clarification by explaining that intelligence is a subset of specialized information derived from a process designed to meet the needs of policymakers. Specifically, the Iowa Department of Public Safety defines criminal intelligence in a more detailed way and outlines how it relates to the intelligence cycle.

> The intelligence cycle, as it pertains to criminal intelligence, is the process of developing raw information into finished intelligence for consumers, including policymakers, law enforcement executives, investigators, and patrol officers. These consumers then use this finished intelligence for decision-making and action. Intelligence may be used, for example, to further an ongoing investigation, or to plan the allocation of resources.[63]

Although the definition pertains to criminal intelligence, the general understanding can apply to other types of intelligence by slightly altering the specific language.

#### 1. Intelligence Cycle Models

Providing a general overview of the intelligence cycle is not a simple task. The literature indicates debates have occurred about how to describe it and its origination best. It is possible to link the beginnings of the intelligence cycle to the nation's post-World War II desire to evade strategic surprises foreign countries. The National Security Act of 1947 resulted in the creation the CIA led by the Director of Central Intelligence.[64] Early information about the intelligence cycle appeared in military-focused literature in the late 1940s. The 1948 military manual *Intelligence for Commanders* defined the significant features of intelligence gathering (Figure 2), which is believed to be one of the first versions of the intelligence cycle. Similarities in the core components, such as

[62] Mark M. Lowenthal, *Intelligence: From Secrets to Policy*, 6th ed. (Washington, DC: CQ Press, 2015), 2.

[63] "The Intelligence Production Cycle," Iowa Department of Public Safety-Division of Intelligence, accessed January 8, 2017, http://www.dps.state.ia.us/intell/intellcycle.shtml.

[64] "National Security Agency Act of 1947," Office of the Director of National Intelligence, accessed June 23, 2017, https://www.dni.gov/index.php/ic-legal-reference-book/national-security-act-of-1947.

direction, collection, and processing of this first version of the intelligence cycle are evident in later iterations that were adopted by numerous intelligence agencies.

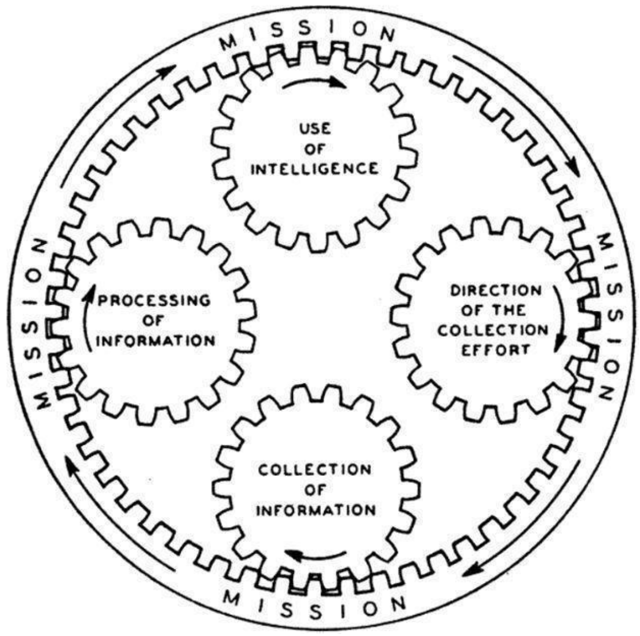


Figure 2. Early Intelligence Cycle.[65]

Over the ensuing years, the process of intelligence analysis evolved to include multiple agencies. Including the Office of the Director of National Intelligence (ODNI), the intelligence community has 17 members.[66] As the intelligence community grew, so did the needs of the participating agencies. Variations to the intelligence cycle models are the bi-product of agency-specific interpretations and needs. Some of the differences are subtle with the addition or elimination of a single phase of the cycle, while others like the Joint Chiefs of Staff's Joint Publication 2-0 *Joint Intelligence* add an evaluation and feedback phase that is in place throughout the process.[67] The FBI intelligence cycle

65 Source: Robert R. Glass and Phillip B. Davidson, *Intelligence is for Commanders* (Harrisburg, PA: The Military Service Publishing Company, 1948), 5.

66 "Member Agencies," United States Intelligence Community, accessed January 9, 2017, https://www.intelligencecareers.gov/icmembers.html.

67 Joint Chiefs of Staff, *Joint Intelligence, Joint Publication 2.0* (Washington, DC: Joint Chiefs of Staff, 2013), I–6, http://www.dtic.mil/doctrine/new_pubs/jp2_0.pdf.

consists of six steps that include the identified requirements (of the intelligence), planning-direction, collection, processing-exploitation, analysis-production and dissemination (Figure 3).[68] Although the FBI cycle has some common elements of the post-World War II military version, it has evolved to center on collaboration, a component completely missing in the first model of the cycle.


Figure 3. FBI Intelligence Cycle.[69]

The USMC model provides a comparative example (Figure 4). The "requirements" phase is absent, and the cycle ends with the "utilization" phase.[70] In the USMC's warfighting publication, *Intelligence Operations*, a comprehensive statement regarding the intelligence cycle says:

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68 "Intelligence Branch," Federal Bureau of Investigations, accessed October 8, 2016, https://www.fbi.gov/about/leadership-and-structure/intelligence-branch.

69 Source: Federal Bureau of Investigations.

70 Department of the Navy, *Intelligence Operations*, Marine Corps Warfighting Publication (MCWP) 2-1 (Washington, DC: U.S. Marine Corps, 2003), 1–3.

No single phase of the cycle is more important than the others. All of the phases are interdependent. Without proper direction, the other phases will not focus on the correct objectives. Without effective collection, there may be too much or too little information and what information there is may prove to be irrelevant. Without processing and production, there is a mass of random data instead of the knowledge needed for the planning and execution of operations. Intelligence is meaningless unless it reaches the right people in time to affect the decision-making process and in an understandable form.[71]

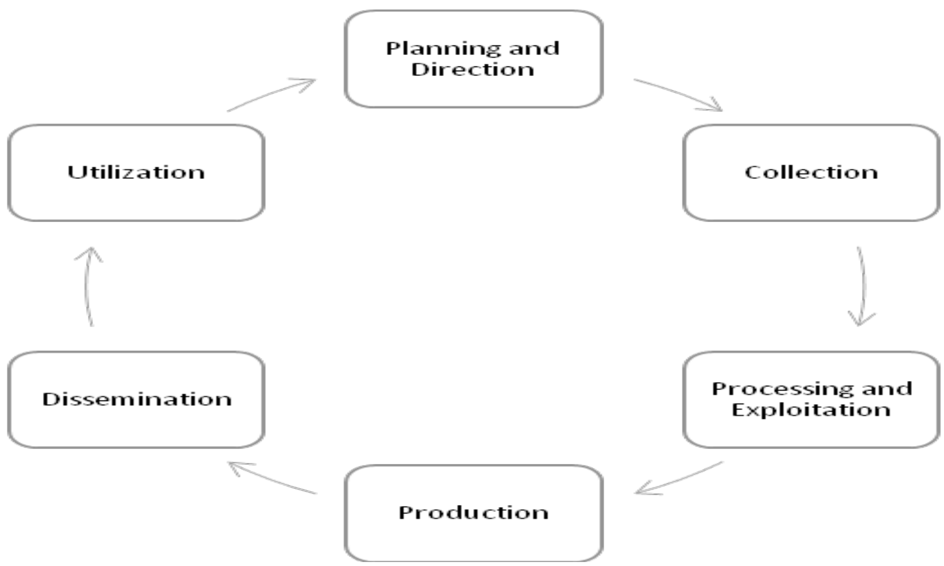


Figure 4. USMC Intelligence Cycle.[72]

The addition of the utilization phase of the USMC model is to support the finished intelligence being put into action following the dissemination.

The CIA intelligence cycle (Figure 5) depicts a version that has fewer steps than those of the FBI and USMC. The traditional CIA intelligence cycle shows it as a recurring process made up of five parts as follows:

- *Planning and direction* encompass the management of the entire effort and involve determining collection requirements based on customer requests.

[71] Department of Navy, 3–1.

[72] Source: Department of Navy, 3–1.

- *Collection* refers to the gathering of raw data to meet the collection requirements. These data can be derived from any number and type of open and secret sources.

- *Processing* refers to the conversion of raw data into a format that CIA analysts can use.

- *Analysis and production* describe the process of evaluating data for reliability, validity, and relevance, integrating and analyzing it, and converting the product of this effort into a meaningful whole, which includes assessments of events and implications of the information collected.

- Finally, the product is *disseminated* to its intended audience.[73]


Figure 5. The CIA Intelligence Cycle.[74]

[73] Rob Johnston, *Analytic Culture in the U.S. Intelligence Community: An Ethnographic Study* (Washington, DC: Government Printing Office, 2005), 45–46.

The CIA model has been in use for decades. In *Analyzing Intelligence*, former CIA Deputy Director Richard Kerr provides an overview of agency analysis related to the effectiveness of the agency's intelligence cycle process occurring between 1950 and 2000. Some key challenges related to intelligence were identified: preconceived mindsets of those requesting the intelligence, politicization, informational gaps, and the need for expertise building and warning challenges.[75] The desire for early warning is a primary focus for the intelligence community to stop or minimize adverse incidents.

Although no standardized version of the cycle accepted by all relevant agencies exists, the similarities among the intelligence process models indicate some consensus on aspects of the fundamental processes and components.

### 2. Perspectives of the Intelligence Cycle

Much of the literature on the intelligence cycle and its implementation concentrates on the policy perspective, as well as application and use, and general policy conservatism is an underlying theme in much of it. "There is much more emphasis on avoiding error than on imagining surprises."[76] This statement reflects the view that some analysts involved in the intelligence cycle are more focused on risk aversion.

Dahl characterizes the discussion of the intelligence process in his book, *Intelligence and Surprise Attack*, in which he identifies three broad schools of thought on intelligence: the traditionalist, reformist, and contrarian. These categories serve as a basis for evaluating literature related to the subject of intelligence and the intelligence cycle.[77] Dahl also provides another point of reference that further divides intelligence into strategic and tactical.[78]

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[74] Source: Central Intelligence Agency, *Factbook on Intelligence* (Washington DC: The Central Intelligence Agency, 1995), https://fas.org/irp/cia/product/facttell/index.html.

[75] Roger Z. George and James B. Bruce, ed. *Analyzing intelligence: Origins, Obstacles, and Innovations* (Washington, DC: Georgetown University Press, 2008), 51–52.

[76] Johnston, *Analytic Culture in the U.S. Intelligence Community*.

[77] Erik J. Dahl, *Intelligence and Surprise Attack* (Washington, DC: Georgetown University Press, 2013).

[78] Dahl.

The traditionalist views intelligence processes and the intelligence cycle application from more historical perspective. Although traditionalists have varied opinions, core concepts are generally agreed upon. Lowenthal examines the intelligence process and argues that the collecting intelligence from as many sources as possible creates synergy and a form of "all-source intelligence."[79] Lowenthal's 36 years of experience as an intelligence practitioner, as well as a policy-level executive in various branches of the government, provides credibility to his ideas.

From a reformist view, or "how it can be made better" view, Mark Phythian, Professor of International Security, and author of several books on intelligence theory, provides insight into the future of the intelligence cycle. He suggests that it is necessary to connect academic theory and experience to understand the intelligence cycle thoroughly. In his view, an academic understanding of the cycle has limitations that can be enhanced by a practitioner perspective. Phythian and the contributors in *Understanding the Intelligence Cycle* describe the cycle in various forms and configurations, and continually critically evaluating the intelligence cycle is the theme that resonates throughout the text with the goal of providing new ideas and representations of the traditional cycle.[80] Similarly, *Transforming U.S. Intelligence* has a reformist slant, as it focuses on "identifying transformative solutions that combine technology with creative tactics and strategies so exponential growth in capabilities might be possible."[81] This text is different from Phythian's in that it is heavily focused on technological evolution and the role in future intelligence endeavors.

In *Intelligence Analysis, A Target-Centric Approach*, Clark provides a non-linear alternative to the intelligence cycle.[82] The target-centric approach does not describe the intelligence cycle as one that is simple or linear; it is a network that contains numerous

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79 Lowenthal, *Intelligence*, 91.

80 Mark Phythian, ed., *Understanding the Intelligence Cycle* (London: Routledge, 2013).

81 Jennifer E. Sims, *Transforming U.S. Intelligence* (Washington, DC: Georgetown University Press 2005).

82 Robert M. Clark, *Intelligence Analysis: A Target-Centric Approach* (Washington, DC: CQ Press, 2010), 13–14.

feedback loops.[83] These feedback loops provide a constant evaluation of the process. Additionally, Clark describes an objective-oriented view of a problem that creates a shared pictured for all stakeholders in the process rather than a directed or planned intelligence product need found in the intelligence cycle. The reformist point of reference is focused on process innovation and enhancement.

The contrarian position has a fundamentally negative focus, which is based on perceived intelligence failures. This viewpoint provides balance to the more positive nature of the traditionalist perspective. Zegart identifies multiple concerns with the failure of the intelligence process. She argues that when analyzing foreign policy and cold war ideology, several issues emerge that provide evidence to support a counter-argument to the effectiveness of the intelligence process over the last 50 years. Zegart suggests that culture is a fundamental component of the problem, which is reflected in the statement, "Culture has an invisible but powerful hold, coloring how intelligence officials view the world and their role in it."[84] Much of this perspective is based on the belief that the intelligence process is biased and singled minded.

A hybrid of the contrarian and reformist perspectives is found in the CIA report *Analytic Culture in the U.S. Intelligence Community*, which also brings a social science analysis of the intelligence cycle. The author, Rob Johnston, who specializes in cultural anthropology, indicates that the conventional intelligence cycle model does not consider the myriad of tasks and complexity facing intelligence analysts, which renders it less than optimally effective and in need of rethinking.[85] One key recommendation offered is that the entire traditional intelligence cycle model should be revisited and redesigned to consider its overarching intended goal more accurately. What that redesign looks like was not explicitly defined, but was merely a recommendation.

A review of the literature indicates no explicit consensus regarding whether the intelligence cycle is useful actually exists. However, the foundational theories and their

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[83] Clark, 13.

[84] Amy B. Zegart, *Spying Blind: The CIA, the FBI, and the Origins of 9/11* (Princeton, NJ: Princeton University Press, 2007).

[85] Johnston, *Analytic Culture in the U.S. Intelligence Community*, 45.

models of the intelligence cycle exist in much of the literature with subtle variations in specific designs of the cycle. The range of opinions expressed by practitioners and SMEs all add to the complexity of the debate. Despite the lack of a defined agreement among those experts in the intelligence field or researchers who study the intelligence cycle, its use does seem to have value, which indicates the need to further evaluate the usefulness of use for the wildland fire problem. The CIA intelligence cycle model is further evaluated for wildland fire application in Chapter IV due to the simplicity of the steps.

## D. INTELLIGENCE CYCLE AND WILDLAND FIRES

No specific literature exists on the link between the intelligence cycle and management and prevention of wildland fires. This thesis focuses on applying the established intelligence cycle to the wildland fire problem, which is based in part on two previous Naval Postgraduate School theses that examine the concept of connecting the intelligence process to disciplines outside of the traditional criminal intelligence field. Specifically, Schultz, an emergency manager, identified the need for improved intelligence processing and developed an emergency management centric intelligence model.[86] Stokes, a senior DHS intelligence officer, examined the intelligence process model, and proposed and analyzed its application to the homeland security enterprise in its entirety.[87] These sources engaged in literature research similar to the review conducted in the current thesis, which both focus on the non-traditional intelligence cycle application.

Schulz's and Stokes's independent concentration on alternate applications of the cycle resonates well with evaluating new ways to address the wildland fire problem. Both authors work in disciplines outside the intelligence community, which is similar to wildland firefighting. Institutionalizing the intelligence cycle process in non-law enforcement-centric disciplines could be advantageous in a variety of disasters.[88] For

[86] William N. Schulz, "Improving the All-Hazards Homeland Security Enterprise through the Use of an Emergency Management Intelligence Model" (master's thesis, Naval Postgraduate School, 2013).

[87] Roger L. Stokes, "Employing the Intelligence Cycle Process Model within the Homeland Security Enterprise" (master's thesis, Naval Postgraduate School, 2013).

[88] Schultz, "Improving the All-Hazards Homeland Security Enterprise."

example, Schultz suggested developing an emergency management intelligence cycle. This thesis indicates how the writings of Schulz and Stoke provide groundwork that focused on emergency management that can be expanded upon to develop new ways to consider the intelligence cycle in relation to wildland fires.

Disaster studies were also reviewed in the current thesis because they provide a comparison between intelligence concepts and other applications. In support of this concept, the National Response Framework (NRF) articulates an all-hazards approach to homeland security regardless of the type, origin, or magnitude of major disasters or emergencies, including disastrous wildland fires.[89] The NRF directs much of the response and recovery actions to significant disasters that involve a total of 14 core capabilities consisting of a range of processes key to managing and preventing disasters. Of these 14 core capabilities, planning and public information and warning directly correlate with the intelligence cycle and its potential role in wildfire management and response.

