Developing Fire Investigation Guidelines for the St. George Fire Protection District

Bruce R. Johnson

St. George Fire Protection District, Baton Rouge, LA

Certification Statement

I hereby certify that this paper constitutes my own product, that where the language of others is set forth, quotation marks so indicate, and that appropriate credit is given where I have used the language, ideas, expressions, or writings of another.

Signed: 

Abstract

The problem was that the St. George Fire Protection District (SGFPD) did not have an established Standard Operation Guideline (SOG) for the investigations of fires. The purpose of this research was to develop a fire investigation SOG for the SGFPD to provide a competent and unified investigation from the first arrival on scene to the completion of a formal investigation. This Applied Research Project (ARP) utilized action research for the development of a competent and unified fire investigation SOG for the SGFPD. Four research questions were asked: (a) what are the best practices for conducting a fire investigation that should be incorporated into an SOG at SGFPD (b) what are the fire investigation roles and responsibilities of personnel during the fire scene operation at SGFPD, (c) what are the current issues experienced by suppression personnel and the Fire Prevention Officers (FPOs) during fire scene investigations at the SGFPD, and (d) what are the factors that contribute to the current issues being experienced by suppression personnel and FPOs during fire investigations at the SGFPD? An analytical analysis of current fire investigation best practices and recognized potential issues were identified in national publications and SOGs of other fire departments to establish a consensus fire investigation benchmark. A situational analysis of the current SGFPD fire investigation procedures was also conducted and the results were compared to the established analytical benchmark. The factors and issues identified are primarily a lack of general knowledge and practical training as compared to the recognized national guidelines and standards. There were three fire investigation SOGs that were developed based on the results of this research project: *Preliminary Investigation, Investigator Call-out,* and *Formal Investigation* SOGs. In addition, it was recommended that a rigorous and robust education and training program should accompany the implementation of the new fire investigation SOGs.

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Introduction

The 20th century philosopher, George Santayana said, “Those who cannot remember the past are condemned to repeat it.” The significance of this quote should not be lost on the fire service. Without understanding the events and factors that led to a current situation we will never understand, and often repeat the same mistake again. The fire service is not exempt from this tough lesson of history. Part of that effort to learn from the past comes from the fire investigation process. The investigation of each fire provides the opportunity for understanding the factors that contributed to the ignition and spread of the fire to minimize the potential impact of future fires. For this to take place, a systematic and objective method of investigating fires to determine the origin and cause of the fire must take place.

Fire investigation has evolved, especially in the last three decades, from various methods of on the job training and anecdotal knowledge being passed down to the employment of the scientific method as the foundation of a fire investigation. But if the fire investigation methods are to be effective in the fire service, there must be a systematic and objective method utilized and understood by the fire investigators, company officers, and fire fighters in the approach to the investigation process. To this end, there must be established guidelines for all fire service personnel to understand the investigative process and their respective roles and responsibilities in that process. These roles and responsibilities within an established methodology must be clearly defined with common terminology employed for an effective and competent fire investigation to take place.

The problem is that the St. George Fire Protection District (SGFPD) does not have an established Standard Operation Guideline (SOG) for the investigations of fires. The purpose of

this research is to develop a fire investigation SOG to ensure that suppression personnel and Fire Prevention Officers (FPOs) provide a competent and unified investigation from the first arrival on scene to the completion of a formal investigation. This Applied Research Project (ARP) will utilize action research for the development of an SOG for a competent and unified fire investigation process at the SGFPD. Four research questions were asked: (a) what are the best practices for conducting a fire investigation that should be incorporated into an SOG at SGFPD (b) what are the fire investigation roles and responsibilities of personnel during the fire scene operation at SGFPD, (c) what are the current issues experienced by suppression personnel and the FPOs during fire scene investigations at the SGFPD, and (d) what are the factors that contribute to the current issues being experienced by suppression personnel and FPOs during fire investigations at the SGFPD?

Background and Significance

The SGFPD has provided fire and medical services to the residents of East Baton Rouge Parish (EBRP) for over 40 years. The SGFPD grew from a non-profit volunteer corporation, to a robust career department with over 150 full time suppression and support personnel. The SGFPD now has 8 stations to cover the response area that consists of approximately 85 square miles and provides medical and fire services to over 100,000 citizens within the SGFPD community. With the increase of population, a reciprocal increase of call volume has place significantly more demands on the SGFPD personnel who respond to emergency events.

As an organization, SGFPD has responded to these demands with increased manpower, more stations, newer apparatus, improved Personal Protective Equipment (PPE), and increased the utilization of computer technology to increase the safety and protection of those we serve, as

well as the employees of the SGFPD. In an additional effort to increase the prevention and mitigation efforts, the SGFPD established a full-time Fire Prevention Bureau (FPB) in 1997.

Over the years, the FPB responsibilities have grown as well as the number of FPB staff. The SGFPD Fire Protection Bureau currently consists of a Chief of Fire Prevention and three FPOs. The duties of the FPO consists of annual fire inspections of the 5676 occupancies within the SGFPD, and rotating on-call fire investigation duties 7 days a week. Of the 7,751 calls in 2014 that SGFPD responded to, fire calls represented 255 of those calls with 26 of those fire incidents requiring a formal investigation by a SGFPD FPO (St. George Fire Protection District, 2015). There are two aspects of the fire investigation process at the SGFPD, an investigation by the suppression personnel during the initial response to the fire scene, and a formal investigation by the FPO if required. FPOs are called out by the Incident Commander (IC) for formal investigations of fires that the IC is unable to determine origin and cause or of suspicious nature.

All FPOs' credentials consist of being Fire Fighter I and II, certified by Peace Officer Standards and Training Council (POST) as law enforcement officers, certified Emergency Medical Technicians (EMT), certified fire investigators, graduates from the National Fire Academy (NFA) Fire/Arson Origin and Cause Investigations (R206) class, and have earned an Associate's Degree in Fire Science. Each year they are required to complete 20 hours continuing education related to POST certification, 24 hours of continuing education related to investigations, and every two years complete 48 hours of continuing education for EMT with an additional 24 hour refresher course. Company officers are required to obtain a fire investigation certification, Fire Fighter I & II, and an Associate's Degree in Fire Science prior to promotion.

Although the training of the SGFPD personnel is excellent, there are no guidelines established for fire investigation practices at the SGFPD. The lack of guidelines promotes an

inconsistent and ineffective investigation process of each fire incident. Successfully establishing an SOG will standardize the procedures ensuring a systematic and unified investigation and identify the required training for all SGFPD personnel.