> Core Capability 1—Planning
> Objective: Conduct a systematic process engaging the whole community, as appropriate, in the development of executable strategic, operational, and/or community-based approaches to meet defined objectives.[90]
>
> Core Capability 2—Public Information and Warning
> Objective: Deliver coordinated, prompt, reliable, and actionable information to the whole community through the use of clear, consistent, accessible, and culturally linguistically appropriate methods to effectively relay information regarding any threat or hazard and, as appropriate, the actions being taken, and the assistance being made available.[91]

The identified core capabilities are analogous to the planning and the dissemination phases of the intelligence cycle. The planning component is similar to the starting point, and the dissemination phase aligns with the public information and warning core capability as the ending or dissemination phase of the intelligence cycle.

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[89] Department of Homeland Security, National Response Framework, Second Edition, May 2013, https://www.fema.gov/media-library-data/20130726-1914-25045-1246/final_national_response_framework_20130501.pdf.

[90] Department of Homeland Security, 20.

[91] Department of Homeland Security, 21.

As emergency management continues to evolve at the national level, improved specificity regarding how to prevent and manage emergencies and the establishment of related policies is evident. Policies, such as the NRF, provide the necessary basis to deal with a broad spectrum of incidents in part because each disaster requires a clear response, management strategy, and assistance plan based on the scale and complexity of the event.[92] When evaluating the impact of disasters, including wildland fires, the significance of the impact may trigger policy change. This policy change is reactive to respond to errors or shortcomings.

Not all experts believe that policy changes resulting from the analysis of events are useful or constructive. In *Lessons of Disaster,* Birkland indicates that policy change does not always yield the desired result and cites the 9/11 attacks as an example. Following that event, an assumption was that the management of all disasters and terrorism is the same, and independent policy was unnecessary.[93] An example of that assumption is that managing a commercial jet crashing into a 100-story high-rise building is the same as managing a magnitude 6.7 earthquake in downtown Los Angeles. Birkland also contends that Federal Emergency Management Agency's (FEMA's) merge with the DHS possibly led to the later realized shortcomings during disasters, such as Hurricane Katrina, due to the dilution of the identified role and responsibilities.[94] Evaluating the linkage between homeland security and emergency management may be helpful to apply the intelligence cycle model to wildland fires. This application can be based on the core concepts of the intelligence cycle and align it with core disaster policies, such as the NRF. Although minimal scholarly work is available that considers that relationship, the following chapters explore and evaluate it.

[92] Francis X. McCarthy and Jared T. Brown, *Congressional Primer on Responding to Major Disasters and Emergencies*, CRS Report No. R41981 (Washington, DC: Congressional Research Service, 2015), 3, https://www.fas.org/sgp/crs/homesec/R41981.pdf.

[93] Thomas A. Birkland, *Lessons of Disaster: Policy Change after Catastrophic Events* (Washington, DC: Georgetown University Press, 2006), 187.

[94] Birkland, 188.

## E. SUMMARY

The study of and practical concerns about the wildland fire problem originate from a number of perspectives that range from the narrow and common focus of physical sciences on the structural ignition problem to life sciences, which tend to fixate on ecosystem studies and climatology. Both fields of science can be coupled with social sciences to consider the human interaction component of the wildland fire problem. These perspectives ultimately drive much of the policy focused on wildland fires despite their disparate views and corresponding recommendations. This literature review identified themes of consensus and debate related to the wildland fire problem, and despite silos and differing views, all scholars and expert practitioners agree that the wildland fire problem is significant and requires action. An analysis of existing research revealed that policy perspectives, such those related to how to best prevent or minimize wildland fire impacts, do not always align with life, environmental, or social sciences' views or what is known about fire science.

The second section of the literature review examined two intelligence dissemination platforms, the wildfire centric GACCs and the all-risk or all-hazard focused national network of fusion centers. During the search for studies and data on the GACCs, limited evaluative documents were discovered and available for review. However, studies and documents focused on the broader evaluation of fusion centers were available and discussed. The determination of a "best practice" intelligence product dissemination platform will require further analysis. It appears that linking the GACCs and the national network of fusion centers may be critical in supporting wildland firefighting activities from the fire prevention level all the way down to the tactical level. At a minimum, the SMEs assigned to the GACCs can provide analytical support to the centers. Optimal interaction can occur by embedding wildland intelligence analysts at fusion centers that have wildland fires in their threat profile.[95]

The final section of the literature review examined intelligence and the intelligence cycle. Perspectives on intelligence and the intelligence cycle indicate that

[95] Department of Justice, *Global Justice Information Sharing Initiative*, 2.

some common beliefs, as well as divergent opinions, are held; e.g., some practitioners contend that a need exists for alteration and updating the current intelligence process model due to obsolescence. The core information gathered in this literature review is elaborated upon in Chapter III, which further evaluates fire service intelligence collection. The components of the intelligence cycle and research that attempts to establish critical linkages between the cycle and the wildland fire problem exist in Chapter IV. Lastly, the findings of the literature review are applied in Chapter V and provide a framework for examining a case study of the Waldo Canyon fire.

This literature review has demonstrated a gap in research and thinking about the application of the intelligence cycle to wildland firefighting. Little or no discussion has appeared in the firefighting literature about the use of the intelligence cycle or other intelligence principles. The following chapters build on this review to incorporate two seemingly unrelated topics into the research question posed earlier: How might the framework of the intelligence cycle be used to prevent devastating WUI fires?

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# III. INTELLIGENCE COLLECTION IN SUPPORT OF THE FIRE SERVICE

This chapter examines current practices of intelligence collection used to support fire service in the prevention and management of wildfires. A broad spectrum of intelligence types is used by the fire service that originates from several collection methodologies. These methodologies can be divided into five primary intelligence (INT) collection types. This chapter describes them and how they are used by various end users while evaluating their effectiveness in preventing and managing fires. The current use of technology and its integration with other types of intelligence collection sources are discussed to provide a comprehensive perspective of variations in wildland fire intelligence practices.

## A. FIRE SERVICE INTELLIGENCE

The concept of fire service intelligence is not new and exists in a variety of ways. Daily and weekly bulletins are commonly used to provide a view of what is happening in real time. The bulletins report on several types of intelligence that fall into four distinct, but related categories:

- Estimative intelligence: Information used by the fire service about potential threats of fire.
- Warning intelligence: This category involves critical notifications provided to policymakers, agencies, and citizens that a threat is very likely.[96] A prime example of warning intelligence is a red flag warning, which is intended to provide early notification of dangerous fire weather. The National Weather Service (NWS) issues red flag warnings for 24-hour periods and can last for several days.[97]

[96] "What Is Intelligence?" Central Intelligence Agency, last updated June 20, 2008, https://www.cia.gov/news-information/featured-story-archive/2007-featured-story-archive/what-is-intelligence.html.

[97] "Understanding Wildfire Warnings, Watches and Behavior," National Weather Service, accessed January 18, 2017, http://www.nws.noaa.gov/om/fire/ww.shtml.

- Research Intelligence: This type of intelligence involves a comprehensive assessment of an issue, often over an extended period. A bi-product of research intelligence is often accurate estimative intelligence.

- Scientific and technical intelligence (S&T): Refers to detailed information from multiple sources typically integrated to generate a broader picture of the fire threat. For example, research intelligence may evaluate historical fire occurrences in a specific region, and that information is analyzed in relation to real-time technical weather data that results in the identification of fire threat. Generally, technical intelligence acquired from weather monitoring that often includes measures of relative humidity, wind speed, and fuel moisture aligns well to validate the importance of NWS red flag warnings. This thesis intends to demonstrate how scientific and technical intelligence attributes can be employed by the fire service.

The outcomes of the intelligence process may provide specific, localized and situational awareness to first responders. Most commonly seen is warning intelligence that tells of a potential threat. The dissemination may also focus on citizens at a community level and result in evacuation orders. Frequently, the messaging derived from intelligence efforts involves illuminating a broad-spectrum threat picture for an entire region that includes areas the size of counties or even states. In developing these messages, strong relationships between the needs of the end user and those creating the information is important to accomplish the intended intelligence objectives.[98] Once key intelligence information is generated, the consumer base can shift to include public, private, and governmental communities barring restrictions for any classified information.

Some intelligence products are specifically designed to be useful to both fire service professionals and the community. One example is CAL FIRE's very high fire hazard severity zone maps, which are intended to identify areas of more significant fire

[98] Loch K. Johnson, "Making the Intelligence "Cycle" Work," *International Journal of Intelligence and Counter Intelligence* 1, no. 4 (1986): 16.

risk. These maps are designed as a prevention tool for use before a fire occurs and serve as an example of research intelligence that integrates information on past fire history and current residential interface areas to generate wildland fire specific intelligence. These maps identify geographic areas that are at most risk from a fire due to proximity to wildland interface areas, vegetative fuel composition, and historic fire data (Figure 6).[99]

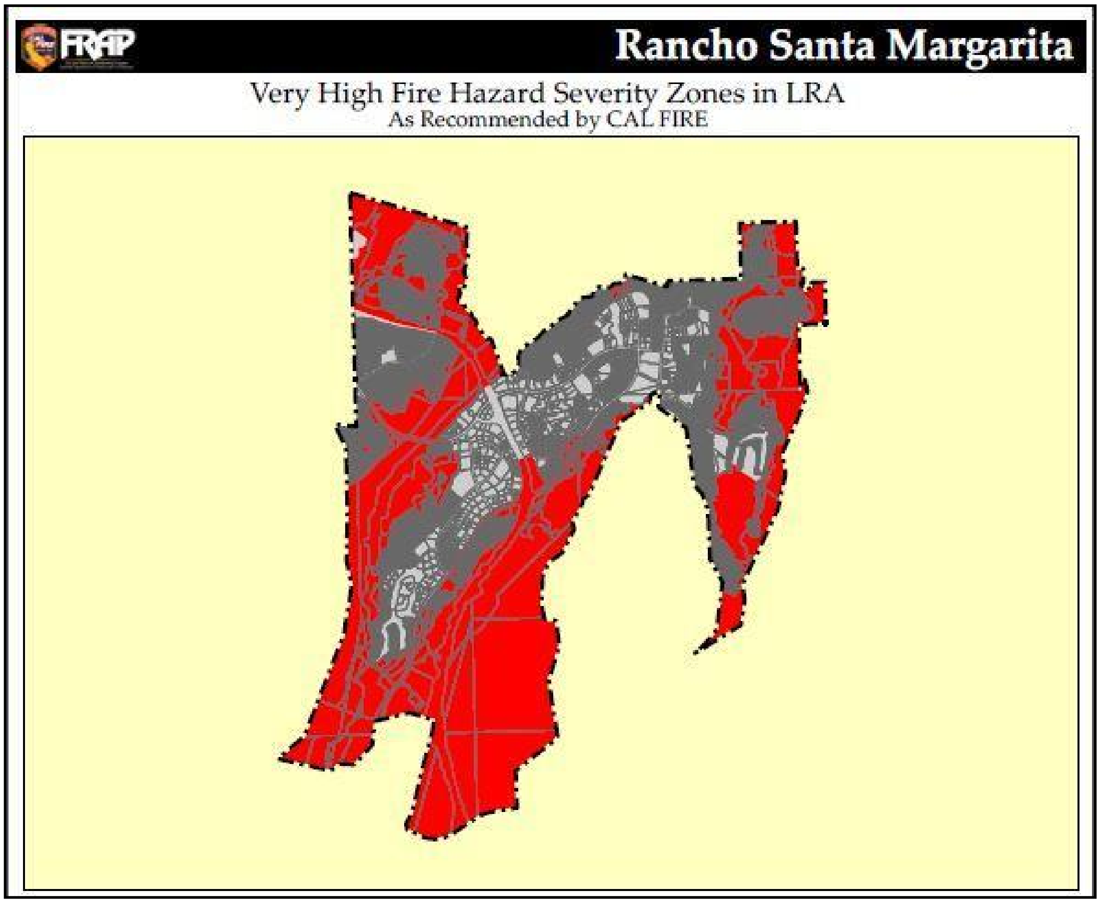


Figure 6. Fire Hazard Severity Zone Map.[100]

This type of product is useful to fire service professionals and citizens alike to provide situational awareness that considers multiple factors, such as construction types,

[99] "California Fire Hazard Severity Zone Map Update Project," Cal Fire, 2012, http://www.fire.ca.gov/fire_prevention/fire_prevention_wildland_zones_maps.

[100] Source: "Rancho Santa Margarita," Cal Fire, 2011, http://www.fire.ca.gov/fire_prevention/fhsz_maps/FHSZ/orange/c30_RanchoSantaMargarita_vhfhsz.pdf.

vegetative fuels types, and historic fire data. Combining the background information from these kinds of maps with upcoming weather alerts in the processing and analysis portion of an intelligence cycle can lead to more actionable intelligence that can directly improve outcomes in the future. Residents often are aware that they live in a threat area, and adding high-risk weather indicators into the equation, provides improved and more precise information about the threat. Ideally, homeowners would consider this type of intelligence when formulating a "Ready, Set, Go" action plan; being ready before a fire starts, being set as the fire approaches, and going early.[101] The same information can assist fire service professionals in making better-informed decisions when wildland fires start.

## B. RELEVANCE OF THE INTS

The fire service consumers' unique intelligence needs currently serve as driving influences of the various collection categories. These INT collection sources can be broken down into five core groups that include:

- Measurement and signature intelligence (MASINT): Technically derived intelligence from various sensing instruments
- Human intelligence (HUMINT): Intelligence gathered through interpersonal contact
- Open source intelligence (OSINT): Intelligence gathered from publicly available sources
- Geospatial intelligence (GEOINT): Intelligence gathered that relates to a particular location
- Signals intelligence (SIGINT): Intelligence gathered from electronic signals and communications systems

[101] Cal Fire, *Ready, Set, Go! Your Personal Wildfire Action Plan* (Ventura County, CA: Cal Fire, n.d.), accessed March 18, 2017, http://calfire.ca.gov/communications/downloads/fact_sheets/ReadySetGo_Plan.pdf.

These types of raw intelligence data are analyzed and ultimately disseminated to intelligence practitioners and analysts. Each of the five categories makes a specific and unique contribution to the different phases of wildland fire management with the goal of using data to minimize impacts before, during, and after a fire incident. Intelligence collection within these five categories occurs regularly; however, coordination between the stakeholders is not consistent, and the data they generate do not typically take place as part of an established intelligence model. An examination of the five collection categories establishes areas of current fire service use.

The historical context of HUMINT includes espionage and elicitation, which is the gathering of information during a conversation between two or more people.[102] Wildland fire prevention activities regularly use HUMINT as a mechanism to evaluate threats, as reflected, for example, in situations when direct interaction occurs between fire service professionals and the residents in communities most threatened by wildland fires. HUMINT collection is limited by the number of fire agency personnel available to make direct physical contact. Given that an estimated 70,000 communities in the United States exist in the wildland-urban interface, the information collection that results from direct human interaction is overwhelming.[103] Finding alternatives to address the HUMINT data collection needs from such significant numbers is necessary for the future.

Another shortcoming of HUMINT is the subjectivity of the information gathered from personal interaction. The need to validate this human data with other information sources is often required. An example may be a fire inspector evaluating a wildland interface area would need to validate property ownership information gathered from a resident with maps or contracts. Regardless of the challenges associated with human data gathering, the opportunity for fire service officials to interact with citizens and key staff of other professional fields often fosters positive relationships that enhance

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[102] Clark, *Intelligence Analysis*, 97.

[103] International Association of Wildland Fire, *WUI Fact Sheet* (Missoula, MT: International Association of Wildland Fire, 2013), 6, http://www.iawfonline.org/pdf/WUI_Fact_Sheet_08012013.pdf.

communication in the long run. Another positive result is that communities develop a strong sense that their safety and protection is a primary concern of the fire service.[104]

GEOINT is the most frequently collected wildland fire data set, which may include imagery and mapping data of communities and other geographic areas. Commercial or governmental satellites, fixed wing or rotary aircraft, and unmanned aerial vehicles or drones collect the information. GEOINT is often synonymous with imagery intelligence (IMINT), which is basically overhead imagery (space-based, airborne) and is useful as a pre-planning tool before fires start. This preventative-focused imagery attempts to identify areas at risk to provide essential information for generating future programs to mitigate the associated risk. Equally valuable, once a wildfire starts, GEOINT can be a mechanism for monitoring current fire status and estimated communities and critical infrastructure at risk. This type of information often supports operational resource needs by determining access and optimal deployment locations. Layering other types of intelligence on top of a GEOINT framework as part of a fusion process is common, which often includes demographic information, such as census data, to determine the size of the population that is in harm's way or that potentially needs evacuation. As an established collection mechanism, GEOINT positively supports wildland fire prevention and operational actions.

MASINT analysis provides technical data that fall into several subcategories. The most pertinent to wildland fires are radar intelligence (RADINT), infrared intelligence (IRINT), and weather intelligence. RADINT is beneficial for visualization of a geographic area through smoke, haze, and foliage to try to detect and identify a targeted area of concern. IRINT is frequently used to determine areas of an active fire that require further resources to extinguish. Much like GEOINT, IRINT is captured by satellite, fixed wing, and rotary wing aircraft. The third example of MASINT is weather-related intelligence, which is one of the most significant sources utilized at the GACCs. A prime example of a MASINT intelligence product disseminated by the Predictive Services

[104] Lachapelle and McCool, "The Role of Trust in Community Wildland Fire Protection Planning."

Section at the GACC is the *Monthly/Seasonal Outlook*.[105] The *Monthly/Seasonal Outlook* couples a regional geospatial view with weather discussions that include temperature and precipitation; both types of information are then linked to generate specific moisture measurements in living and dead wildland fire fuels. This predictive intelligence product establishes potential fire threats and risks for a defined region.

OSINT involves the collection of information readily available to the public from sources, such as the internet, social media, broadcasts and print. Some of the other INTs are also open source data due to the broad availability on the internet. For example, some geographical and mapping information (GEOINT) is readily available on Google Earth. These OSINT images can be helpful in viewing WUI areas of a municipality.

Not all the collection methods align with the traditional needs of the fire service; SIGINT is an example. The conventional perception of signals (SIGINT) is that it is a component of spying, which is obviously not a function of the fire service. SIGINT consists of collection of electronic signals from communications systems. Interception and exploitation of communications technologies are evolving to become a fire service need. An example where SIGINT may be of interest to fire services is related to international terrorist organizations' threats to use fire as a weapon. FDNY Assistant Chief Joe Pfeifer recognizes the threat, "A full understanding of fire as a weapon and implications for response is essential for homeland security."[106] The threat is not merely that fire can serve as a general use weapon, but specifically, that fire can serve as a weapon in the wildland environment. The tactic of using fire as a weapon was employed in the Israeli forest in 2016, where more than 1,770 fires were extinguished over an eight-day period.[107] In the winter 2012 edition of *Inspire*, international terrorist organization al-Qa'ida in the Arabian Peninsula provided a detailed account of how to best start an intentional wildland fire. Specific preoperational intelligence collection recommendations

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[105] Geographic Area Coordination Centers, *Southern and Central CA Monthly/Seasonal Outlook—OSCC, Riverside* (Riverside, CA: Geographic Area Coordination Centers, 2018), https://gacc.nifc.gov/oscc/predictive/outlooks/myfiles/assessment.pdf.

[106] Joseph W. Pfeifer, "Fire as a Weapon in Terrorist Attacks," *Combating Terrorism Center* 6, no. 7 (July 2013), https://ctc.usma.edu/posts/fire-as-a-weapon-in-terrorist-attacks.

[107] János Besenyő, "Inferno Terror: Forest Fires as the New Form of Terrorism," *Terrorism and Political Violence* (2017): 5–7.

in the magazine included choosing a dry season prone to strong winds, watching weather broadcasts to keep updated, and studying scientific magazines and the internet to learn the climate of target countries.[108] Understanding the threat is perhaps the first step; taking action to gather preoperational intelligence through SIGINT is another.

The goal of more efficiently using SIGINT data is to disrupt attacks before they occur through the interception of pre-operational communications, such as phone calls, texts, other forms of messaging, and monitoring of social networks. The fire service would not readily have access to this type of data collection. Established intelligence agencies like those found in the ODNI, which is well versed in this type of intelligence, would be responsible for these collection activities.

Combining the multiple INTs as key elements of the processing step of the intelligence cycle allows for enhanced and more precise characterizations of potential or ongoing wildland fire threats. Well-established private sector vendors provide these data sets. One such company is used by much of the fire service, ESRI, which hosts interactive maps that include active or recent fires, burn perimeters, wind conditions, and rainfall.[109] ESRI uses streaming data from multiple collection and diagnostic sources and combines the information to create maps. Another valuable component of the ESRI mapping is a data layer that captures public social media posts, such as Instagram, Flickr, Twitter, and YouTube that creates a blend of HUMINT and OSINT (Figure 7).[110] The map also includes RADINT, which is displayed as a storm front, and IRINT, which is shown as red dots indicating "hot spots." Both sources of intelligence collection are merged to create a more comprehensive understanding of the fire situation.

108 The AQ Chef, "It Is of Your Freedom to Ignite a Firebomb," *Inspire*, no. 9 (Winter 1433|2012): 30–36, https://info.publicintelligence.net/InspireMay2012.pdf.

109 "Disaster Response Program, Wildfire Support," ESRI, accessed April 27, 2017, http://www.esri.com/services/disaster-response/wildfire.

110 ESRI.

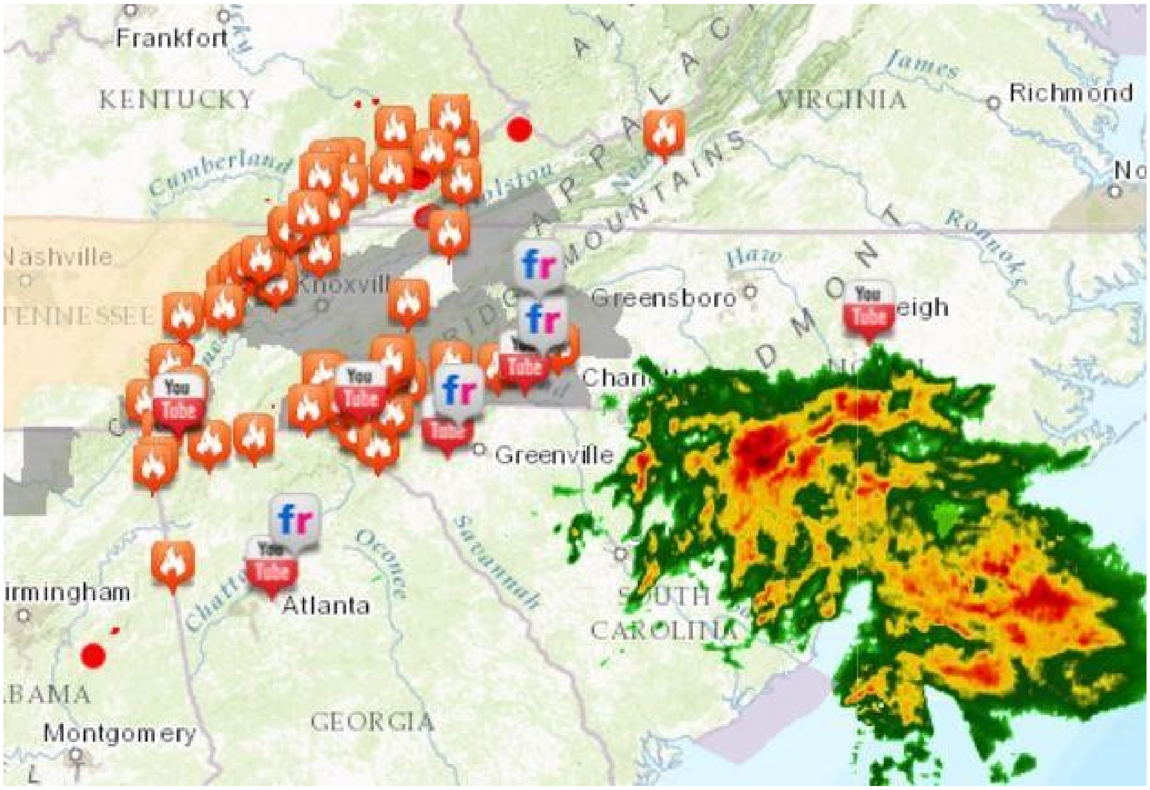


Figure 7. U.S. Wildfire Activity Public Information Map.[111]

A specific example of a comprehensive, high-level product is the *FEMA Daily Operations Briefing.*[112] The Briefing provides a macro view of elevated fire weather, red flag warnings, and summaries of current wildfires and status of requested and declared FMAGs. This type of GEOINT and OSINT is primarily focused on situational awareness that is too broad in focus to make the intelligence actionable. The fire weather outlook map (Figure 8) found in the *FEMA Briefing* is an example of an intelligence product that lacks this specificity. Large areas at risk are shown without targeting specific geographic locations. Intelligence products, such as the Fire Weather Outlook, leave the end user needing additional information, such as the condition of fire receptive vegetation.

[111] Source: ESRI.

[112] "Daily Operation Briefing," Federal Emergency Management Agency, 2017, http://www.disastercenter.com/FEMA%20Daily%20Situation%20Report%20Archive%202017.html.

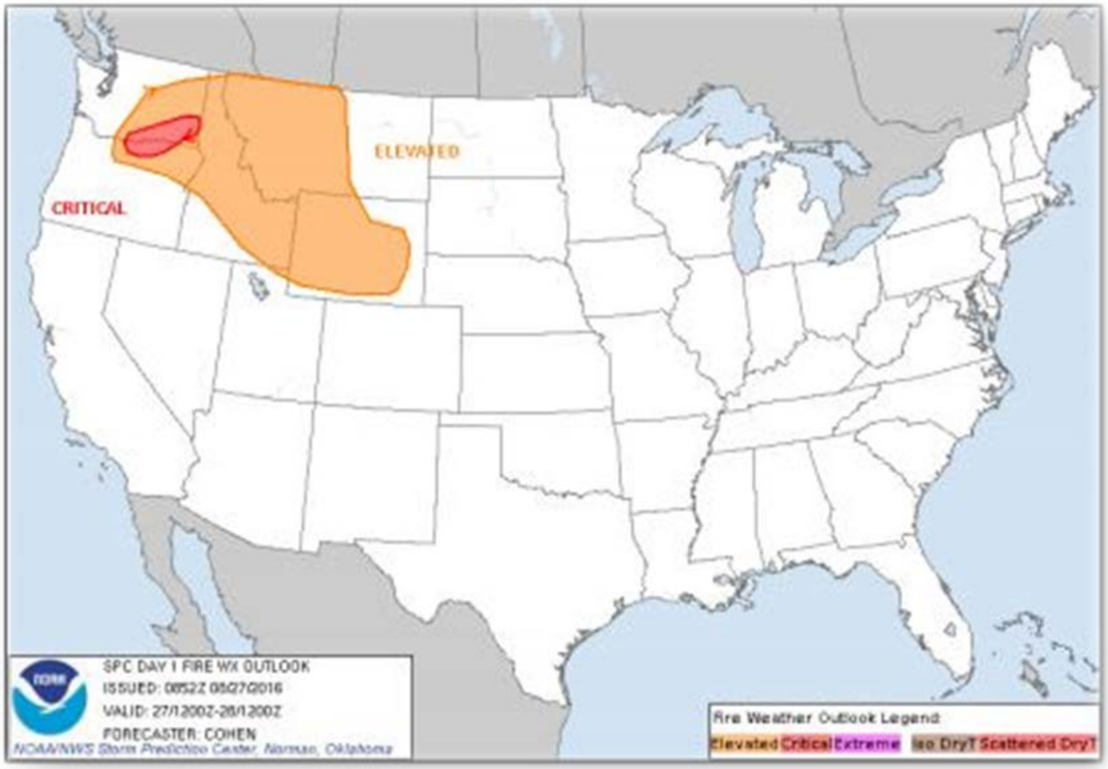


Figure 8. Fire Weather Outlook.[113]

The variable nature of the INTs provides for a synergy where the integrated and processed data points result in an ideal product that leads to the prevention or minimizing a fire's impacts. Independently, the collection disciplines leave gaps in achieving the goal of minimizing risk, primarily because the sources do not integrate information well. Some experts contend that intelligence derived from multiple collection sources strengthens the products available for fire service response and prevention.[114] One of the few examples of solid coordination of multiple collection sources is seen in extended fire behavior forecasts that focus on specific operational periods from one to three days. In this instance, historical wildland fire information sources, such as weather indices, geographic location, fuel types and fire modeling, are processed and analyzed to yield a

[113] Source: Federal Emergency Management Agency, *Daily Operations Briefing, Saturday, August 27, 2016, 8:30 a.m. EDT* (Washington, DC: Department of Homeland Security, 2016), http://www.disastercenter.com/FEMA+Daily+Ops+Briefing+08-27-2016.pdf.

[114] Lowenthal, *Intelligence*, 91.

probability of ignition that is a form of early warning. Chapter IV elaborates on the value of systematically identifying and processing multiple fire intelligence sources through the intelligence cycle.

## C. TECHNOLOGY AND THE INTs

Early detection of wildland fires has been an ongoing challenge, as it is common for wildland fires in remote areas to go unreported in the incipient stages. Delays in detection can lead to the rapid escalation of a fire and can also result in threats to life, property, and the environment that exponentially increase as fire size grows. As a given fire expands, fire suppression costs increase concurrently with the fire size. Technology is a solution that can help fire managers mitigate the impacts of wildland fires.

Currently, satellite data provide valuable information that directly supports intelligence production for other fields. One such satellite, the Terra satellite, includes five different instruments that monitor a variety of global issues, and three of the five instruments are applicable to wildland fire intelligence collection: advanced spaceborne thermal emission and reflection radiometer (ASTER), multi-angle imaging spectroradiometer (MISR), and moderate resolution imaging spectroradiometer (MODIS).[115] ASTER measures the electromagnetic spectrum, which is used to create detailed maps. MISR is useful in monitoring the smoke plumes from wildland fires and the associated atmospheric aerosol particles, whereas MODIS views the entire surface of the planet every couple of days and can locate active fires by measuring thermal anomalies.[116] Monitoring burned areas for uncontained perimeters and hot spots is also valuable intelligence provided by MODIS.

The Terra satellite is a useful tool for intelligence collection, as its nearly real-time imagery provides a mechanism for early warning.[117] Coupling this satellite data with other historical data sets provides a basis for intelligence analysis to create strategic

[115] "Terra, The EOS Flagship, Terra Instruments," NASA, accessed May 9, 2017, http://terra.nasa.gov/about/terra-instruments.

[116] "MODIS, Data Products," NASA, accessed May 9, 2017, https://modis.gsfc.nasa.gov/data/dataprod/.

[117] NASA, "Terra, The EOS Flagship."

and tactical recommendations to decision makers. Once the FireSat is implemented, the collection system will be managed by scientists at National Aeronautics and Space Administration (NASA). It is expected that NASA's collection of highly technical and detailed data and its coordination with established dissemination networks will enhance fire service access to actionable information.

A network of satellite-based sensors is only in the developmental stages for the fire service. The network identified as FireSat is the creation of NASA's Jet Propulsion Laboratory and when completed, it will consist of over 200 thermal infrared imaging sensors.[118] The project is getting closer to an initial operating capacity date of 2018.[119] The goal of the network is to provide rapid detection of relatively small fires by deploying an interconnected system of sensors. According to NASA, "Once operational, FireSat would represent a complete monitoring coverage of wildfires ever from space."[120] The FireSat network would augment the monitoring currently accomplished by the NASA Terra satellite, a broader technology currently used by the fire service and other fields. Unfortunately, the full FireSat deployment timeline has not been formalized, but NASA fully intends to implement the program.

Another technological innovation that enhances intelligence gathering is the high-performance wireless research and education (HPWREN) project that is only used in a portion of California. HPWREN is a project of the Applied Network Research group at the San Diego Supercomputer Center located at the University of California San Diego that began in 2000.[121] It was designed around a wireless data network to support research, education, and public safety disciplines. The network serves the California geographic areas of San Diego, Imperial, and Riverside counties, which fall into the lower third of the state and includes primary backbone nodes designed to provide

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[118] Veronica Magan, "Satellite Sensors Would Deliver Global Fire Coverage," *Satellite Today*, November 24, 2015, http://www.satellitetoday.com/regional/2015/11/24/satellite-sensors-would-deliver-global-fire-coverage/.

[119] Tactical Fire Remote Sensing Advisory Committee, *FIRESTAT* (Freiburg, Germany: Global Fire Monitoring Center, 2017), http://www.fire.uni-freiburg.de/current/FIRESAT-Brochure-2017.pdf.

[120] Tactical Fire Remote Sensing Advisory Committee.

[121] "High Performance Wireless Research & Education Network," University of California, San Diego, accessed January 2, 2017, http://hpwren.ucsd.edu.

connectivity in remote locations, which is helpful in providing relevant sensor information to fire officials.

The design of the network is complex to meet the multiple needs of various end users. Information on real-time weather, fuel conditions, and camera images are provided and has been valuable before and during wildland fires. An example of specific data collected from one of the mountaintop monitoring locations includes anemometry (wind speed and direction), solar radiation, precipitation, relative humidity, barometric pressure, atmospheric temperature, fuel moisture, fuel temperature, and imagery captured from pan-tilt-zoom cameras. Based on input from fire agencies, real-time meteorological alarms send alerts when indices meet pre-established points. These data points are scientifically calculated highs and lows that have a direct correlation to new wildland fire starts and the associated exponential growth of the same fires. New relationships are being created to bring more stakeholders like Orange County, California into the network. The current performance will be further enhanced as the network grows to include more geographic areas and partner agencies and the data generated can be integrated with other data sources. Once the network design is complete, populations at risk from wildland fires can receive real-time actionable intelligence, and as the geographic footprint of HPWREN increases, so will the ability to limit wildland fire destruction through intelligence collection and analysis.