While the introduction of a formal SOG for fire investigation is a technical solution, it will also present an adaptive challenge for the personnel as discussed in the NFA's Executive Fire Officer's (EFO) Executive Leadership course. The current SGFPD fire investigation practices vary with experience and attitudes between each employee which presents an organizational adaptive challenge of conforming to a new formal fire investigation management structure. This ARP is designed to analyze the SGFPD fire investigation process to determine the current issues and those factors that contribute to these issues to develop an effective SOG for the SGFPD. This ARP links directly with the terminal objective set out in unit 3 of the Executive Leadership course to "examine the systems within which the adaptive challenge exist, using purposeful collection of data to help clarify and define what occurs with these systems" (United States Fire Administration, 2015, p. SM 3-1). In addition, this ARP will also assist the United States Fire Administration's (USFA) Strategic Plan 5th goal to "lead the Nations' Fire and Emergency Services by establishing and sustaining USFA as a dynamic organization" ("United States Fire Administration," n.d., p. 22) with the research of best practices to establish an SOG for effective fire investigation practices at the SGFPD.

Literature Review

The scope of this literature review will be conducted to understand the fire investigation practices/methods utilized within the fire service for fire suppression and investigation personnel. The literature review will cover the following:

- Best practices for conducting a fire investigation

- Roles and responsibilities during a fire investigation
- Factors/Issues related to a fire investigations

Best Practices

Fire investigation has evolved from a non-scientific origin to a systematic scientifically based profession (Dioso-Villa, 2013). The knowledge and skills utilized in the early development of fire science was akin to oral tradition in which the validity of the hypothesis and suppositions were based on anecdotal experience and interpretation which were assumed to be true (Faigman & Saks, 2008). The fact is old timers passed their knowledge down to the new guy without any scientific testing to verify the validity of their fire investigation skills and techniques (Carman, 2013). It was in response to these issues that in 1985 the NFPA Standards Council appointed a Technical Committee to address the issues concerning the methodology of the current fire investigation practices that subsequently developed into the *NFPA 921 Guide for Fire and Explosion Investigations* (Kennedy, 2012).

The first edition of *NFPA 921 Guide for Fire and Explosion Investigations* was published in 1992 to present a consensus of the recognized practices for the fire investigation profession (Carman, 2011). Although the acceptance of NFPA 921 as the "standard of care" was met with much resistance over the years, it has transformed both private and public fire investigation methodology to a science based discipline (Dioso-Villa, 2013). Subsequent editions of NFPA 921 are published in a three year cycle to keep abreast of the scientific and technical research advancements of fire investigation in 1995, 1998, 2001, 2004, 2008, 2011 and the current edition of 2014.

On January 12, 2013, the International Association of Arson Investigators (IAAI) reiterated their official position that NFPA 921 "is widely recognized as an authoritative guide

for the fire investigation profession. In addition, NFPA 921 is an important reference manual, and sets forth guidance and methodology regarding the determination of the origin and cause of fires" (International Association of Arson Investigators, 2013, para. 1).

The general scope of NFPA 921 is to provide guidelines for the systematic investigation and analysis of fire and explosions for both public and private agencies for the identification of both the origin and cause of fires (National Fire Protection Association, 2010). The terms *origin* and *cause* are important terms to understand and are defined by NFPA 921. *Origin* is defined by NFPA 921 as "the general location where a fire or explosion began" (National Fire Protection Association, 2010, p. 3.3.119). The term *cause* is defined as "the circumstances, conditions, or agencies that brought about or resulted in the fire or explosion incident" (National Fire Protection Association, 2010, para. 3.3.22). While the purpose of each fire investigation is to determine the origin and cause of the fire, there is an extensive amount of skills and knowledge that is encompassed in NFPA 921 that provide the tools to assist in that effort.

A review of the table of contents provides a quick overview of NFPA 921 and each of the chapters describes the following specific aspects of the best practices for the systematic approach and fire investigation methodology for an effective origin and cause investigation:

1. Administration
2. Reference Publications
3. Definitions
4. Basic Methodology
5. Basic Fire Science
6. Fire Patterns
7. Building Systems

8. Electricity and Fire
9. Building Fuel Gas Systems
10. Fire-Related Human Behavior
11. Legal Considerations
12. Safety
13. Sources of Information
14. Planning the Investigation
15. Documentation of the Investigation
16. Physical Evidence
17. Origin Determination
18. Fire Cause Determination
19. Analyzing the Incident for Cause and Responsibility
20. Failure Analysis and Analytical Tools
21. Explosions
22. Incendiary Fires
23. Fire and Explosion Deaths and Injuries
24. Appliances
25. Motor Vehicle Fires
26. Wildlife Investigation
27. Management of Complex Investigations
28. Marine Fire Investigations

The primary systematic approach outlined by NFPA 921 for fire investigation is the scientific method. The scientific method is defined in *Chapter 4 - Basic Methodology* as the

process used to first determine the point of origin and then to determine the cause that brought the ignition source and the fuel together (National Fire Protection Association, 2010, para. 4.1). The steps of the scientific methods stated are NFPA 921 (National Fire Protection Association, 2010, para. 4.3) and are applied to determine both the origin and the cause of the incident being investigated:

- Recognize the need
- Define the problem
- Collect data
- Analyzed the data
- Develop a hypothesis
- Test the hypothesis
- Select final hypothesis

The purpose of the scientific method is to form a working hypothesis by using a systematic methodology to evaluate and eliminate theories as to the circumstances and conditions that resulted in the fire that results in a final determination of the origin and cause of the fire (DeHaan & Icove, 2012). It is also recommended that the investigator establish an overall systematic framework for the scope of the fire investigation (National Fire Protection Association, 2010, para. 17.2.4). The scientific method is the methodology utilized within a systematic framework for both the origin and the cause investigation, but notes that various actions may take place continuously and possibly at the same time within the overall methodology (National Fire Protection Association, 2010, p. 17.2.2).

The systematic methodology used for both origin and cause determination is clearly defined in NFPA 921 in which the scientific method is applied during the systematic process.