Two countries have designed and launched innovative technology-based systems unavailable in the United States to support wildland fire intelligence. Canadian researchers developed the airborne wildland intelligence system (AWIS) that focuses on thermal infrared remote sensing and meets the need for intelligence collection during the night that is available before new incident operational periods. This system's intelligence collection focuses on several primary issues that include hot spots, burned areas, water and saturation conditions, vegetative surface changes, fire suppression features, and interface structures.[122] The benefit of this system is the data acquisition is occurring in

[122] Doug Campbell, "Airborne Wildfire Intelligence System: A Decision Support Tool for Wildland Fire Managers in Alberta," *AeroSense 2002, International Society for Optics and Photonics* 4710 (2002): 159–170.

less active periods of the fire. Croatian researchers took a different approach when they developed ground-based automatic wildfire surveillance and monitoring network that has similarities to HPWREN. The project named Istria iForestFire Net is still in the developmental stages. iForestFire Net has the two primary goals of automatic early wildland fire detection and remote video fire monitoring that are in alignment with HPWREN. The Croatian study identified the types of high-tech sensors that would be especially useful to fire service, such as:

- Video cameras sensitive in visible spectra; their detection is based on smoke recognition during the day and fire flame recognition during the night.
- Infrared (IR) thermal imaging cameras that detect heat flux from the fire.
- Optical spectrometry that identifies the spectral characteristics of smoke.
- Light detection and ranging (LiDAR) systems that measure laser light backscattered by the smoke particles.
- Radio-acoustic sounding systems for remote temperature measurements.
- Acoustic volumetric scanners that recognize the fire acoustic emission spectrum
- Sensor network-based systems, where some sensor nodes (in most cases wireless sensors) are deployed in the forest that measure different environmental variables used for fire detection.
- Use of animals as mobile biological sensors equipped with sensor devices.[123]

Currently, around the world, fire services do not integrate satellite data with information from ground-based networks, and ideally, they would be integrated through

[123] Darko Stipaničev at al., "Advanced Automatic Wildfire Surveillance and Monitoring Network," *6th International Conference on Forest Fire Research Coimbra, Portugal*, 2010.

the creation of a single network as another application of fusion. Independently, each of the technologies has a significant positive impact on wildland fire prevention and mitigation, but using them in a coordinated way would likely greatly increase the success of managing and preventing wildland fires. Experts have suggested that linking the critical concepts of sensor network data acquisition, information integration, and distribution is key to the success of the technology deployment.[124] At present, the technical collection of information comes in many forms and is not managed by a single fire service agency, despite the indication from research findings that an aggregate collection of variable data sources compiled and posted in a single location may be highly beneficial. Some examples of this type of format include the National Interagency Wildfire Coordination Center and the NWS, which both use hyperlink information from internal and external sources. Merging satellite data and ground-based real-time remote sensor data with computational techniques can allow decision makers to forecast a fire's rate of spread and make decisions based on the intelligence.[125] This capability can significantly minimize fire impacts through early warning and incident planning. Further, the utilization of advanced technology in intelligence collection aligns well with the methodologies of the intelligence cycle, which are elaborated upon in the next chapter.

## D. SUMMARY

This chapter focused on the role of intelligence and intelligence collection methods in the current wildland fire environment. HUMINT, MASINT, GEOINT, OSINT, and SIGINT all have a role in the wildland fire predictive processes, yet the fire service does not formally characterize the INTs as precursors to actionable intelligence. The robust nature of technology and its application to the wildland fire problem further supports the role of the INTs. Satellite, aerial and ground-based sensors alike provide valuable information to assist the intelligence cycle process, yet at the national level,

[124] William S. Hodgkiss, "Sensor Networks and Telemetry" (lecture, Scripps Institution of Oceanography, La Jolla, CA, June 28, 2005), http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.532.3751&rep=rep1&type=pdf.

[125] Ilkay Altintas et al., "Towards an Integrated Cyber Infrastructure for Scalable Data-Driven Monitoring, Dynamic Prediction and Resilience of Wildfires," *Procedia Computer Science* 51 (2015): 1633–1642, http://www.sciencedirect.com/science/article/pii/S1877050915011047.

much of the innovative technology is not being currently used, and the full integration of data from multiple sources is often lacking. A few innovations were discussed that included promising technological systems being used in other countries. In the next chapter, the concepts of fire service intelligence, the intelligence collection types, and the technology component of intelligence collection as they relate to the CIA intelligence cycle are discussed.

# IV. INTELLIGENCE CYCLE APPLICATION TO WILDLAND FIRES

This chapter analyzes how the intelligence cycle may be applied to wildland fires and focuses on its potential effectiveness as a method that may enhance intelligence support. The discussion includes a strength and weakness examination of individual component phases of the CIA intelligence cycle and identifies how each relates to current and potential wildland fire use. In the traditional intelligence cycle, a strong desire exists to minimize single-minded thought processes commonly referred to as stovepipes. Intelligence analyst Robert Clark said, "The only product a stovepipe generates is smoke."[126] In that spirit, the exploration of the advantages that the multifaceted and widely encompassing processes inherent to the intelligence cycle may bring to the wildfire problem is evaluated. This chapter determines whether the application of the intelligence cycle can solve "all-hazard" problems and eliminate these types of stovepipes in the wildland fire arena. Chapter III showed that the fire service needs improved wildland fire intelligence; this chapter evaluates how the intelligence cycle may be able to improve performance in combating fires.

## A. CIA INTELLIGENCE CYCLE MODEL

Multiple versions of the intelligence cycle have been in existence for approximately 70 years. As discussed in the literature review in Chapter II, experts have differing views about the intelligence cycle. Some practitioners question the cycle's overall validity in the current era, whereas others find specific versions of it useful. Taking the basic concepts of the intelligence cycle found in the CIA model provides a reasonable starting point to determine the feasibility of application to the wildland fire problem. The CIA model is well-established and frequently referenced across several fields, which makes it worthwhile to consider. The nuances of the intelligence cycle have relevance across multiple disciplines; as one expert puts it, "Intelligence as a discipline commonly aligns with political science, international affairs, criminal justice, and

126 Clark, *Intelligence Analysis*, 88.

homeland security."[127] although wildland fires do not correspond with these identified applications, the evolving all risk nature of homeland security makes its value to the field important to consider. As with any process, the ability to add variation may enhance desired outcomes.

For an adopted intelligence process to be effective, it has to be simple to explain, comprehend, and apply; if not, its implementation is likely to be ineffective, and the probability of resistance to its introduction can be high if fire service professionals do not see the value. The simplicity of the CIA intelligence cycle may increase the chances that it may be successful if adopted by the fire service. Still, the CIA model is not without its problems. A primary complaint is that agencies tend to hold onto sensitive information due to the secretive nature of the subjects. Fortunately, it is not a significant issue in the wildland fire realm, as the most crucial information is less often focused on individuals, such as terrorists, and the data used is almost exclusively open source or unclassified.

The CIA's model dictates that intelligence cycle steps proceed chronologically in an organized manner. In practice, however, this chronologic methodology can be limiting if the collected information is not updated continuously while working towards finished intelligence products. The cycle is basic enough that SMEs can efficiently develop oral and written products, such as bulletins and briefings.[128] The goal of the intelligence attained is not to validate assumptions, but to empower decision makers.[129] The logical assumption is that the finished product leads to end users making educated decisions, often in urgent situations.

The desired outcome of the CIA intelligence cycle is accomplished through the collection of key information from INTs to prevent and minimize future or ongoing repercussions. By processing the information from the sources, data can be analyzed efficiently to produce actionable intelligence. The intelligence cycle is complete when the appropriate public and private sector entities acquire the finished intelligence. This type

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[127] Keith Cozine, "Teaching the Intelligence Process: The Killing of Bin Laden as a Case Study," *Journal of Strategic Security* 6, no. 3 Suppl. (2013): 81.

[128] Phythian, *Understanding the Intelligence Cycle*, 4.

[129] Cozine, "Teaching the Intelligence Process," 87.

of intelligence provides policymakers with estimative data that may require action, such as increased resource deployment. A broad objective of the cycle is to limit surprise because unexpected events and information can correlate with the dissemination of faulty intelligence regarding a possible threat.[130] Former Director of the National Security Agency William Odom sums it up well, “dissemination is at root a communications issue.”[131] As the final step of the intelligence cycle, effective dissemination is central in providing usable and accurate finished intelligence products. Getting the products to the rights decision makers promptly directly impacts implementation of the intelligence. The following discussion describes each phase of the intelligence cycle and how it currently or could potentially more effectively apply to the wildland fire problem. The strengths of each phase are identified, and exisiting areas of weakness are addressed to facilitate process improvement.

### 1. Planning and Direction

“Planning and direction is the management of the entire effort, from identifying the need for data to delivering an intelligence product to a consumer. The whole process depends on guidance from public officials.”[132] The planning component is the first step of the process that identifies the needs of the fire service customer. When the needs are strategic, the customer is commonly policymakers, such as fire chiefs; when the needs are more tactical, the customer is incident commanders. The planning component to minimize threat impacts commonly occurs in both the strategic and tactical firefighting environment.

Correlations can be drawn between the planning and direction phase of the CIA intelligence cycle and the FEMA incident command system (ICS) planning process. In the FEMA model, planning involves situational evaluation, developing objectives, selecting strategies, and determining resource needs to meet the objectives.[133] The

130 Johnson, “Making the Intelligence “Cycle” Work,” 16.

131 William E. Odom, *Fixing Intelligence: For a More Secure America* (New Haven, CT: Yale University Press, 2008), 21.

132 Central Intelligence Agency, *Factbook on Intelligence*.

133 Central Intelligence Agency, 5.

planning cycle is an example of an established tool in the ICS, which is a core component of FEMA training. The planning process commonly supported by planning "P" (Figure 9) is an incident command tool regularly applied to operational incident management and it similarly occurs in the planning and direction phase of the CIA intelligence cycle. In the fire service, intelligence needs are identified by fire service stakeholders who in turn assign resources and tasking to meet the intelligence needs. Once identified, these planning and direction requirements can occur repetitively. For example, regional fire service managers have predictive outlook needs provided continuously rather than as the result of specific requests. The constants used include daily outlooks, seven-day fire potential outlooks, and monthly outlooks that offer proactive intelligence in anticipating significant fire activity.

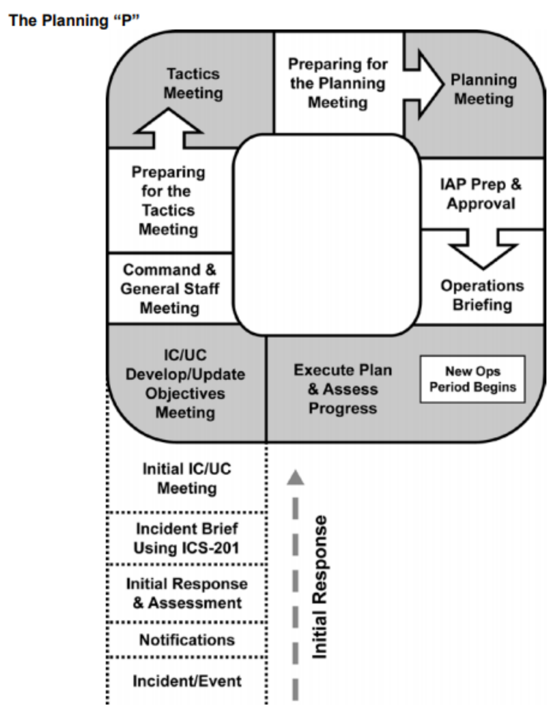


Figure 9. The Planning "P."[134]

[134] Source: Federal Emergency Management Agency, *Incident Action Planning Guide* (Washington, DC: Department of Homeland Security, 2012), 6, https://www.fema.gov/media-library-data/20130726-1822-25045-1815/incident_action_planning_guide_1_26_2012.pdf.

### *a. Strengths*

Current fire service planning and direction practices will make it easy to adopt the CIA intelligence cycle model. The CIA model provides a starting point for the guiding framework of the intelligence cycle that is critical in all decision making, whether tactical or strategic. The CIA model requires defining the focus of the data analysis, which includes identifying the availability of resources required to complete the analysis, which occurs early in the cycle. Identifying local area relevance and context in the planning and direction phase also improves the focus of the intelligence. As a result of these actions, fire intelligence products, such as the NWS fire weather forecasts are consistently produced to meet the needs of regional and local fire service customers.

### *b. Weaknesses*

Some shortcomings appear in the CIA model's planning and direction phase as applied to wildland fires from a theoretic perspective. In theory, the CIA intelligence cycle begins at the planning and direction phase and follows a linear path to the completion of finished intelligence. Close adherence to the intelligence cycle can lead to flaws, such as the inability to adjust rapidly due to its step-by-step design. These deficiencies can present themselves when the planning and direction phase does not adequately identify the specific and full range of intelligence needs of the fire service. Deficits are evident when fire potential and risk information are not produced in synchrony, and the planning process does not recognize the local context of the intelligence beyond the core findings. The planning phase often defines what and where the fire problem exists, yet falls short of establishing why it is a problem, or more importantly, what can be done to mitigate the risk.

A request from fire service officials may include fire-potential information that dictates preparedness levels without identifying the specific communities threatened; hence, the information provided is not detailed enough. Although it did not occur as an identified step of any intelligence cycle, some success has been made in planning and direction in the fire service. More can be done at a strategic planning level to drive the intelligence towards more precise information on the what, where, and why of the wildland fire intelligence need.

### 2. Collection

"Collection is the gathering of the raw information needed to produce finished intelligence."[135] The fire service has not adopted the CIA intelligence cycle; however, collection is one of the more robust components that occurs in intelligence development. As referenced in Chapter III, the intelligence INTs appear in many different forms in the fire service, and the collection of information seems to be coordinated and systematic at local and regional levels.

#### *a. Strengths*

An observed strength in the fire service data collection phase is the rapid evolution of technologically driven information sources. Much of the information collected comes in the form of sensor and scientific data, which results from the rapid development of technology in all aspects of daily life, including enhanced data collection from the sky and land. Leveraging updated technology in the collection phase of the intelligence cycle drives strategic understanding of the wildland fire problem through predictive analytics in the form of forecasts, warnings, and models.

The goal of the collection phase is to gather as many relevant data points as possible while avoiding the attainment of unnecessary information. An example of when the collection phase effectively brings together multiple data points is the wildland fire decision support system's (WFDSS's) mapping, which involves several informational layers, each with several data types:

- Base layers: topographic, Google Maps, Google Physical, U.S. states
- Incident: planning areas, fire perimeters, management action points, points of interest, objective shapes, point of origin

[135] Central Intelligence Agency, *Factbook on Intelligence*.

- Analysis: ignitions, barriers, landscape masks, basic fire behavior, short term fire behavior, near term fire behavior, values at risk
- Fire environment and safety: incidents (adjacent, within map view), active planning areas (adjacent), active MODIS 6, 12, and 24 hour and year to date
- Estimated ground evacuation time, retardant avoidance, aquatic retardant avoidance
- Disturbance history: fires in the current year, historical wildfires, fuel treatments
- Fire weather and danger: significant fire potential, fire weather forecast zones, remote automated weather stations
- Boundaries: jurisdictional agency, responsible agency, federal administrative areas, the nature conservancy lands, county lines, landscape source
- Designated areas—wilderness, potential wilderness, special, other, BLM
- Infrastructure-facilities, communication, energy, roads and trails
- Natural and cultural resources: air quality, critical Habitats
- Unit fire planning shapes—fire management units[136]

***b. Weaknesses***

Inconsistencies in combining and successfully integrating multiple information points are a weakness in the collection phase of the cycle. Fortunately, multiple layers of

136 Erin K. Noonan-Wright et al., "Developing the U.S. Wildland Fire Decision Support System," *Journal of Combustion* 2011 (2011): 7.

information are integrated into WFDDS to provide fire leadership with the best possible facts during the decision-making process.[137]

Similar, but smaller projects, such as the integrated reporting of wildland-fire information (IRWIN), show promise in the use of technology for the integration of complex information sets from multiple sources in wildland fire intelligence collection. Sanctioned by the U.S. Department of Agriculture USFS, and the DOI, IRWIN focuses on bringing information together from multiple applications to reduce redundancy and improve data quality. IRWIN currently integrates over 20 applications, with five to six additional applications planned per year in subsequent years.[138] Initiatives, such as IRWIN, and the previously mentioned HPWREN, show promise as to what the future hold regarding data collection and unification fire information. Systems that integrate multiple technology data sources like IRWIN and the WFDDS mapping system represent a potential or desired move forward to better information collection.

### 3. Processing

"Processing involves converting the vast amount of information collected to a form usable by analysts through data reduction."[139] Efficient processing of the data and information needed to create focused intelligence is taking place in the fire service in the predictive services sections at the GACCs. Similarities exist between the processing phase of the CIA intelligence cycle and processing currently in use by the fire service.

#### *a. Strengths*

Much of the processing that occurs in developing fire centric intelligence involves translating scientific data points into layman terms that fire managers and firefighters both can understand. For example, the desired component of a wildland fire intelligence product may be the probability of ignition (PIG), which is the estimated percentage that a

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137 Noonan-Wright et al., 5.

138 Forest and Rangelands, "Integrated Reporting of Wildland-Fire Information (IRWIN)," Informational Bulletin 0001-16, last modified April 10, 2017, https://www.forestsandrangelands.gov/WFIT/applications/IRWIN/index.shtml.

139 Central Intelligence Agency, *Factbook on Intelligence*.

firebrand will cause ignition when it contacts receptive fuels.[140] The variable data points to determine the PIG, such as dry bulb temperature readings, shading components, and fine dead fuel moistures, are used in the processing phase. The processed data assists intelligence practitioners in the analysis phase when coupling the data points, such as the PIG with other weather indices and geospatial information.

The Santa Ana wind threat index (SAWTI) is another example of the fire service working on processing methods like the CIA intelligence cycle. The SAWTI categorizes Santa Ana winds in five categories that indicate the probability of fire growth and ability to stop the fire: no rating, marginal, moderate, high and extreme.[141] These categories are determined by processing two data sets focused on fuel conditions and weather models. The index uses a prognostic fuel model that measures dead fuel moisture, live fuel moisture, and the greenness of annual grasses. This fuel condition data set is combined with a weather model derived from wind speed and the moisture in the air to create a large fire potential forecast. This forecast is then linked to a historical fire incidence to establish the index rating. Since Santa Ana winds are a California phenomenon, the regions that the SAWTI include are Zone 1 (Los Angeles/Ventura), Zone 2 (Orange/Inland Empire), Zone 3 (San Diego), and Zone 4 (Santa Barbara).[142] This intelligence tool processes specific information from multiple data points to create an intelligence product that can then be analyzed for best use.

#### *b. Weaknesses*

The processing of information so that it is helpful to analysts is only as effective as the ability to collect the requisite data. As the producers of the intelligence receive the collected information, a level of assumption is made that all the needed information is present. If more significant volumes of information are collected, enhanced processing capabilities need to occur with improved technology. It follows that as technological

140 "Glossary A–Z," National Wildfire Coordinating Group, December 2, 2016, https://www.nwcg.gov/glossary/a-z#letter_p.

141 "Santa Ana Wildfire Threat Index," Southern California Geographic Coordinating Center, accessed February 22, 2017, https://gacc.nifc.gov/oscc/predictive/weather/SAWTI.htm.

142 "Forecast Report," USDA Forest Service and Predictive Services, accessed February 22, 2017, http://sawti.fs.fed.us/#8/33.982/-119.185.

innovation occurs in data collection, enhancements will also occur in the processing stage.

### 4. Analysis

"Analysis describes the process of evaluating data for reliability, validity, and relevance; integrating and analyzing it; and converting the product of this effort into a meaningful whole, which includes assessments of events and implications of the information collected."[143] The CIA intelligence cycle has some alignment with the WFDSS process. The WFDSS indicates "when assessing a fire situation, a cyclical process of assessment, risk-characterization, analysis, and deliberation begins in order to make a risk-informed decision," which is similar to the cyclical process of the intelligence cycle that includes the analysis phase.[144]

Several USFS analytic successes in the wildland fire realm include BehavePlus, FARSITE, and FlamMap. These programs provide predictive analytics based on variable input information.

> BehavePlus is composed of a collection of mathematical models that describe fire behavior, fire effects, and the fire environment based on specified fuel and moisture conditions. The program simulates rate of fire spread, spotting distance, scorch height, tree mortality, fuel moisture, wind adjustment factor, and many other fire behaviors and effects.[145]
>
> FARSITE computes wildfire growth and behavior for long time periods under heterogeneous conditions of terrain, fuels, and weather. It uses existing fire behavior models for surface fire spread, crown fire initiation, and crown fire spread, post-frontal combustion, and dead fuel moisture.[146]
>
> The FlamMap fire mapping and analysis system describe potential fire behavior for constant environmental conditions (weather and fuel

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[143] Central Intelligence Agency, *Factbook on Intelligence*.

[144] Noonan-Wright, "Developing the U.S. Wildland Fire Decision Support System," 4.

[145] "BehavePlus," Fire, Fuel, and Smoke Science Program and the Missoula Fire Sciences Laboratory, accessed March 2, 2017, https://www.firelab.org/project/behaveplus.

[146] "FARSITE," Fire, Fuel, and Smoke Science Program and the Missoula Fire Sciences Laboratory, accessed March 19, 2017, https://www.firelab.org/project/farsite.

> moisture). FlamMap permits conditioning of dead fuels in each pixel based on slope, shading, elevation, aspect, and weather.[147]

These systems allow for fire scientists and fire behavior analysts to take collected and processed information and turn it into actionable intelligence to be used by fire managers or firefighters battling an ongoing fire.

#### *a. Strengths*

Wildland fire centric strengths in the analysis process are centered on predicting fire behavior.

#### *b. Weaknesses*

Still, weaknesses exist, which include the unavailability of SMEs to analyze collected and processed data. This identified weakness could provide an opportunity for fusion center integration. Without adequate SMEs, analysis leading to finished intelligence falls short unless the analysis is automated. Two examples of SMEs in the field are fire behavior analysts (FBAN) and long-term fire analysts (LTAN). The NWCG, a critical sanctioning agency for ICS standards and qualifications, recognizes both positions. The FBAN and LTAN positions are responsible for producing wildland fire decision support documents and make recommendations to fire service leadership. If resources like FBANs and LTANs are available to perform analysis, then actionable intelligence will likely result from the process.

### 5. Dissemination

Dissemination is the distribution of the finished intelligence to the consumers, the same policymakers whose needs initiated the intelligence requirements."[148] As stated previously, the CIA intelligence cycle is not currently used in the fire service, but, dissemination of intelligence is regularly used to meet the needs of fire agencies and decision makers.

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[147] "FlamMap," Fire, Fuel, and Smoke Science Program and the Missoula Fire Sciences Laboratory, accessed March 19, 2017, https://www.firelab.org/project/flammap.

[148] Central Intelligence Agency, *Factbook on Intelligence*.

### *a. Strengths*

Numerous wildland fire centric dissemination sources are available at a regional and national level. The GACCs are a prime example of a regional entity. At a national level, the National Interagency Coordination Center provides short-term and seasonal outlooks that consider the entire United States. Another example of a national level dissemination platform is the USFS's Emergency Management and Response—Information Sharing and Analysis Center (EMR-ISAC). EMR-ISAC distributes for official use only intelligence (FOUO) products and weekly open source and non-sensitive documents. The goal of the EMR-ISAC is to provide products that support public safety agencies in their all-hazards missions.[149]

### *b. Weaknesses*

Despite the successes of fire service intelligence dissemination efforts, evaluating the possibility for enhancements can yield areas of improvement. One common problem is lack of connectivity. For example, the GACCs and the existing network of fusion centers are both well-established dissemination platforms that operate efficiently, but they do not have an established connection for information sharing. Although they both handle multiple types of intelligence, they are different in many ways and do not coordinate the dissemination of information. This difference is in part due to their differing subject matter expertise, which for the GACCs, is primarily focused on wildland fires. In contrast, the all-risk, all-hazard mission mindset at many fusion centers may reduce intelligence specificity, at least with intelligence that relates to fires. Some fire service intelligence customers may perceive wildland fire intelligence as irrelevant if the threat is not applicable to their region. Ohio is one example, with few wildland fires and two fusion centers, the Ohio Statewide Terrorism Analysis and Crime Center and the Greater Cincinnati Fusion Center.[150] Still, coordination in the dissemination of

149 United States Fire Administration, *Emergency Services Sector Factsheet* (Emmitsburg, MD: United States Fire Administration, n.d.), accessed November 6, 2017, https://www.usfa.fema.gov/downloads/pdf/emr-isac_factsheet.pdf.

150 National Interagency Fire Center, *National Year-to-Date Report on Fires and Acres Burned by State and Agency for 03/16/2018* (Boise, ID: National Interagency Fire Center, 2018), https://gacc.nifc.gov/sacc/predictive/intelligence/NationalYTDbyStateandAgency.pdf.

information with fusion centers may be worthwhile to fire service, given the size of the network. The magnitude of the fusion center network is huge by comparison to fire service coordinating centers; 79 fusion centers and only 10 GACCs (see the Appendix). From a sheer numbers perspective, the national network of fusion centers allows for more significant dissemination.

Another difference between the GACCs and fusion centers is the availability of SMEs who are traditionally embedded at GACC locations. These experts are most commonly professional meteorologists, who are often not considered or placed at fusion centers. Related to this point, fire service representation at the fusion centers is not specifically uniform; some fire service fusion representatives serve as generalists, while others may have investigations, hazardous materials, urban search, and rescue or wildland firefighting backgrounds.

With the primary mission of logistical coordination and mobilization at the GACCs, the intelligence needs have a slightly different tone.[151] The GACC predictive services components include intelligence products that identify regional resource requirements and provide fire danger outlooks to local fire service leaders. The fire service intelligence needs from the fusion centers most effectively fall under the all-risk mission. With only 77 percent of the centers identifying their primary mission as all-hazard, a void is created that needs filling.[152] Twenty-three percent of the centers would not include disasters, such as wildland fires, in their core mission.

Another gap that may need to be addressed is related to the type of fusion center. Of the 79 fusion centers, 54 are categorized as primary fusion centers, and 25 are recognized fusion centers.[153] The primary fusion centers deliver statewide information and intelligence, whereas the recognized fusion centers focus on major urban areas.[154] States that only have primary fusion centers often required to fulfill both regional and

151 Geographic Area Coordination Centers, "About Us."

152 Department of Homeland Security, *2015 National Network of Fusion Centers Final Report*, 9.

153 "Fusion Center Locations," Department of Homeland Security, last published January 9, 2018, https://www.dhs.gov/fusion-center-locations-and-contact-information.

154 Department of Homeland Security, "Fusion Center Locations."

local needs. Without regional relevance, threat and warning intelligence often is too broad or vague to accomplish a defined intelligence need.

## B. SUMMARY

Identifying core issues of the intelligence cycle and its direct application to wildland fires was the goal of this chapter. Although the fire service does not use a formalized intelligence cycle, some current practices are consistent with the CIA model. When looking at the components' parts and processes currently in use, information indicates a value in the application of the intelligence cycle for fire service decision makers. This chapter discussed the fire service's informal adoption of the five constituent components of the CIA intelligence cycle model, including the strengths and the gaps or problems of each in the way they currently are applied in the fire services. The application of the intelligence cycle can be helpful to producers of the intelligence and customers alike despite some of the current implementation challenges.

Planning for large-scale wildland fires and their prevention is an enduring focus that depends on effective intelligence production. The collection and processing of information, such as weather indices and geographic areas at risk, support the planning portion of the cycle. Current analysis actions create finished fire intelligence that can be further enhanced in the future as technology evolves. The dissemination component of the intelligence cycle appears to occur in single, isolated paths that are too linear. Expanding dissemination can also support the adoption of the intelligence cycle.

Chapter V is a case study of the 2012 Waldo Canyon fire. Focusing on the CIA intelligence cycle model, the five individual phases of the cycle are assessed to evaluate utilization before, during, or after the fire.

# V. CASE STUDY: WALDO CANYON FIRE

> Some lessons are being learned about how we can mitigate some of the fires in the future. Hopefully, out of this tragedy, some long-term planning occurs, and it may be that we can curb some of the damage that happens the next time.
>
> President Obama at the Waldo Canyon fire[155]

## A. INTRODUCTION

This chapter presents a case study of the Waldo Canyon fire and provides an analysis of the fire service's use of intelligence to determine whether components of the intelligence cycle were present and used during each phase of the fire. It opens with a description of the fire and relevant antecedent events to provide an understanding of the scale of the incident and actions by public safety. The analysis includes an evaluation of intelligence utilization and the application of the CIA intelligence cycle process to the case of the Waldo Fire. The discussion is organized according to the phases of the CIA cycle and takes into account the nuances of the fire. Although the fire service did not officially use the intelligence cycle as a model at any point in this case, principles of the CIA model were apparent before, during, and after the fire. The case study concludes with an evaluation of how the fire could have been handled more effectively if the principles of the intelligence cycle had been comprehensively applied.

## B. SCENARIO

On Saturday, June 23, 2012, a fire started in Pike National Forest, approximately three miles west of the city of Colorado Springs. It burned for 18 days and was declared contained on July 10, 2012; it had burned for more than two weeks.[156] Significant impacts affected multiple communities, with 18,247 acres and 347 homes burned and 46

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[155] "President Obama's Remarks in Colorado Springs on Waldo Canyon Fire," *Denver Post*, June 29, 2012, http://www.denverpost.com/2012/06/29/president-obamas-remarks-in-colorado-springs-on-waldo-canyon-fire/.

[156] "President Obama's Remarks in Colorado Springs on Waldo Canyon Fire," 5.

homes damaged. The fire-affected jurisdictions included the NFS (14,422 acres), El Paso County (2,309 acres), and the City of Colorado Springs (1,516 acres).[157] Of the 52,056 residents affected, 28,770 people from 11 different areas were evacuated, and two people died, which made the Waldo Canyon fire one of the most destructive wildland fires in Colorado history.[158] The fire's costs were significant: $15.7 million for fire suppression and $350 million for property damage.[159]

As the size of the fire grew, so did the number of structures and population that was threatened (Table 2).

Table 2. Timeline of Waldo Canyon Fire.[160]

| Date | Acres (estimate) | Structures threatened | Evacuated (estimate) | Containment |
|---|---|---|---|---|
| 6/23/12 | 2,000 | | | 0% |
| 6/24/12 | 3,600 | 13,000 | | 0% |
| 6/24/12 | County Disaster Declaration<br>FMAG is approved | | | |
| 6/25/12 | 4,500 | 15,000 | | 5% |
| 6/26/12 | 6,200 | 15,000 | 30,000 | 5% |
| 6/27/12 | 18,500 | 20,000 | 32,000 | 5% |
| 6/28/12 | 16,750* | 23,000 | | 15% |
| 6/28/12 | Presidential Disaster Declaration<br>Human remains found in the fire ruins | | | |
| 6/30/12 | 17,659 | 15,000 | | 55% |

[157] Denver Post, 106.

[158] Denver Post, 107.

[159] Fred Durso Jr., "After Waldo Canyon," *NFPA Journal*, September 1, 2012, http://www.nfpa.org/news-and-research/publications/nfpa-journal/2012/september-october-2012/features/after-waldo-canyon.

[160] Adapted from "Waldo Canyon Fire Review, Pike and San Isabel National Forest," USDA Forest Service, June 2013, https://www.fs.fed.us/fire/publications/fire_review_reports/2012/waldo_canyon.docx.

| Date | Acres (estimate) | Structures threatened | Evacuated (estimate) | Containment |
|---|---|---|---|---|
| 6/30/12 | 347 confirmed structures destroyed | | | |
| 7/03/22 | 18,247 | | | 88% |
| 7/03/12 | Secretary of Homeland Security site visit | | | |
| 7/10/22 | 18,247 | | | 100% |

* Acreage dropped as more accurate numbers were measured.

## C. BACKGROUND

The 2012 Waldo Canyon fire is a noteworthy fire in Colorado's wildland fire history based on the fire's size and the damage it caused, which led to a significant amount of discussion and reports on it from government and other public safety agencies, science, and academia. However, the majority of available information comes from public safety and jurisdictional government, although a variety of agencies subsequently conducted after action reviews to evaluate areas of strength, weakness, and improvement.[161]

Since the fire posed a significant risk to life, property, and the environment, on June 24, 2012, FEMA issued a FMAG. The FMAG declaration creates a FEMA funding source to offset the state's eligible firefighting costs for managing, mitigating, and controlling the fire. Ultimately, President Obama declared a major disaster for Colorado, as the event met the severity and magnitude criteria for supplemental federal

[161] After Action Reviews (AARs) are performed to discuss what transpired in sufficient detail and transparency. The key points include what was the plan, what happened, why it did happen, what went well and why, and what can be done better the next time. The ultimate goal is to correct weaknesses and sustain strengths. "Incident Response Pocket Guide," National Wildfire Coordinating Group Incident Standards Working Team, January 2014, Xii.

assistance.[162] The supplemental federal assistance allocated additional federal response and recovery funds of approximately $4 million.[163]

Colorado Senators Udall and Bennet requested that the USDA conduct a comprehensive scientific review of the fire to "examine the factors that led to the level of intensity and damage, and learn what can be done to reduce future risks."[164] Following approval, the NIST started work on the area to enhance wildfire disaster resilience through risk reduction, and its resulting study exemplifies "the most comprehensive examination of a wildland-urban interface fire."[165] The report noted that before the Waldo Canyon incident, no nationally recognized system for preplanning risks to structures or entire communities existed.[166] A system is necessary to gain a clear understanding of the significant exposure risks and vulnerabilities for individuals and the greater community. NIST researcher Maranghides stated, "It is not critical you have the answer 100 percent of the time, you just need to know how much you can trust it."[167] The NIST study provides the vision forward to deal better with the enduring threat.