The recommended methodology for the examination of a fire scene for determining origin is (National Fire Protection Association, 2010, para. 17.2.5):

- Initial scene assessment
- Develop preliminary hypothesis
- In depth examination and reconstruction
- Final fire spread hypothesis
- Identify fire's origin

The use of a systematic methodology is used for determining the cause of the fire as well after the origin has accurately been determined (National Fire Protection Association, 2010, para. 18.1) according to the following steps:

- First fuel ignited
- Ignition source
- Oxidizing agent
- Circumstances that resulted in the fire

Within the broad scope of the investigation framework the investigator will perform some additional general functions while determining the origin and cause, fire spread, and who is responsible for the incident which includes (National Fire Protection Association, 2010, para. 14.3.1):

- Leadership
- Safety assessment
- Photography
- Note taking, mapping, diagramming
- Interview witnesses

- Searching scene
- Evidence collection and preservation

Roles and Responsibilities

According to Louisiana State 2006 RS 40:1566 it is required by the Chief of the fire department or those they appoint, to investigate the cause, origin, and the circumstances of every fire occurring in their jurisdiction (Investigation of fire; reports; records of fires, 2006). It is important to note that while the roles and responsibilities of the suppression personnel and the FPO vary, both should apply the scientific method within a systematic methodology according to the recommended practices of NFPA 921 for determining the origin and cause of the fire.

Suppression Personnel

Although suppression personnel typically have basic fire investigation training, they are an important part of the fire investigation process. A broad responsibility of suppression personnel related to the investigation is to first quickly extinguish the fire to preserve the fire scene and physical evidence (National Fire Protection Association, 2010). When the scene is safe, it is then the IC's responsibility to ensure that a preliminary fire investigation is conducted to determine origin and cause of the fire (National Fire Protection Association, 2010). There are five general responsibilities identified by the National Institute of Justice for suppression personnel that are part of the preliminary investigation at the scene prior to requesting a formal investigation (*A Guide for Investigating Fire and Arson*, 2009):

- Observe the fire and scene
    - Locate witnesses
    - Vehicles on scene
    - Flame and smoke conditions

    - Conditions overall at scene
    - Building fire systems
    - Unusual aspects of scene
- Scene safety
    - Evaluate
    - Establish safety zone
    - Use proper Personal Protective Equipment (PPE)
- Preserve fire scene
    - Note evidence
    - Protect evidence
    - Preserve evidence
- Security and scene control
    - Set up perimeter
    - Control access
    - Initiate documentation of scene
- Coordinate investigation activities
    - Establish Incident Command System (ICS)
    - Determine origin and cause if able
    - Request resources if needed
    - Debrief situation to appropriate personnel as required

On fires that the IC is able to determine the origin and cause and it is not determined to be criminal act, a preliminary fire investigation is the only investigation that may be needed (National Fire Protection Association, 2010). However, if after the preliminary fire investigation

the IC is unable to determine the origin and cause of the fire, or during the primary investigation the IC believes the fire may be intentional or involve criminal activity, a qualified fire investigator should be called and additional actions should be taken by the IC before the arrival of the investigator (Chandler, 2009). While the suppression and professional investigator share overall responsibility to determine the origin and cause of each fire, each requires different qualifications that need to be met based on their roles and responsibilities.

The minimum qualifications required to be certified as a fire fighter related to fire investigations are defined in *NFPA 1001 Standard for Fire Fighter Professional Qualifications*. It must be noted that NFPA 1001 is a standard and therefor shall be mandatory in compliance. Meeting the required qualifications will allow suppression personnel to perform a basic preliminary investigation. The certification process requires that fire fighters master the following Job Performance Requirements (JPR) based on knowledge and skills related to fire investigation to obtain Fire Fighter I and Fire Fighter II certifications (National Fire Protection Association, 2012):

- Identify obvious signs of origin and cause
- Techniques for the preservation of fire cause evidence
- Assess patterns for origin determination
- Assess evidence for cause determination
- Types of evidence
- Ability to protect evidence
- Roles and responsibilities in fire investigations
- Legal aspects of evidence location and collection

Investigation Personnel

The four major areas of responsibility identified by the National Institute of Justice for investigation personnel during a formal investigation after the preliminary investigation is completed are (*A Guide for Investigating Fire and Arson*, 2009):

- Evaluating the scene
    - Contact IC and establish presence
    - Define scene perimeter
    - Identify and interview witnesses
    - Determine security of scene at time of fire
    - Identify needed resources to conduct investigation
- Documenting the scene
    - Exterior fire scene
    - Interior fire scene
    - Points of origin
    - Ignition sources
    - Sketch the scene
    - Take relevant notes, descriptions and observations of scene
- Processing the scene
    - Identify, collect, and preserve evidence
    - Prevent evidence contamination
    - Secure evidence
    - Evidence chain of custody
- Complete the investigation

- Final review of scene
- Complete documentation
- Release scene

In order to meet these responsibilities, the fire investigator must maintain the requisite knowledge and performance skills required by the industry standards. The requisite knowledge and performance skills are clearly defined in *NFPA 1033 Standard for Professional Qualifications for Fire Investigator* for both public and private entities (National Fire Protection Association, 2013). It is important to note that NFPA 1033 is a *standard.* A standard indicates a mandatory minimum level of JPR for fire investigators that shall be met in order to carry out their duties (National Fire Protection Association, 2013). In addition, it is the first responsibility of the fire investigator is to stay up to date on the advancements of fire investigation practices.

The NFPA 1033 states that "the fire investigator shall have and maintain at a minimum an up-to-date basic knowledge of the following topics beyond the high school level" (NFPA, 2013, p. 6):

- Fire Science
- Fire Chemistry
- Thermodynamics
- Thermometry
- Fire Dynamics
- Explosion Dynamics
- Computer Fire Modeling
- Fire Investigation
- Fire Analysis

- Fire Investigation Methodology
- Fire Investigation Technology
- Hazardous Materials
- Failure Analysis and Analytical Tools
- Fire Protection Systems
- Evidence Documentation, Collection, and Preservation
- Electricity and Electrical Systems

While some may considered the fire investigation a separate aspect from fire suppression activities, it is important to remember that both are directly related to each other and fall within the scope of the National Incident Management System (NIMS) to maintain a unified command structure for both the suppression activities and the investigation processes (NIMS, 2013). This will ensure that all efforts are on task and promote cooperation and effectiveness during the fire scene operations with a clearly defined chain of command.

Factors/Issues

Misconceptions

In his June 11th, 1962 speech at Yale University, President John F. Kennedy said that "The great enemy of truth is very often not the lie, deliberate, contrived, and dishonest, but the myth, persistent, persuasive, and unrealistic. Too often we hold fast to the clichés of our forebears. We subject all facts to a prefabricated set of interpretations." Perhaps President Kennedy wasn't talking about fire investigations, but it certainly applies. Unsupported misconceptions of fire investigations practices have taken on the veneer of facts and science from the genesis of the fire investigation profession.