## D. INTELLIGENCE RELATED TO THE WALDO CANYON FIRE

The Waldo Canyon fire is no different from other disasters regarding the implementation of post-incident evaluation to increase the understanding of the factors leading to it and how effectively it was managed. Although several agencies conducted post-incident evaluations, none performed analyses related to intelligence models. The remainder of this chapter discusses and evaluates the application of the CIA intelligence cycle model and its five individual phases to all stages of the Waldo Canyon fire. What

162 "President Declares Major Disaster for Colorado," Department of Homeland Security, release number: HQ-12-050, June 29, 2012, https://www.fema.gov/news-release/2012/06/29/president-declares-major-disaster-colorado-0.

163 Department of Homeland Security.

164 Pam Zubeck, "Waldo Canyon fire Spreads in the Scientific Community," *Colorado Springs Independent*, March 6, 2013, http://www.csindy.com/coloradosprings/waldo-canyon-fire-spreads-in-the-scientific-community/Content?oid=2637860.

165 "NIST Study of Colorado Wildfire Shows Actions Can Change Outcomes," NIST, November 9, 2015, https://www.nist.gov/news-events/news/2015/11/nist-study-colorado-wildfire-shows-actions-can-change-outcomes.

166 NIST.

167 Zubeck, "Waldo Canyon fire Spreads in the Scientific Community."

follows is a description of how the Intelligence Cycle could have been applied during the Waldo Canyon Fire, which became apparent during post-incident reconstruction.

### 1. Intelligence Cycle Phase 1—Planning/Direction

Identification of the threat and determination of how to mitigate that risk best represent the core purpose of the planning component of the intelligence cycle. The FEMA target and core capabilities identify planning as the systematic method to meet established objectives. This definition of planning has a direct correlation to the planning and direction phase of the intelligence cycle.[168] "Wildland Urban Interface fires are very different from earthquakes, hurricanes, and tornadoes where the hazard cannot be controlled," said NIST fire researcher and principal investigator Alexander Maranghides.[169] This perspective has provided an opportunity and impetus to plan for wildland fire threats. To develop a useful planning model, fostering variable stakeholder interactions is necessary.[170] With respect to the Waldo Fire, because of the history of wildfires in the area, planning was a long-term process involving various agencies that began years before the incident. Colorado Springs is progressive in its approach to lessening the risk in the WUI, and several formal policies resulted from the mitigation efforts. These policies included the wildfire mitigation plan (2001), Colorado Springs community wildfire protection plan (2011), and WUI evacuation appendix (2008).[171] The last update to the WUI evacuation appendix took place before the fire in 2012. All these policies provided a backdrop to the planning component and serve as the initial formal recognition of a wildland fire problem in the area.

[168] FEMA target and capability planning definition: Planning is the mechanism through which federal, state, local and tribal governments, non-governmental organizations (NGOs), and the private sector develop, validate, and maintain plans, policies, and procedures describing how they will prioritize, coordinate, manage, and support personnel, information, equipment, and resources to prevent, protect and mitigate against, respond to, and recover from catastrophic events. Department of Homeland Security, *National Preparedness Goal*, 6.

[169] NIST, "NIST Study of Colorado Wildfire Shows Actions Can Change Outcomes."

[170] Brooks et al., "Collaborative Capacity," 1.

[171] "City of Colorado Springs Waldo Canyon fire Initial After Action Report," Wildfire Today, 6, October 23, 2012, http://wildfiretoday.com/documents/WaldoCynFireAAR.pdf.

The planning goal was to identify the communities at risk in the interface area. Before the Waldo Fire, community exposure to a disastrous wildland fire was apparent, and the 2012 report indicated that in the previous two decades, 250,000 people had moved into Colorado's highest wildland fire risk areas.[172] The growing high-risk areas, known as red zones, have been a vital focus of the planning and direction of the location of the threats, which includes determining the mechanisms most critical to mitigating fire risk. The population growth continues; 31 percent of Coloradans live in red zones, thus indicating the potential exposure to a large proportion of the state's citizens.[173] In 2002, the Colorado Springs fire department created a red zone map that identified 35,000 homes at risk.[174] This number is now likely much higher. This information is updated regularly and readily available to government agencies and the public. Monitoring building trends, population movements, and identified threat areas (red zones) provides the building blocks for planning and direction. These actions are analogous to intelligence preparation of the operating environment (IPOE) with the primary objective of providing predictive intelligence.[175]

The planning phase can also incorporate pre-established actions to mitigate the risk. The Fire Adapted Communities (FAC) Coalition, a group of key stakeholders focused on wildland interface safety, made it clear that active partnerships in the planning phase are critical to gathering lasting support and broadening influence.[176] Through these partnerships, FEMA awarded pre-disaster mitigation grants to Colorado Springs in 2005, 2007, 2009, and 2012. The grants provided for fuel reduction and management programs designed to create defensible spaces throughout communities at risk. After the Waldo

[172] Michael Kodas and Burt Hubbard, "Policies Put More Coloradans at Risk," Rocky Mountain PBS News, June 27, 2012, http://inewsnetwork.org/2012/06/27/policies-put-more-coloradans-at-risk/.

[173] Rocky Mountain PBS News Staff, "Data: Homes in the Red Zone," Rocky Mountain PBS News, October 2, 2013, http://inewsnetwork.org/2013/10/02/data-homes-in-the-red-zone/.

[174] Durso, "After Waldo Canyon."

[175] Department of the Army, *Joint Intelligence Preparation of the Operational Environment*, Joint Publication 2-01.3 (Washington, DC: Department of the Army, 2014), https://fas.org/irp/doddir/dod/jp2-01-3.pdf.

[176] Stephen Quarles et al., *Lessons Learned from Waldo Canyon, Fire Adapted Communities Mitigation Assessment Team Findings* (Hayfork, CA, Arlington, VA: Fire Adapted Communities Learning Network, 2013), http://www.iawfonline.org/Waldo-Canyon-Rpt-FINAL-shrunk%203.pdf.

Fire, an 82 percent property-save rate in specific communities resulted from the planned mitigation efforts.[177]

The planning component of the intelligence cycle can create the foundation for sustained early warning, which has been the case in the Waldo area. A starting point of the cycle evolves through a range of pre-fire and pre-mitigation efforts that evaluate the extent of social, economic, and ecological impacts.[178] When a fire occurs, the planning process begins again to determine alternative strategies to deal with the effects of the fire. Focusing on a large-scale area is key to pre-fire mitigation endeavors intended to protect the 70,000 communities at risk of wildfire throughout the United States.[179] In the case of the Waldo Canyon fire, the communities that responded to early warning information experienced much better results compared to communities that responded later. The resulting intelligence-based preparation yielded higher mitigation rates in those early response areas.

### 2. Intelligence Cycle Phase 2—Data Collection

The data collection process plays an important role before, during, and after a wildfire starts. The type of data collected is based on several factors that ultimately provide a clear understanding of risk and vulnerability of individual structures and entire communities.[180] The pre-incident collection of key information is a significant factor that protected several communities from the impacts of the Waldo Canyon fire and was a process within an established prevention program. Part of that wildland fire prevention process by the city of Colorado Springs was the collection of LIDAR imaging from aircraft, which provided a visual representation of communities at risk. In Colorado Springs, LIDAR information and images defined the magnitude and scale of plant life, structures, vehicles, and topography, and continue to provide support for the city's fire department fire prevention programs.[181] The fire department managed the resulting

[177] Quarles et al., 23.

[178] Wildfire Today, "City of Colorado Springs Waldo Canyon fire Initial After Action Report," 8.

[179] Durso, "After Waldo Canyon."

[180] NIST, "NIST Study of Colorado Wildfire Shows Actions Can Change Outcomes."

[181] Zubeck, "Waldo Canyon fire Spreads in the Scientific Community."

intelligence as a tool to identify communities at risk, which in the case of the Waldo fire helped to minimize fire impacts, and was also useful after extinguishment. Comparative data was available due to the use of historical LIDAR information, and researchers and investigators then had a clear understanding of what precisely existed in the area before the incident.

During the fire, data collection was a focus of the LTAN assigned to the fire. "The role of the LTAN is to provide probabilistic and deterministic information on long-term fire advancement, fire behavior, and spread direction, based on local information, topography, historical and current fire spread, and with historical and current fire weather data."[182] The LTAN filled an important position on the type 1 national incident management team (IMT) by monitoring weather and fuel conditions and then predicting fire growth and spread. The resulting data collection supported predictive fire modeling programs that estimated the fire progression in the coming days and included historical, current, and future weather patterns that provided accurate modeling.[183] Additional infrared information was collected from fixed-wing aerial platforms and satellite imagery to support the intelligence production.

During the fire incident, scientists from NIST, with assistance from the USFS, investigated what burned, how badly it burned, and why it burned.[184] The study's findings were used to create best practice prevention measures while supporting future firefighting tactics. The Waldo Canyon fire set in motion a two-tiered system for collecting actionable information after a fire has occurred, with one tier representing collection during the fire and the second tier focused on future prevention.[185] Experts understood that the collection of data after an incident had occurred would not change the outcomes of the event, but it could affect future comparable incidents. Following the

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182 "Long Term Fire Analyst," National Wildfire Coordinating Group, last modified January 29, 2018, https://www.nwcg.gov/positions/ltan.

183 Rick Stratton, "The Waldo Canyon fire: Fires on the Colorado Front Range and Home Destruction," Wildland Fire Lessons Learned Center, July 7, 2012, https://www.wildfirelessons.net/Higher Logic/System/DownloadDocumentFile.ashx?DocumentFileKey=b7dc6d92-acd2-4685-a60f-df1fb33b6347.

184 Stratton.

185 Stratton.

planning phase, the NIST researchers created a detailed timeline of the Waldo Canyon fire. The timeline research relied on a variety of collection inputs including interviews with the public and responders, weather data, aerial imagery, photos and video, and automated vehicle locators (AVL).[186] After the collection phase of the intelligence cycle, the amassed NIST data moved on to the processing phase.

In addition to NIST, the FAC collected relevant data after the fire occurred. The FAC focus was a social-centric approach as compared to the science-centric approach of the NIST. The configuration of the FAC assessment team reinforced the value of a variety of SMEs in the collection process. The FAC team had two sets of researchers, one set with structural and forestry specialists and the second with social scientists and public education experts.[187]

The FAC collection attempts focused on home assessments to capture data on how the homes ignited during the Waldo Canyon fire. During field inspections of homes, the FAC wildfire mitigation assessment team examined the building materials and construction techniques used in all residences, and damaged homes were compared to non-damaged homes. Vulnerability identification helped characterize the causative factors that led to the most structural damage.[188] The compilation of these data by the FAC is consistent with the CIA intelligence cycle's human observation (HUMINT) process. Photographs (IMINT) and global positioning system (GPS) data (GEOINT) provided support for interview data (HUMINT) collected by assessment team members. The primary data sets were (a) fire spread from vegetation to the building, (b) fire spread from non-structural combustibles, and (c) home-to-home fire spread. The assessment team used surveys called damage assessment forms to gather the information, and for consistency, the FAC form mirrors that employed by the NIST to assess any damage from a fire. The FAC's goal is to collect data on the impacts after a fire, which served a vital role in the Waldo Canyon area, to prevent future disasters. Ultimately, the field

[186] Alexander Maranghides et al., *A Case Study of a Community Affected by the Waldo Fire—Event Timeline and Defensive Actions*, NIST Technical Note 1910 (Gaithersburg, MD: National Institute of Standards and Technology, 2015), http://dx.doi.org/10.6028/NIST.TN.1910.pdf.

[187] Quarles et al., *Lessons Learned from Waldo Canyon*, 4.

[188] Quarles et al., 10.

survey validated findings of other investigations specific to the underlying causes of structural ignition.[189] The post-fire data collection played an essential role in formulating intelligence designed to reduce future impacts from similar fires. This data collection methodology is in alignment with phase 2 of the CIA intelligence cycle.

### 3. Intelligence Cycle Phase 3—Processing

The processing phase of the intelligence cycle aggregates the collection information and packages the data for subsequent analysis. Deconfliction of various information sources is often an essential processing step necessary to confirm the reliability of the source data. The El Paso County Sheriff's Office after action report provided a reliable characterization of how the processing component of the cycle was applied. The Office established a joint information center (JIC) to create universal messaging with representatives from six municipalities and two impacted counties.[190] In addition to the various jurisdictions, over 50 fire and law enforcement agencies participated in various data processing.[191] The vast amount of data collected from the various entities required an efficient processing component that included active engagement with press information officers, emergency operations centers, and incident command posts to improve overall processing abilities.[192] Throughout the entire incident, all key agencies had continual staffing, which provided an all-inclusive scope of information. This 24-hour staffing model supported rapid information dissemination to the public.

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[189] Quarles et al., 23.

[190] The Joint Information Center (JIC) ensures the coordination of public information during incidents where multiple agencies and jurisdictions are operating. The JIC's intent is to coordinate incoming and outgoing information. This coordination occurs through information gathering, verification, coordination, and timely dissemination. Federal Emergency Management Agency, *Basic Guidance for Public Information Officers (PIOs)* (Washington, DC: Department of Homeland Security, 2007), https://www.fema.gov/media-library-data/20130726-1623-20490-0276/basic_guidance_for_pios_final_draft_12_06_07.pdf.

[191] El Paso County Sheriff's Office, *Waldo Canyon fire After Action Report* (Colorado Springs, CO: El Paso County Sheriff's Office, 2013), 31–32, https://web.archive.org/web/20130531175844/http://shr.elpasoco.com/NR/rdonlyres/248EEB6B-F942-453F-AA97-962DB564996C/0/Waldo_Canyon_Fire_After_Action_Report.pdf.

[192] Federal Emergency Management Agency, *Basic Guidance for Public Information Officers*.

The inherent variation in the data received in the processing phase necessitated intensive coordination that was detailed and nuanced. During the NIST study, anomalies in different information sets existed in the data collection, and the processing phase played a crucial role in the identification and correction of the inconsistencies. In the CIA intelligence cycle, problems with unclear data or potentially inaccurate data collection can be resolved by comparing different data sources to guarantee accuracy. One example occurred with some of the Waldo Canyon photo and video imagery, as the data captured in specific locations did not have accurate timestamps. A solution was found by pairing AVL data to create a plus/minus variation in time stamping on the photo and video media.[193] Processing such examples provide information that can accurately be analyzed to make strategic and tactical recommendations.

The volume of data collected from multiple sources, which can leave fire service and other public safety agencies exceeding their capabilities, may adversely affect the processing phase of the intelligence cycle and limit the use of gathered data. For the raw data collected to be usable, relevant, and sensitive to the needs of the intended consumer, collaborative communication must take place.[194] Fortunately, data sets collected before, during, and after the Waldo Canyon fire supported actionable analysis that resulted from multi-agency interoperability and open lines of communication.

#### 4. Intelligence Cycle Phase 4—Analysis

Analysis of the information collected in advance of a fire or after it can provide an improved early warning system to prevent a catastrophic reoccurrence. In the case of the Waldo Canyon fire, the most influential analysis occurred after the fire. The FAC investigation of the post-fire environment in Colorado Springs compared the outcomes of

[193] AVL is used to determine the physical location of a vehicle automatically using the GPS. This satellite derived geospatial information is examined independently or as part of larger multi-vehicle network. It creates a representation of vehicle travel and location at a point in time. Sang Keon Lee et al., *International Case Studies of Smart Cities: Orlando, United States of America* (Washington, DC: Inter-American Development Bank, 2016), http://dx.doi.org/10.18235/0000408#sthash.7CyR58Vy.dpuf.

[194] Odom, *Fixing Intelligence*, 33.

the fire to mitigation strategies recommended by the FAC program.[195] Four primary risk and mitigation strategies to reduce future fires resulted from the analysis:

- Building design and material improvements and maintenance could have reduced loss.
- A community-wide approach is best.
- Fuels reduction is important.
- Partners in preparedness can equal success.[196]

The four risk and mitigation strategies are helpful in the analysis phase by further identifying intelligence products and dissemination needs. Building design and material improvement are directly associated with the prevention component of wildland fires. Construction features, building materials, landscaping, and natural vegetation all constitute fuels. Accurately analyzing the connections between these fuels further identifies the level of exposure for impacted communities. The concept of a community-wide approach, when aligned with messaging and dissemination, meets the needs of both the citizenry served and the fire service. This community-wide approach is further supported by establishing a lasting partnership with all impacted stakeholders. Actionable intelligence to prevent reoccurrence or minimize consequences continues to evolve for these identified strategies.

The NIST study, which reflects another effort to analyze data from the fire, recognized that actions before a fire could change outcomes for like situations in the future. Its analysis of data collection created a wildland urban interface hazard scale that mapped the variable ranges of exposure risk. These risks identify the threat from embers and active fire throughout the community, and also pinpoint specific neighborhoods and area within the broader Colorado Springs region.[197] Additional analysis determined that high-density structure-to-structure spacing is a significant consideration that needs to be

[195] Quarles et al., *Lessons Learned from Waldo Canyon*, 4.

[196] Quarles et al., 24–25.

[197] NIST, "NIST Study of Colorado Wildfire Shows Actions Can Change Outcomes," 2.

addressed to enhance safety. Further, any identified issues in structural or spatial arrangement represent data that goes back into the intelligence cycle for use by key officials and stakeholders. The analysis of the additional data drives updated fire prevention messaging to communities at risk.[198] The NIST work in wildland fires and the wildland-urban interface is an ongoing national program designed to enhance disaster resilience. Reducing fire risk on buildings, critical infrastructure, communities, and emergency responders enhances any WUI community's resistance to adverse impacts.[199]

Post-fire analysis from a meteorological and climatological perspective is valuable to understanding future fire risk. In the case of the Waldo Canyon fire, the analysis included a comparison of before and after weather and geospatial data that included geographic information system (GIS) images, aerial images, thermal readings, and vegetation models.[200] All the information collected and analyzed from the fire has been used to support risk calculation and anticipated fire spread. The overall goal of the analysis is to find correlations between weather conditions and vegetation, to try to model the data to help forecast fire seasons and more efficiently prepare emergency responders.[201]

In addition to forecast and post-fire analysis, the real-time analysis was conducted during the Waldo Canyon fire by the Colorado Information and Analysis Center (CIAC), which is the Colorado fusion center. CIAC operations take an all-hazards approach to the intelligence cycle and focus on multiple threats, including natural disasters.[202] During 2012, several high-profile opportunities to support the all-hazard mission mindset in Colorado arose with incidents as varied as the Aurora theatre shooting, the United States

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[198] Maranghides, *A Case Study of the Community Affected by the Waldo Fire*, 8.

[199] NIST, "NIST Study of Colorado Wildfire Shows Actions Can Change Outcomes," 3.

[200] Mario Garza and Sam Freeman, *Waldo Canyon Fire* (Blacksburg, VA: Virginia Polytechnic Institute, n.d.), accessed October 9, 2016, https://vtechworks.lib.vt.edu/bitstream/handle/10919/50689/garza_poster.pdf;sequ.

[201] Garza and Freeman.

[202] County Sheriffs of Colorado, "Colorado Information Analysis Center," Colorado Sheriff XXIX, no. 1 (Summer 2008): 23, https://coloradosheriffs.org/wp-content/uploads/2017/01/COSheriffSummer08.pdf.

Presidential debates, and the Waldo Canyon fire.[203] Specific to the Waldo Canyon fire, the CIAC deployed mobile analytic response teams to the fire to provide on-scene intelligence support.[204] The response team provided investigative support that generated tactical and operational intelligence to support incident commanders and policymakers.

### 5. Intelligence Cycle Phase 5—Dissemination

The Colorado Springs fire department has a pre-fire mitigation program that was in place for years before the Waldo Canyon fire. The Mountain Shadows community took the brunt of the fire's impact, and only an estimated five percent of homes in that community participated in the wildfire mitigation efforts that urged residents to safeguard their homes against these types of fire.[205] This lack of action indicates some weakness in the dissemination of early warning information. In contrast, the community of Cedar Heights largely embraced pre-fire mitigation efforts, as an estimated 60 percent of residences participated in hardening their homes' defenses.[206] Cedar Heights suffered significantly less damage than Mountain Shadows since the community acted on the assessed threat to the community.

The dissemination of evacuation orders to communities affected by the Waldo Canyon fire had both strengths and weaknesses. In most situations, early warning allowed for quick evacuation processes with clearly defined road closures, and the information distributed to the public minimized life loss and removed large portions of the population from harm. However, the lack of clear and concise terminology in the evacuation orders and communications created some messaging issues. The use of a mass notification system that was not tailored to specific communities and used vague language resulted in evaluation ambiguity for many residents. Terms such, as pre-evacuation, voluntary

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[203] Colorado Division of Homeland Security and Emergency Management, *FY 2013 Annual Report* (Centennial, CO: Colorado Division of Homeland Security and Emergency Management, 2013), 30, http://dhsem.state.co.us/sites/default/files/Annual%20Report.pdf.

[204] Global Justice Information Sharing Initiative, "Colorado Information Analysis Center Support to Colorado Wildfires," U.S. Department of Homeland Security, January 2013, http://www.dhs.gov/2012-fusion-center-success-stories.

[205] Durso, "After Waldo Canyon."

[206] Durso.

evacuation, and mandatory evacuation, needed precise definitions to alleviate confusion among the public.[207]

The fire burned within 1.5 miles of the City of Woodland Park, so the city had to disseminate evacuation information and address related issues. To ensure the information reached a broad audience, Woodland Park officials used a variety of dissemination and information-sharing platforms that included public briefings, press releases, smartphone messaging, reverse 911, Facebook, YouTube, streaming video, a city website, electronic messaging signs, local television, cable television, and the emergency messaging system Nixle.[208] Table 3 illustrates the full spectrum of dissemination methodologies used during the fire on June 27, 2012, as evacuations became critical.

Table 3. June 27, 2012, Woodland Park Chronology of Intelligence Dissemination.[209]

| Time | Dissemination | Incident Communications |
|---|---|---|
| 08:00 AM | • Local television | Televised Press Briefing from Colorado Springs. As of 11:00 PM June 26, 15,324 acres burned. Fire sentries placed every 50 yards along U.S. Hwy 24 in the Cascade to prevent the fire from leaping Hwy 24. |
| 09:00 AM | • Public briefings | Teller County Sheriff's Office [situational update] briefing. Winds for today are expected to be out of the west and southwest. There is 0–5% containment of the fire. There will be back burning near Rampart Reservoir. The fire is expected to push to the east then northeast. |
| 11:30 AM | • Streaming video<br>• Cable television<br>• City website | Woodland Park Mayor and City Manager brief city employees and citizens in council chambers of current situation including possible evacuations. The briefing was live streamed, televised on cable and posted on the city website. |
| 12:13 PM | • Emergency messaging | Nixle email and text message from Teller County: Mandatory Evacuation—East Teller County/Woodland Park, See local media—website for details |

[207] El Paso County Sheriff's Office, *Waldo Canyon fire After Action Report*, 16.

[208] City of Woodland Park, *City of Woodland Park Waldo Canyon fire After Action Report* (Woodland Park, CO: City of Woodland Park, 2013), 11, https://www.yumpu.com/en/document/view/50176896/city-of-woodland-park-waldo-canyon-fire-after-action-report.

[209] City of Woodland Park, 12–13.

| Time | Dissemination | Incident Communications |
|---|---|---|
| 12:42 PM | • Emergency messaging | Nixle email and text message from Woodland Park Police Department: Mandatory Evacuation East Teller County and previously identified standby evacuation areas in Woodland Park. See Teller City web page for a map. |
| 1:15 PM | • Press release | Press Release from Teller County is announcing the mandatory evacuation of portions of Woodland Park and Teller County. |
| 1:32 PM | • Reverse 911 | Reverse 911 message to specific areas: Your area is under mandatory evacuation. Please remain calm and evacuate the area in an orderly manner. An evacuation shelter has been set up at Cripple Creek and Victor High School. |

The *Colorado Springs Independent* provides an alternate view of the success of the dissemination. Pam Zubeck, one of the paper's journalists, asserts that the differences in destruction between the Cedar Heights and Mountain Shadows communities resulted from the variances in the distribution of the first resources. Cedar Heights, with an average home value of $546,000, had 23 fire apparatus assigned on the second day of the fire, while Mountain Shadows, with an average home value of $340,000, had no fire apparatus assigned to it on that same day.[210] Evidence indicates that this comparison may have been taken out of context. The allocation of resources was likely based on strategic decisions linked to current and expected weather conditions, as well as the defensibility of the communities at risk. Minimal destruction validated the effective dissemination and marketing of the known hazard exposures to the community of Cedar Heights.

Disseminating the analysis conducted by the FAC has been facilitated efficiently by the Colorado Springs wildfire mitigation firewise program, which was launched in 2002 and encompasses 36,485 individual addresses in the WUI.[211] Its educational campaign called "Sharing the Responsibility" has yielded positive results through increased community engagement. The educational focus has involved layers of

[210] Pam Zubeck, "Misfire, How City Leadership Left Residents—and Their Heroes—Exposed during the Waldo Canyon Tragedy," *Colorado Springs Independent*, December 12, 2102, http://www.csindy.com/coloradosprings/misfire/Content?oid=2598215.

[211] Quarles et al., *Lessons Learned from Waldo Canyon*, 5.

stakeholders and included the individual homeowners to entire communities.[212] This program and others like it serve as an appropriate information distribution tool. Regarding the Waldo Canyon fire, the success of programs, such as the Colorado Springs wildfire mitigation firewise program, is directly linked to dissemination and adoption of actionable information.

An unintended consequence of information dissemination is residences' concerns about privacy. After providing information to the public concerning what homes were at highest risk, some Colorado Springs residents wanted the information to be password protected. They did not want their neighbors "spying" on them, to which the Colorado Springs fire department officials replied, "We want your neighbors to spy on you."[213] Although this statement may appear draconian, proper context is needed since the intent of the open source, readily-available information is to create a climate of accountability, not surveillance. This mindset is comparable to the public safety "see something, say something" campaign designed to thwart malicious actors.

Tactical intelligence was disseminated to firefighting resources through the IMT once it assumed command of the fire. The situation unit leader, who is typically part of the planning section, prepared incident intelligence by collecting and analyzing incident data with feedback from field observers (FOBS) and technical specialists (THSP). The feedback originated from personal observations from the FOBS deployed on the fire line and information gathered from weather monitoring processed by THSP. The goal is to provide frontline fire intelligence to deployed firefighters to allow combat maneuvering and appropriate resource ordering. Despite some decent dissemination of information to essential officials, shortcomings were identified in regard to getting the most appropriate information to agency administrators. The host governmental entities and agencies had difficulty integrating with the IMT due to lack of familiarity with the team. An analysis of the situation revealed that future training could enhance efficiencies of information dissemination by allowing supporting agencies to be actively engaged in the process.[214]

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[212] Quarles et al.

[213] Durso, "After Waldo Canyon."

[214] USDA Forest Service, "Waldo Canyon Fire Review," 12.

From a strategic perspective, targeted intelligence dissemination is beneficial and can be evident throughout the life of an incident. In Colorado Springs, pre-incident messaging engaged at least a significant portion of the community to foster preparedness and wildfire mitigation work.[215] Evacuation orders given during the incident decreased life safety impacts to residents and the responders tasked with protecting them. Post-incident intelligence sharing closes the intelligence cycle process and starts it over again. In the case of the Waldo Canyon fire, post-incidence intelligence served to identify strengths, weaknesses, and areas for improvement.

## E. SUMMARY

Various components or elements of the CIA intelligence cycle were at play in this fire, even though a conscious effort may not have been made to use the CIA model or any formalized intelligence cycle model. Completely stopping another Waldo Canyon fire is not a realistic goal, but minimizing the impacts of one can be accomplished. According to Jack Cohen of the Missoula Fire Lab in Montana, "We can still have extreme wildfire behavior and still not necessarily have a residential fire disaster."[216] Deconstructing the Waldo Canyon fire and examining the various parts of the intelligence cycle's relevance to the event provides a framework for application in the wildland fire environment to minimize wildfire impacts on communities. Leveraging existing and evolving policies may further improve firefighting efforts in the future. The nature of data gathered before, during, and after fires and the application to actionable intelligence may further improve outcomes. As the speed of data acquisition increases in the digital age, end users' expectations also increase, as well as the opportunity for fire service and other officials to gather, analyze, and disseminate data quickly. The use of the intelligence cycle to prevent and manage fires may evolve to help the fire service, and related agencies respond to external demands and societal implications in the wildland fire environment.

The analysis of the Waldo Canyon fire suggests that the pre-fire prevention phase can benefit primarily from the use of focused intelligence. The threat of wildland fires is

[215] Wildfire Today, "City of Colorado Springs Waldo Canyon fire Initial After Action Report," 15.

[216] Kodas and Hubbard, "Policies Put More Coloradans at Risk."

a long-term problem, and communities subject to the most significant risk must be prepared, not only to save lives but also for the reason that cost savings can be realized through the effective use of the intelligence cycle as a process to limit surprise and provide early warning. After practical recommendations to manage fuels better in high-risk areas, estimates indicate a monetary saving of $12 to $24 for every $1 invested in mitigation activities.[217] It may be possible to duplicate these results at a national level with the pervasive adoption of the intelligence cycle.

Although traditionally, fire service professionals and academicians have not formally created a linkage between wildland fires and the intelligence cycle, this case study indicates that all components of the cycle were present to some degree in the Waldo Canyon fire case. However, no evidence suggests that a formalized or intentional intelligence cycle process occurred even though each phase of the cycle is represented independently or in combination with other phases.

Unforeseen difficulties may arise when using the intelligence cycle model related to skepticism of the government's and residents' privacy. A resident who lost her home in the fire stated, "There was a false sense of 'the government is in control,' and no, they are not."[218] The case study analysis provided an evaluation to determine whether the intelligence cycle and its components were used, which determined that no formal intelligence cycle was implemented in handling the fire. However, the assessment identified evidence of the employment of the five components of the CIA model. Taking the phases of the CIA cycle and applying them comprehensively to wildland intelligence efforts could have enhanced the successes observed before, during, and after the Waldo Canyon fire, and, thus, have improved outcomes. To date, an intelligence cycle by the fire service in the greater Colorado Springs area has not been adopted after the Waldo Canyon fire. While many of the previously identified intelligence practices remain in place, an opportunity exists to formalize a well-defined wildland fire centric model.

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[217] Kodas and Hubbard, 7.

[218] Zubeck, "Misfire, How City Leadership Left Residents."

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# VI. CONCLUSIONS AND RECOMMENDATIONS

This final chapter summarizes the previous five chapters, draws conclusions, and makes recommendations about the intelligence cycle and its specific application to wildland fire prevention and management. Drawing from earlier discussions in this paper, shortcomings and implementation issues are highlighted, and evidence from other fields that effectively utilize the intelligence cycle and scholarly research findings are used to generate related solutions that could lead to best practices in fire services. How effective can the intelligence cycle contribute to reducing the impacts of disastrous wildland fires? Based on the published works of both practitioners and researchers, this paper has argued that the intelligence cycle may be a practical approach to wildland fire prevention, response, and management.

## A. SUMMARY OF RESEARCH

This thesis examined non-typical applications of the intelligence cycle and its components. It is reasonable to characterize the intelligence cycle as a mechanism used to lessen the impacts of a perceived or occurring threat. However, for this thesis, the intelligence cycle was examined as a tool that could stop bad things from happening. Specifically, it has focused on the bad type of event called wildland fires, which are disastrous due to the potentially significant negative impact they can create on a community or set of communities.

The complex scope of the wildland fire problem was detailed to include the multiple impacts of fires, which involve life loss and bodily injury, property damage, environmental damage, and a wide range of fiscal implications. The fiscal impacts are shared amongst the victims of the fires, the geographic areas, and the responding agencies that can be a blend of local, state, regional, or national. Ultimately, the federal government plays a sizeable financial role from the prevention, response, and recovery perspectives. Research indicates that the wildland fire problem is best characterized as an enduring issue studied by experts from a number of physical science fields, particularly from the life and social sciences. The intricacies of the wildland fire problem combined with the broad spectrum of stakeholders—from researchers to practitioners to community members—represent the complexity of the issue and potential resolutions.

This thesis analyzed the intelligence cycle as a process that could be useful to meet the needs of decision makers, who often are faced with decisions that must be made with only short notice. The examination of the early versions of the cycle and some of the most common applications highlighted the core components of the process, as well as their dynamics and interrelationships. The discussion of the traditionalist, contrarian, and reformist viewpoints of intelligence provided an understanding that interpretation is not fixed and the application of the intelligence cycle is best viewed as fluid. Understanding the variability of the intelligence cycle models and identifying a primary starting point is desired to make future recommendations.

Determining the existence of a wildland fire intelligence cycle or the use of the intelligence cycle by the fire service was vital before conducting in-depth research on the subject. The analysis of existing studies and government documents revealed that no formal or informal recognition of the intelligence cycle occurs in the wildland fire arena. However, initial research indicates that the feasibility of emergency or disaster management adoption of an intelligence cycle is realistic and worth pursuing. This research also suggests that a similarly viable path for alternative applications of the intelligence cycle to the wildland fire problem exists.

Lastly, this thesis reviewed the relevant regional intelligence entities that can play a role in wildfire prevention and control. The GACCs and the national network of fusion centers both have strengths and weaknesses related to their effectiveness due to the scope and scale of the respective missions. Although a significant number of agencies make up the intelligence community, focusing on an ideal dissemination platform was important in this thesis. The analysis of available data indicated that the CIA intelligence cycle model was ultimately the platform with the most potential and relevance to the wildland fire problem because of its simplicity and similarity to current wildland fire intelligence endeavors.