John J. Lentini points out that the seed of this misinformation may be traced back to the publishing of *Arson and Arson Investigation Survey and Assessment* by the Law Enforcement Assistance Administration (LEAA) in 1977 (Lentini, 2006) relating to "arson indicators". Arson indicators are the results of a fire that would "indicate" the cause of the fire as incendiary (Beyler, 2009). Although the LEAA publication contained caution as to the validity of the "arson indicators," the caution was disregarded by the National Bureau of Standards (NBS), later known as the National Institute of Standards and Technology (NIST). NBS published the *Fire Investigation Handbook* and listed the arson indicators without any question to the validity of the "arson indicators". Lentini continued by stating that a circular process of citations crediting the *Fire Investigation Handbook* perpetuated the acceptance and use of the "arson indicators" without any scientific validity throughout the fire investigation industry. A few of the faulty "arson indicators" that have been debunked over the years (Starr, 2011) are:

- *Crazing of windows* indicates rapid heating and means an accelerant was used
- *Burn marks on floor* indicate fire was intentionally set by pouring liquid on ground
- *Melted metals* indicate that an accelerant was used to reach higher temperatures
- *Burn mark under doors and furniture* indicates liquid accelerant was used
- *Spalling* indicates that liquid accelerant was poured on concrete and lit
- *Alligatoring* with small fat blisters means slow fire, large shinning blister rapid fire
- *Sharp V- pattern* indicates fast moving fire that must have started with a liquid accelerant

Although fire science has evolved and many misconceptions have been identified, the early practice has led to wide acceptance of invalid investigation practices and techniques that still linger to this day.

Salvage and Overhaul

During the salvage and overhaul activities suppression personnel need to be careful not to destroy any evidence that includes contents and structure related to the origin or cause of the fire (FM Global, 2009). Overall the suppression crews should be aware of the impact that straight-stream nozzles, pulling ceilings, breaking windows, collapsing walls and improper overhaul and salvage techniques impact the effectiveness of the fire investigation process (National Fire Protection Association, 2010). It is critical to the investigation as well, that fire fighters do not remove excessive amounts of the drywall from the studs during overhaul to allow the fire investigator to examine the fire patterns on the walls that are important for determining area of origin (Disbrow, 2011). Disbrow states further that fire officers should supervise overhaul operations to avoid any unnecessary damage and ensure that the investigator is aware and approves of any removal of contents or building materials from the structure.

Whether conducting the preliminary investigation or the formal investigation of the scene, the removal of fire debris, walls, ceilings, doors, and or contents prevents the investigator from evaluating the fire scene in the context of the event (National Fire Protection Association, 2010). It is best after initial fire suppression activities are completed in which an investigator has been called or is on scene, that non-essential salvage and overhaul should be delayed until the investigation is complete or the fire investigator says it is okay to continue salvage and overhaul activities (Chandler, 2009).

Evidence

In general, all fire scenes should be secured and considered evidence, as well as the surrounding areas, to ensure that the integrity of any potential evidence is maintained from the first arrival on scene to the conclusion of investigation (International Fire Service Training

Association, 2005). It is critical to develop and implement evidence collection procedures as a comprehensive process with three general aspects: recognition, recovery, and preservation (United Nation's Office on Drug and Crime, 2009). Without clearly defined evidence guidelines and training that reflect the accepted industry standard, issues may arise from the mishandling of evidence (United Nation's Office on Drug and Crime, 2009).

First, improperly secured or preserved scenes can lead to activities that may modify, contaminate, or compromise the evidence or the scene. Second, an improperly secured or preserved scene can lead the destruction of evidence which could mislead the investigator, alter the results, or prevent the proper origin and cause determination. Third, personnel on scene may contaminate evidence if improper collection techniques are not established. All fire scene personnel must understand any potential evidence should be undisturbed if possible or if needed to be removed to preserve it prior to the arrival of the investigator, ensure that the evidence is photographed, location documented, and tagged before removal (Button, n.d.).

Additionally, poor evidence procedures can also lead to the *spoliation* of evidence. NFPA 921 defines spoliation as the "loss, destruction, or material alteration of an object or document that is evidence or potential evidence in a legal proceeding by one who has the responsibility for its preservation" (National Fire Protection Association, 2010, para. 3.3.162). Suppression and investigation personnel should understand the legal impact of fire scene activities as it relates to the spoliation of evidence throughout the entire incident. Whether the fire is believed to be incendiary or accidental in nature, the evidence needs to be maintained from the first arrival on scene, during the investigation process, and through any necessary legal proceedings that may take place related to the fire.

Systematic Procedures

In the early days of fire investigation, there was a lack of definitive technical publications and application of scientific principles for fire investigation practices until the introduction of NFPA 921 in 1992. Over the years, NFPA 921 has refined the practices regarding fire investigation that eventually became recognized as the "standard of care" for the fire investigation industry and courts (Lentini, 2007). There have been around 270 cases from the United States, 49 from Canada, one from Australia, and one from New Zealand that have reference NFPA 921 in court decisions (Hewitt & McKenna, 2015). However, for the significance of NFPA 921 to continue to impact fire investigation practices it must be correctly and consistently applied in the fire service.

The failure to apply systematic procedure and the scientific method as an investigation practice is evident in a legal case in Phoenix reported by The Arizona Republic (Casey, 2014). The article states that on May 7th, 2009 a fire was investigated at the home of Carl Vincent Ball Caples in Phoenix, AZ. Caples was subsequently accused of arson and arrested based on the investigation performed by the Phoenix Fire Department (PFD) investigators. The attorney for Mr. Caples contented that the PFD investigators determined the cause as arson based on a fire-accelerant detecting canine, even after the labs results were inconclusive. Additionally, it was noted that once the investigators thought it was arson during the investigation, they failed to consider any other possibility of the cause of the fire or investigate potential evidence to prove otherwise. The case was dismissed on the day of his trial based an investigation by the defense attorney's expert that determined the fire to be unintentional as the result of an electrical short in the attic. The County Attorney questioned the competence of the PFD investigators in a second case as well in which they've determined arson as the cause. The County Attorney stated that

they would not prosecute any of the investigations performed by the PFD investigators and are reviewing about 30 past and pending cases they worked. The investigators are being sued for violation of the civil-rights of Mr. Caples, and the City of Phoenix is being sued for failure to provide proper investigation training and allowing the investigators to use discredited techniques. Without clear investigation guidelines that reflect NFPA 921, the fire investigation process will continued to be relegated to an "art" instead of a science and be discredited in the courts. In addition, training needs to meet the standards set forth by the applicable NFPA publications.