## B. ANALYSIS

Chapters III, IV, and V focused on creating connections between the intelligence cycle and the wildland fire problem. These analyses were primarily the result of comparisons between current understanding and practices and the validity of alternative interpretations. To frame the intricacies of the intelligence cycle model best, the CIA model was analyzed to identify relationships with the wildland fire environment. Due to the simplicity of the CIA model, the five phases of the cycle were individually inspected to determine relationships between the fire service's current intelligence practices and application to wildland fires. The analysis indicated that the fire service employs some steps and processes that reflect a piecemeal approach to the use of intelligence in the wildland fire environment. However, the correlation related to wildland fires are not strategic nor a reflection of an organized process model, such as the CIA intelligence cycle. Still, the evidence that correlations to the CIA intelligence cycle already exist supports the idea that the greater use of the intelligence cycle model can be made in the future by building on current practices.

Once the examination of the individual steps of the CIA model showed a connection to the wildland fire environment, further assessment was indicated. The intelligence collection phase deals with the specific types of INTs, and the analysis concluded that they are useful to the wildland fire problem. Although not all types or subtypes of the INTs are relevant, the primary collection disciplines of HUMINT, MASINT, GEOINT, SIGINT, and OSINT are key to support the fire service best. The full spectrum of the INTs allows the fire service to collect the information needed to develop intelligence products.

The fire service's use of technology among these INTs was identified for the individual phases of the intelligence cycle. Once again, this collection was not by design to support a formalized intelligence cycle. Regarding the systematic use of technology, wildland fire intelligence collection is well established and continues to evolve. The analysis in this thesis indicates that ongoing improvements in technology will support a more complete and well-developed intelligence cycle in the future with more focus by the fire service arena at the local, state, and national levels. This examination identified the value of developing a synthesis of a ground-based and satellite intelligence collection to realize an optimal solution for use by fire service decision makers.

This paper's consideration of current and future intelligence dissemination options focused on the GACCs and the national network of fusion centers. These two types of data sources have notably different foci and scope; the fusion center network has a broader public safety focus whereas the GACCs provide specific wildland and geographic information. The larger role and information gathered and disseminated by the fusion center network makes it easier to reach more stakeholders. However, the fusion centers lack wildland fire specificity that the GACCs provide. The conclusion by the present author is that it is more realistic to enhance the wildland fire centric representation at the existing fusion centers with more personnel rather than further expand the number of GACCs. Adding additional personnel at fusion centers impacted by the wildland fire threat instead of adding more GACCs is more attainable.

This thesis also analyzed and dissected the Waldo Canyon fire and the effectiveness of the fire service in managing it. The case study analysis provided an evaluation to determine whether the intelligence cycle and its components were used, which determined that no formal intelligence cycle was implemented in handling the fire. However, the assessment identified evidence of the employment of the five components of the CIA model. As previously observed, the phases were much more organic and haphazard in origination as opposed to strategic, intentional, and well organized. Another conclusion was that the phases of the cycle did not always take place in a consistent or linear time frame. Some of the actionable intelligence existed before the Waldo Canyon fire, while other intelligence evolved during or after the incident took place.

From a holistic perspective, the core concepts of the intelligence cycle commonly occur in the wildland fire arena and were evident in the Waldo Canyon fire. However, as a formalized process, the cycle is not explicitly defined and continues to be fractured. Some aspects of each of the phases of the intelligence cycle were represented in the wildland fire process, but only in an informal and unsystematic way. This finding suggests that if the intelligence cycle were to be used more deliberately in the wildland firefighting profession, improvements in both fire prevention and fire suppression and response may be possible by providing a mechanism to communicate actionable intelligence better.

## C. LIMITATIONS

Implementing any changes from the status quo to improve the strategic use of an intelligence cycle that mimics that of the CIA is likely to be difficult. Despite probable challenges, the existence of a wildland intelligence apparatus at the GACCs is promising and can serve as a building block to work efficiently with the national network of fusion centers. As the fire service considers moving forward and proposes changes, questions will inevitably arise. Why change what the fire service is currently doing? If it is not broken, why change it? When looking at the fire problem as an enduring risk with consistently increasing impacts, alternatives should be evaluated. To introduce and implement innovation, approaches that will avoid the alienation of the involved agencies will be needed. Fire service leaders will need to manage this system change effectively to minimize resistance and gain buy-in from all stakeholders.

The complexities of having multiple stakeholders pose a hurdle to implementation, as involved agencies are focused on their individual needs from both a geographic responsibility and fiscal perspective, which makes integration, new strategies, and other systemic improvements more difficult. Adding to the complexity is the organizational oversight that is anchored at the local, state, and federal levels. Given these levels and the range and types of agencies involved, obtaining consensus on an implementation strategy is problematic. To realize significant change best, policy adoption needs to occur at the highest levels, with hard work to gain buy-in from local jurisdictions and agencies. Independent of high-level organizational support, the limited application of the intelligence cycle in the wildland fire environment is likely.

As with any substantive policy and implementation changes, funding is an issue, as potential costs for a comprehensive and well-integrated intelligence cycle can be costly. The costs include orchestrating education, messaging, and implementation in addition to new or more technology. Hopefully, the financial challenges can be minimized by leveraging existing resources, such as grant opportunities and emerging technologies. However, until the ability to minimize fiscal impacts is validated, funding will remain an issue. One option may be to develop and implement a long-term, phased-in strategic plan for change that can also include gradual increases in costs over time.

A final limitation derives from the potential for only partial adoption of a wildland fire intelligence cycle. Without universal acceptance of a cycle, the possibility of stovepiping intelligence is a real concern with problematic impacts on communities threatened by wildland fires. Research indicates that a primary issue with intelligence and the intelligence collection process is that informational stovepipes do not support collaboration and strategic warning, and often result in data silos. The partial implementation of an intelligence cycle will most likely result in minimal improvements to the current problem. If only some agencies use new wildland intelligence cycle processes and others do not, realizing the true potential is problematic.

## D. RECOMMENDATIONS

Driven by the desire to minimize the impacts of disastrous wildland fires, the current author provides recommendations for the future. To be implemented successfully, several recommendations will need significant high-level policy support. The support may be easier to garner as potential benefits are quantified as lives saved, property loss reduced, and environmental impacts minimized. Absent adoption of the following recommendations, the benefits are only characterized as potentials. The evidence indicates that much of the component parts of an intelligence cycle model currently exist in the fire service; using that knowledge will help gain buy-in and implementation support of end users from a grassroots perspective.

The current author recommends the following steps for achieving a fully developed intelligence cycle in fire service:

- *Adopt the intelligence cycle model at a national level as a mechanism to provide a strategic warning for future wildland fires.* Starting with the adoption of a basic intelligence cycle model provides a mechanism for future improvements in wildland fire intelligence. The precise nature of the adopted cycle and its fire service-specific nuances will evolve after the recognition of adoption by key stakeholders. The adoption of the intelligence cycle that mimics that of the CIA would be evident in written policies and training for relevant fire service personnel. It would be realized through the production of new intelligence products, such as daily wildland threat warnings that included specific communities at risk.

- *Develop a wildland fire-centric intelligence cycle that addresses the specific needs of those who will be managing its respective components.* For an adopted intelligence cycle to be effective it has be simple, comprehend and apply. The simplicity of the CIA intelligence cycle will increase the chances that it may be successful if adopted by the fire service. Undoubtedly, the structure of the traditional CIA intelligence cycle process will evolve into an effective tool for fire service that is flexible and easily tailored to needs that may vary over time and location. A cycle that is elastic and adaptable will allow officials and other key stakeholders to use it to meet their nuanced needs and address past shortcomings. Intuitively, this cycle may be achieved most readily by institutionalizing a feedback component in the intelligence cycle that enhances performance through constant evaluation and reassessment over time.

- *Institutionalize a wildland fire service component to fusion centers that manage the enduring threat of disastrous fires.* This type of creative adaptation will generate a larger platform to deliver actionable intelligence to end users and results in the continual expansion of the scope and scale of the fusion centers. The integration of a fire service component to fusion centers could include part-time or full-time wildland fire service representation at fusion centers located in areas at high risk from wildland fires. Staffing fusion centers with experts who have higher levels of subject matter expertise will facilitate the generation of more fire service related intelligence products to a broader audience that includes more significant numbers of public safety and emergency management agencies.

- *Explore funding mechanisms necessary to support the adoption of an intelligence cycle.* The actual fiscal impacts of adopting a nuanced intelligence cycle and integrating wildland fire service representation into fusion centers are unknown. Funding to cover the costs of staffing, personnel development and training, technology, and both internal and external intelligence cycle messaging, would be needed. Establishing dedicated budgetary support from participating agencies or leveraging existing grants are two possible funding mechanisms.

- *Develop a mechanism to measure the results of an intelligence cycle application to the wildland fire problem.* To evaluate properly whether the application of a full intelligence cycle has been useful, a mechanism must be put into place to measure changes in wildland fire life loss, personal property damages, environmental damages, and related fiscal impacts. Data on those key measures gathered before the implementation of the intelligence cycle would be compared to parallel information gathered once the wildland fire intelligence cycle has been implemented, and should continue annually. Any mechanism generated for this ongoing evaluation would need to take into account external factors that could influence results, such as weather patterns. The data sets needed to validate the use of a wildland intelligence cycle will take several years to populate.

- *Conduct further research to identify strengths and weaknesses of the intelligence cycle application.* As with any policy change, reassessment is an integral part of the validation process. Research that focuses on the return on investment for fusion centers that add personnel could prove beneficial and perhaps lead to additional fusion center expansion. Additionally, research that evaluates the effectiveness of explicit wildland intelligence products and their value in specific types of geographical areas or situations would be valuable.

These recommendations provide a sound starting point for what ultimately could make substantial alterations to the wildland fire intelligence process. Building a model that considers past incidents, the current wildland fire problem, and perceived limitations create a more significant opportunity to realize success.

## E. CONCLUSION

When a known threat to homeland security exists, and the threat impacts life, property, and the environment, it is incumbent on policymakers to work towards minimizing their negative effects. This thesis outlines processes that can provide necessary intelligence to reduce risks to those exposed to wildland fires in systematic ways. The development of alternative strategies, such as the adoption and implementation of fundamental processes of the intelligence cycle not currently utilized by the fire service, can minimize outcomes. Using a well-defined intelligence process focused on saving lives, protecting property, and reducing environmental impacts in a fiscally responsible manner is a prudent wildland fire policy. The current thesis has argued that the intelligence cycle is a valuable framework for thinking and re-evaluating about how information about wildland fire threats is collected, analyzed, and disseminated. Its adoption will ultimately help the fire service better communicate with the communities it services, and the resulting enhanced communication will help the fire service be more successful in preventing wildland fires and mitigating the effects of those that do occur.

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# APPENDIX. GEOGRAPHIC COORDINATION CENTER AND FUSION CENTER REGIONAL COMPARISON[219]

| Geographic Area Coordination Centers (GACCs) | Primary States/Areas in GACCs | Fusion Center (Primary) | Fusion Center (Recognized) |
|---|---|---|---|
| Alaska | • Alaska | • Alaska Information and Analysis Center | |
| Northwest | • Washington<br>• Oregon | • Washington State Fusion Center<br>• Oregon Terrorism Information Threat Assessment Network | |
| Northern California | • California<br>• Hawaii | • California State Threat Assessment Center<br>• Hawaii Fusion Center | • Central California Intelligence Center<br>• Northern California Regional Intelligence Center |
| Southern California | • California | | • Los Angeles Joint Regional Intelligence Center<br>• Orange County Intelligence Assessment Center<br>• San Diego Law Enforcement Coordination Center |
| Northern Rockies | • Montana<br>• North Dakota | • Montana Analysis & Technical Information Center<br>• North Dakota State and Local Intelligence Center | |
| Great Basin | • Idaho<br>• Nevada<br>• Utah | • Idaho Criminal Intelligence Center<br>• Utah Statewide Information and Analysis Center<br>• Southern Nevada Counter-Terrorism Center | • Nevada Threat Analysis Center |

219 Department of Homeland Security, "Fusion Center Locations."

| Geographic Area Coordination Centers (GACCs) | Primary States/Areas in GACCs | Fusion Center (Primary) | Fusion Center (Recognized) |
|---|---|---|---|
| Rocky Mountain | • Colorado<br>• Kansas<br>• Nebraska<br>• South Dakota<br>• Wyoming | • Colorado Information Analysis Center<br>• Kansas Intelligence Fusion Center<br>• Nebraska Information Analysis Center<br>• South Dakota Fusion Center<br>• Wyoming Information and Analysis Team | |
| Southwest | • Arizona<br>• New Mexico<br>• Texas (West) | • Arizona Counter Terrorism Information Center<br>• New Mexico All Source Intelligence Center | • El Paso Multi-Agency Tactical Response Information eXchange |
| Eastern | • Connecticut<br>• Delaware<br>• Illinois<br>• Indiana<br>• Iowa<br>• Maine<br>• Maryland<br>• Massachusetts<br>• Michigan<br>• Minnesota<br>• Missouri<br>• New Hampshire<br>• New Jersey<br>• New York<br>• Ohio<br>• Pennsylvania<br>• Rhode Island<br>• Vermont<br>• West Virginia<br>• Washington DC<br>• Wisconsin | • Connecticut Intelligence Center<br>• Delaware Information and Analysis Center<br>• Illinois Statewide Terrorism and Intelligence Center<br>• Indiana Intelligence Fusion Center<br>• Iowa Division of Intelligence and Fusion Center<br>• Maine Information and Analysis Center<br>• Maryland Coordination and Analysis Center<br>• Massachusetts Commonwealth Fusion Center<br>• Michigan Intelligence Operations Center<br>• Minnesota Fusion Center<br>• Missouri | • Chicago Crime Prevention and Information Center<br>• Boston Regional Intelligence Center<br>• Detroit and Southeast Michigan Information and Intelligence Center<br>• Kansas City Regional Terrorism Early Warning Interagency Analysis Center<br>• St. Louis Fusion Center<br>• Greater Cincinnati Fusion Center<br>• Northeast Ohio Regional Fusion Center<br>• Delaware Valley Intelligence Center<br>• Western Pennsylvania All Hazards Fusion Center<br>• Southeastern Wisconsin Threat |

| Geographic Area Coordination Centers (GACCs) | Primary States/Areas in GACCs | Fusion Center (Primary) | Fusion Center (Recognized) |
|---|---|---|---|
| | | Information Analysis Center<br>• New Hampshire Information and Analysis Center<br>• New Jersey Regional Operations Intelligence Center<br>• New York State Intelligence Center<br>• Ohio Statewide Terrorism Analysis and Crime Center<br>• Pennsylvania Criminal Intelligence Center<br>• Rhode Island State Fusion Center<br>• Vermont Intelligence Center<br>• West Virginia Intelligence Fusion Center<br>• Washington Regional Threat Analysis Center<br>• Wisconsin Statewide Intelligence Center | Analysis Center |
| Southern | • Alabama<br>• Arkansas<br>• Florida<br>• Georgia<br>• Kentucky<br>• Louisiana<br>• Mississippi<br>• North Carolina<br>• Oklahoma<br>• Puerto Rico<br>• South Carolina<br>• Tennessee<br>• Texas (East)<br>• Virginia | • Alabama Fusion Center<br>• Texas Joint Crime Information Center<br>• Arkansas State Fusion Center<br>• Florida Fusion Center<br>• Georgia Information Sharing and Analysis Center<br>• Kentucky Intelligence Fusion Center<br>• Louisiana State Analytical & Fusion Exchange | • Austin Regional Intelligence Center<br>• Dallas Fusion Center<br>• Houston Regional Intelligence Service Center<br>• North Texas Fusion Center<br>• Southwest Texas Fusion Center<br>• Central Florida Intelligence Exchange<br>• Southeast Florida Fusion Center<br>• Northern Virginia Regional Intelligence Center |

| **Geographic Area Coordination Centers (GACCs)** | **Primary States/Areas in GACCs** | **Fusion Center (Primary)** | **Fusion Center (Recognized)** |
|---|---|---|---|
| | | ● Mississippi Analysis and Information Center<br>● North Carolina Information Sharing and Analysis Center<br>● Oklahoma Information Fusion Center<br>● National Security State Information Center<br>● South Carolina Information and Intelligence Center<br>● Tennessee Fusion Center<br>● Virginia Fusion Center | |
| TOTAL: 10 | TOTAL: 52 | TOTAL: 52 | TOTAL: 25 |
| NON GACC | ● 50 States<br>● Washington DC<br>● Puerto Rico | ● Mariana Regional Fusion Center (GUAM)<br>● U.S. Virgin Islands Fusion Center | |
| TOTAL: 10 GACCS | | TOTAL: 54 Primary Fusion Centers | TOTAL: 25 Recognized Fusion Centers |

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