Bias

There are aspects of the human condition that clearly impact the fire investigation process. One of the most significant is conceptual bias. In fact, it is not limited only to fire investigations, but all forensic investigation activities are subjected to the impact of conceptual bias based on the degree the investigation activities rely on human interpretation versus the application of a reliable scientific methodology (National Academy of Sciences, 2009). There are three central concerns related to conceptual bias that impact the investigation process are: (1) it affects all forensic examiners; (2) bias conclusions are reinforced by the investigator belief in the conclusions; (3) reluctance to acknowledge and take action to minimized the effects of bias in the industry in general (Bieber, 2012). The fact that the investigators are not aware of their bias makes the issues difficult to detect and remedy (Lentini, 2008).

There are various forms of conceptual bias that can enter into fire investigation which reinforces the need for a systematic implementation of the scientific method. The impact of bias is recognized by NFPA 921 that identifies two aspects of bias: expectation and confirmation bias. NFPA 921 defines expectation bias in which the investigator draws conclusions without having gathered or processed all relevant information and then conducts the investigation

according to that premature conclusion to support the original assumptions (National Fire Protection Association, 2010). Confirmation bias is defined as when an investigator develops a hypothesis and instead of trying to disprove the hypothesis according to the scientific method; looks for evidence that will confirm the original hypothesis which can lead to the failure of considering other hypothesis (National Fire Protection Association, 2010).

Education/ Training

With the publications of NFPA 1033 and 1001 as standards there are clearly defined requisite knowledge and requisite skill requirements which define the parameters of investigation practices for both suppression and investigation personnel (National Fire Protection Association, 2013). The requisite skills are the practical application of the requisite knowledge defined by NFPA standards that must go hand and glove for effective professional development. The requisite knowledge is the education component that can be understood as the "fundamental knowledge one must have to perform a specific task" (National Fire Protection Association, 2013, p. 3.3.10). While the requisite skills is the training component that can be understood as "the essential skills one must have to perform a specific task" (National Fire Protection Association, 2013, p. 3.3.11).

The fact is that most investigators begin their career with little or no formal investigation education or advanced math or science (Carpenter, Roby, & Torero, 2006). Carpenter, Roby, & Torero continue by stating that poor education leads to the development of the poor practice of skills as seen in the Phoenix legal cases. Education and training are the hinge pins for effective fire investigations and both are required. Conversely, lack of or improper education or training can create issues for the effectiveness of a preliminary and formal fire investigation.

Suppression and investigation personnel are required to have established a respective level of knowledge and skills. Professional fire investigators are required by NFPA 1033 to have a basic minimum knowledge and to remain current in this knowledge beyond a high school level (National Fire Protection Association, 2010). It is also the requirements for fire fighters to be proficient in investigation practices that are defined in NFPA 1001 as required for certification (National Fire Protection Association, 2012). Since there are no requirements for continuing education for fire fighters related to fire investigation, it's possible that the suppression personnel's only formal fire investigation education was during rookie school and may lack application of practical skills. While certainly, the level of qualifications for suppression personnel would be lower than the professional fire investigator, frequent education and training is needed to maintain a basic knowledge of fire investigation for all fire service personnel.

It may be believed that with the acceptance of NFPA 921 as a guide, and the NFPA 1033 and NFPA 1001 as standards, that a consensus on a fire investigation procedures have been reached in which a plateau of acceptable scientific practices can be used to accurately and consistently locate the area of origin and determine the cause of a fire. However, the ability to accurately and consistently locate the area of origin is still in question within the past decade. The following experiments illustrate the complexity of the investigation processes and the potential inconsistent application of investigation methodologies in general. The experiments reinforce the importance of ongoing formal education and training that assist in the effective and accurate implementation of the investigation methodologies.

In 2005 Steve Carman, Senior Special Agent for Alcohol, Tobacco, and Fire Arms (ATF), helped design and conduct an experiment to determine trained fire investigator's ability to the location of area of origin (Carman, 2008). There were two new burn cells that were nearly

identical that were allowed to burn for 7 minutes. Each cell was divided into four quadrants for the identification of the area of origin. Investigators were allowed to enter each burn cell and make observations. Only 3 (5.7%) out of the 53 correctly identified the area of origin in each of the burn cells. More significantly, it was three different investigators each time in the two different cells that correctly identified area of origin.

As recently as 2007 Carman conducted a similar experiment with 3 burn cells divided into four quadrants that had different points of origin and each allowed to burn for different lengths of times of 30, 70, and 180 seconds (Lentini, 2012). The cell that burned for 30 seconds had 70 investigators respond with 59 (84%) correctly identifying point of origin. The cell that burned for 70 seconds had 64 investigators respond with 44 (69%) correctly identifying point of origin. The cell that burned for 180 seconds had 53 investigators respond with 13 (25%) correctly identifying point of origin. While the results appear to be better than the 2005 experiment, the cell that burned for 180 seconds (just 3 minutes) had only a 25% success rate which is the same odds as a random guess. Lentini goes on to state that what these experiments shows is the essential unreliable methods used by some fire investigators to determine the area of origin. In summation, the lack of fire investigation education and training has been a chronic issue in all aspects of the fire service. During this literature review it was revealed the significant role of the suppression personnel in the fire investigation process. This influenced a significant inclusion of suppression personnel activities and procedures to be included in the SOG developed for fire investigation procedures at the SGFPD.

Procedures

This ARP was conducted to identify the roles and responsibilities in the application of a systematic fire investigation methodology based on the best practices and standards for the

development of fire investigation guidelines for the SGFPD. The action research utilized procedures that consisted of three major components for the development of a SGFPD fire investigation guideline: situational analysis, draft development, draft review.

Situational Analysis

The first step was to conduct a situational analysis of the current fire investigation procedures at the SGFPD. The intent of the situational analysis was to identify the factors that have contributed to the strengths and weaknesses of the current fire investigation practices.

The situational analysis consisted of three aspects:

- An analytical analysis of current best practices identified in national publications, potential issues and SOG's of other fire departments was conducted to establish a consensus benchmark as a reference in the development of fire investigation guidelines.
- An assessment of the potential stakeholders was conducted by a situational analysis survey (Appendix A) to determine the current knowledge, skills sets, investigation principles, methodologies and factors that are contributing to the current issues.
    - The stakeholders were selected as those who would be directly impacted and would by an integral part in the successful implementation of the new fire investigation guideline.
    - The stakeholders were grouped by rank (Table 1) to understand the respective roles and responsibilities during the investigation process.

RANK	POPULATION	RESPONSE	PERCENTAGE
Firefighters	49	18	36.73%
Lieutenants	36	20	55.55%
Captains	36	16	44.44%
Suppression Chiefs	12	7	58.33%
FPOs	4	4	100%

Table 1: Rank, Population, and Responses

  - The identical survey was administered to each rank for evaluation of each position of the current fire investigation process to assist in identifying factors/issues.
  - The survey was conducted using Survey Monkey and consisted of 10 questions.
  - The link to the survey was emailed to each stakeholder on August 11th, 2015 with an explanation of survey and an offer to answer any questions.
  - A follow-up email was sent out to all stakeholders August 17th, 2015 with a request to complete the survey if they have not and thanking them again for taking their time to assist with the research project.
  - A final follow-up email was sent on August 25th, 2015 asking all stakeholders who have not completed the survey to do so by the survey closing date of August 31st, 2015.

- A comparative analysis of the established consensus benchmark of best practices and the survey assessments were used to correlate the following:
  - Potential issues that may negatively impact the development and implementation of fire investigation guidelines for the SGFPD.
  - All potential resources that may assist in the development and implementation of fire investigation guidelines for the SGFPD.

- Factors that may have exacerbated the current issues?
- Factors that may help improve the current situation?

Draft Development

A SGFPD fire investigation guideline rough draft was developed based on the priorities and objectives identified during the situational analysis.

- On August 31st, 2015 a rough draft of the SGFPD investigation guidelines was developed based on the analytical evaluation of the current national guidelines, SOGs of other fire departments, and industry publications in conjunction with the factors and issues identified in the situational analysis of the current fire investigation practices at SGFPD.

Draft Review

- Review committee
  - The review committee consisted of the Chief of Fire Prevention, three FPO, one Training Officer, three Company Officers, two District Chiefs, and one Assistant Chief.
  - The training officer was identified as an additional stakeholder because of their role of the developing and conducting training at SGFPD.
  - These positions were identified as a representative from the identified stakeholder population that would generally reflect each shift to provide input.
  - The complete situational analysis of the current fire investigation practices and the rough draft guideline were reviewed focusing on the adaptive challenges, education and training requirements of implementing investigation guidelines.
  - Potential factors that would positively or negatively affect the implementation of the investigation guidelines draft was discussed and addressed.

It was decided that the SGFPD Investigation Guideline should be divided into at least three guidelines, one for the preliminary investigation (Appendix G) conducted by suppression personnel, with an addition guideline (Appendix H) was recommended to be developed for establishing 'call-out" criteria for an FPO and to identify responsibilities of the suppression personnel as they wait for the FPO to arrive on scene. The third and final product of this research is an SOG for the formal investigation (Appendix I) conducted by a FPO. It was also suggested by the training officer that a Fire Investigation Workbook (FIW) be developed in the future based on the knowledge and skills required for the roles and responsibilities of the various personnel to meet NFPA standards 1001 and 1033.

Limitations

This action research project had several limitations that may have influenced the results. The first limitation of this research was the researcher's own potential bias. The researcher is one of the four fire investigators at the SGFPD and has a direct interest in the development of the fire investigation guidelines. Although attempting to remain neutral, the researcher had preconceived ideas and expectations that may have influence aspects of the research.

The second limitation was the administration of the survey. The survey was intended to objectively analyze the current fire investigation practices by asking questions on the measurement of knowledge and skills of the respondents. However, it was a self-assessment based on the subjective estimation and beliefs of the respondent taking the survey. There was no objective testing to validate the accuracy of the response and may have skewed the results of the survey that could have affected the final outcome of the research project.

The third limitation was the 6 month time frame that restricted the ability to fully implement and evaluate a final draft of the fire investigation guidelines. The restricted time

frame prohibited the development and implementation of the FIW to ensure all SGFPD personnel have the necessary knowledge and skills needed prior to implementing a fire final investigation guideline as part of the objectives of this research. The completion of the FIW was one of the steps for establishing a final draft for the fire investigation guidelines and is addressed in the recommendations section of this APR.

Results

There were four research questions asked in the development of this ARP to create an SOG that utilizes the best practices recognized by the fire investigation industry for the SGFPD. The following results outline the most pertinent research data to provide a clear overall understanding of the results relating to the ARP research questions. Complete data results are found in the appendices section of this paper. The ARP survey was administered to each rank to identify specific aspects at each level of the current fire investigation practices. The appendices contain the comprehensive data results from the surveys that were submitted to the following ranks: fire fighter (Appendix B), lieutenant (Appendix C), captain (Appendix D), suppression chief officer (Appendix E), and FPO (Appendix F).

Best Practices

The first ARP research question asked to identify some of the best practices for conducting a fire investigation that should be incorporated into a fire department SOG. The analytical evaluation of current published national standards and guidelines, fire department SOG's, and professional fire investigation organizations were reflected in the best practices that are put forth in NFPA 921 and NFPA 1033. Both of these documents, NFPA 921 and NFPA 1033, set clear guidelines and standards for all aspects of the fire investigation process and training that should be incorporated into a comprehensive fire investigation SOG. This is not

only because of the effectiveness of the investigation procedures, but the legal impact based on the authority prescribed to the NFPA documents as the standard of care for the fire investigation industry. It's important to note, with the advancement of fire science the referenced NFPA publications are revised in a 3 or 5 year cycles to reflect updated objective science and legal considerations. It is imperative that the updated NFPA publications be included into the future revisions of fire department SOG as available.

The SGFPD guidelines will establish consistent procedures that define a systematic methodology or approach to the overall investigation process for suppression and investigation personnel. Specifically, the application of the scientific method will be utilized within this systematic methodology for the origin and cause determination to be effective and consistent. In addition, the fire investigation SOG will utilize the Unified Command concept under the NIMS to ensure that suppression and investigation personnel maintain coordination during the fire investigation process from the first arrival on scene to the conclusion of the investigation.

In an effort to better understand the perspectives of the stakeholders, one of the survey questions asked regarding their thoughts of the current fire investigation practices at the SGFPD.

FIRE FIGHTER

There were 44.44% (8) of the fire fighters who indicated that the current fire investigation practices were working just fine, with no problems. While 38.89% (7) of the fire fighters believed that we need to establish clear guidelines for fire investigations at the SGFPD. There were 16.67% (3) of the fire fighters who were not sure of their roles and responsibilities related to the fire investigation process at the SGFPD.

LIEUTENANT

There were 50% (10) of the lieutenants that believed the current fire investigation process is working just fine, with no problems. An additional 35% (7) of the lieutenants responded that we need to establish clear guidelines for fire investigations. Only 5% (1) stated that they were not sure of their roles and responsibilities related to the fire investigation process. Finally, 10% (2) of the lieutenants chose to reply with "other" but did not leave any additional information.

CAPTAIN

A majority of 73.33% (11) of the captains responded that the SGFPD needed to establish clear guidelines for fire investigations. There were 13.33% (2) of the captains that replied there were no problems and the current investigation practices are working just fine. Another 13.33% (2) of the captains responded they were unsure of their roles and responsibilities related to the fire investigation process.

SUPPRESSION CHIEF OFFICER

A significant majority of 71.43% (5) of the suppression chiefs also responded that there is a need to establish clear fire investigation guidelines, while only 14.29% (1) of the suppression chiefs believe that the current investigation practices are working just fine with no problems. Another 14.29% (1) responded with "other" but did not leave any written response.

FPO

A 100% (3) of the FPOs who responded believes that we need to establish clear guidelines for fire investigation at the SGFPD. One of the FPOs skipped this question.

Roles and Responsibilities

The second ARP research question sought to identify the roles and responsibilities of the SGFPD personnel during a fire investigation. It was determined that there are two distinct

aspects of the investigation process addressed by the suppression personnel or the FPO. These were identified as the preliminary investigation and formal investigation. Both the preliminary (suppression) and the formal investigation (FPO) will share a similar structure related to the following framework of the investigation process; observations on arrival, scene safety/security, general observation, interviews, evidence collection/protection, origin determination, cause determination, and concluding the scene. The SGFPD guidelines shall consist of outlining two systematic methodologies for the establishing the responsibilities of suppression personnel and FPO to reflect their respective roles and responsibilities.

The preliminary investigation will begin upon the arrival on scene with the suppression crews making observations of the scene to include: the fire conditions and locations, people and vehicles in the area, any conditions that impede suppression activities, indications of forced entry, and the protection of physical evidence that may present indication of the origin or cause of the fire. The securing of the scene to restrict unauthorized personnel or civilians entry of the area to maintain scene integrity and minimized the potential safety issues. Safety of authorized personnel must be considered and proper protection measures will be implemented. Every effort should be made to minimize the impact of fire suppression and overhaul activities that could destroy potential evidence or materials that could aide in the investigation process. Any evidence will be identified and secured until properly trained personnel can collect the evidence. After the initial knock down of the fire and when it is safe to do so, the IC shall begin an investigation for the origin and cause of the fire.

All witnesses should be identified and personal information collected to include a statement related to their eyewitness of the events. The IC will ensure that any non-essential personnel exit the fire area to minimized potential damage to evidence and allow the IC to begin

the origin and cause investigation. The IC will identify the area of origin and the cause of the fire if able to do so within the scope of their training and skill. If the IC is unable to determine the origin and cause of the fire, or there are indications of incendiary activities, the IC should begin the call out procedures for a FPO. Once the call for a FPO is made, the IC should ensure that the scene is cleared of non-essential-personnel and all non-essential suppression activities are halted to minimize further disturbance of the scene until the arrival of the FPO.

When the FPO arrives on scene, the IC will brief the FPO with all the information collected during the preliminary investigation and assist in the formal investigation as needed. Any decisions related to the investigation such as entry or removal of debris from the fire scene will be cleared by the FPO. The IC will assist the FPO with manpower, equipment and lighting as requested by the FPO until the conclusion of the formal investigation. After the formal investigation is completed, the IC will continue with suppression activities.

The formal investigation will begin upon the arrival of the FPO on scene. The FPO should take note of the weather conditions, vehicles, and people on scene upon arrival. Contact with the IC will be established and all preliminary investigation information will be collected and first-in personnel will be identified. Requests for equipment, personnel, and lighting will be made by the FPO to the IC as needed. Any concerns the FPO may have for safety or scene security will be addressed to the IC who will assist in their remedy. While the order of the FPO investigation activities may vary based on the specific conditions of the fire scene, the FPO will utilized a consistent framework to ensure a methodical and systematic approach takes place in the processing of the scene.

The FPOs' responsibilities will include interviewing the witnesses and collecting additional information from the first-in crews, property owners and direct witnesses. The FPO

will begin with the photographs and examination of the surrounding area and complete exterior of the fire building to include all utilities and equipment. The FPO will begin the interior investigation working from the least burned area to the most burned area if possible. Interior photographs will be taken in a systematic method with any evidence extensively photographed. The FPO can choose to move either clockwise or counter-clockwise during the processing of the interior, but should continue to move in the direction chosen consistently.

The room of origin will be determined using the systematic application of the scientific method. Once the room of origin is determined, the FPO should now determine the area of origin and eventually the point of origin once again using the systematic application of the scientific method. The point of origin is the place where the fire first started. Once the FPO determines the point of origin, using the systematic application of the scientific method the FPO must now determine the cause of the fire. The cause of the fire is where the fuel and the ignition source first came in contact that ignited the fire. During the origin and cause determination, the FPO will photograph any physical evidence that will support the use of the scientific method in the origin and cause determination, ensuring evidence is properly secured and collected. If the FPO is unable to determine the origin and the cause of the fire, additional resources may be required to complete the investigation. Once the investigation is complete, the scene can be turned over to the IC to ensure all suppression activities are completed.

Issues

The third ARP research question attempted to identify some of the current issues experienced by suppression personnel and the FPO during fire scene investigations. While limited in scope, the results provide an overall picture of current issues which was the focus of

the survey. Conversely, collected data also reveals positive aspects of our current fire investigation process as well.

There were four survey questions asked that focused on identifying current issues of the fire investigation process at SGFPD; (1) knowledge of the steps of the overall fire investigation process and the relation with suppression activities, (2) ability to define basic investigation terms and concepts, (3) confidence level of personnel to effectively conduct a fire investigation, and (4) perceived fire investigation issues by the personnel of each rank. The results are separated by rank to allow for a more effective analysis of the data collected and presented as four questions to better understand each issue.

FIRE FIGHTER

The first survey question asked fire fighters about their knowledge of the steps to conduct a fire investigation and its relationship with suppression activities. There were 33.33% (6) of the fire fighters who responded that they had no idea of the steps, while an equal amount of 33.33% (6) said they have a vague idea of the steps. An additional 22.22% (4) of fire fighters stated that they are aware of the steps but do not know how to apply the steps in a fire investigation. Only 11.11% (2) of the fire fighters stated that they know the steps and are able to apply them.

The second survey question presented 18 terms and concepts related to the fire investigation process to the fire fighters as show below in table 2. The fire fighters were asked if they could verbally define the terms and concepts. This was done in order to better understand their general investigation knowledge base.

Answer Choices	Responses
Spoliation	**20.00% 3**
Role Bias	**20.00% 3**
Expectation Bias	**13.33% 2**

Confirmation Bias	**26.67% 4**
Incendiary	**86.67% 13**
Ignition Source	**86.67% 13**
Point of Origin	**93.33% 14**
Point of Ignition	**86.67% 13**
Hypothesis	**73.33% 11**
Combustible	**86.67% 13**
Entrainment	**13.33% 2**
Arching through char	**40.00% 6**
"Drop Down"	**40.00% 6**
Fire Scene Reconstruction	**53.33% 8**
Fuel-controlled Fire	**60.00% 9**
Ventilation-controlled Fire	**66.67% 10**
Negative Corpus	**20.00% 3**
Scientific Method	**46.67% 7**
Total Respondents: 15	

Table 2: Ability to define terms and concepts by fire fighter

The third survey question inquired about the level of the fire fighters' confidence of being able to apply investigation practices and principles to determine origin and cause. Only 5.56% (1) of fire fighters stated that they had excellent confidence in their abilities, while 11.11% (2) responded that they had a good level of confidence. There were 33.33% (6) who felt that they had a fair level of confidence; while 38.89% (7) and 11.11% (2) responded that they had a low or slim to none chance, respectively, of being able to successfully apply investigation practices and principles.

Finally, the fourth survey question presented to fire fighters addressed the perceived issues relating to the current investigation process at the SGFPD (Appendix B). Overall 64.71%

(11) of the fire fighters who responded stated that the lack of investigation education and training for suppression personnel is the number one current issue. An additional 47.06% (8) of the fire fighters believed that the lack of practical experience to apply their knowledge is an issue as well. Finally, 29.41% (5) of fire fighters responded that a lack of coordination between suppression and the FPO investigators is a concern.

LIEUTENANT

The first survey question asked lieutenants about their knowledge of the steps to conduct a fire investigation and its relationship with suppression activities. Overall, 15% (3) of the responding lieutenants stated they have no idea of the steps for fire investigation, while 45% (9) responded that they had a vague idea of the steps, and another 15% (3) stated that they are familiar with the steps but do not really know how to apply them in an investigation. Only 25% (5) of the lieutenants that responded they know the steps to conduct a fire investigation and are able to use them on the fire scene.

The second survey question presented 18 terms and concepts related to the fire investigation process that lieutenants were asked if they could verbally define as show below in table 3. This was done in order to better understand their general investigation knowledge base.

Answer Choices	Responses
Spoliation	15.00% 3
Role Bias	10.00% 2
Expectation Bias	5.00% 1
Confirmation Bias	5.00% 1
Incendiary	70.00% 14
Ignition Source	90.00% 18
Point of Origin	100.00% 20
Point of Ignition	80.00% 16

Hypothesis	75.00% 15
Combustible	100.00% 20
Entrainment	20.00% 4
Arching through char	30.00% 6
"Drop Down"	35.00% 7
Fire Scene Reconstruction	30.00% 6
Fuel-controlled Fire	75.00% 15
Ventilation-controlled Fire	75.00% 15
Negative Corpus	10.00% 2
Scientific Method	30.00% 6
Total Respondents: 20	

Table 3: Ability to define terms and concepts by lieutenants

The third survey question inquired about the level of the lieutenants' confidence of being able to apply investigation practices and principles to determine origin and cause. There was 0% (0) of the lieutenants who responded with a confidence level that was excellent. Another 20% (4) of the lieutenants stated that they have a good level of confidence in their abilities. The majority responded that they had a fair level of confidence with 65% (13), while only 15% (3) believed they had a low level of confidence in their ability. Finally, 0% (0) of the lieutenants responded that they had slim to none chance of being able to successfully apply investigation practices and principles.

The fourth survey question presented to lieutenants addressed the perceived issues relating to the current investigation procedures. There were two responses that showed a majority. First, 52.63% (10) of lieutenants believe that the lack of investigation education and training for suppression personnel is a current issue. The same percentage of 52.63% (10) believed that the lack of practical experience to apply their knowledge is an issue. Finally the

third highest was 36.84% (7) of the lieutenants responded that a lack of coordination between suppression and the FPO investigators is also an issue. Complete results can be found in Appendix C.

CAPTAIN

The first survey question asked captains about their knowledge of the steps to conduct a fire investigation and its relationship with suppression activities. While only 6.67% (1) of the captains responded that they don't know the steps for conducting a fire investigation, 40% (6) stated that they are vaguely familiar with the steps. An equal amount of 40% (6) of the captains responded that they know the steps for conducting a fire investigation but really do not know how to actually apply them to a fire investigation. Finally, 13.33% (2) of the captains responded they know the steps of the fire investigation process and use it during fire scenes.

The second survey question presented 18 terms and concepts related to the fire investigation process that the captains were asked if they could verbally define as show below in table 4. This was done in order to better understand their investigation knowledge base.

Answer Choices	Responses
Spoliation	33.33% 5
Role Bias	6.67% 1
Expectation Bias	6.67% 1
Confirmation Bias	0.00% 0
Incendiary	93.33% 14
Ignition Source	100.00% 15
Point of Origin	100.00% 15
Point of Ignition	86.67% 13
Hypothesis	66.67% 10
Combustible	86.67% 13

Entrainment	13.33% 2
Arching through char	13.33% 2
"Drop Down"	26.67% 4
Fire Scene Reconstruction	60.00% 9
Fuel-controlled Fire	46.67% 7
Ventilation-controlled Fire	53.33% 8
Negative Corpus	0.00% 0
Scientific Method	20.00% 3
Total Respondents: 15	

Table 4: Ability to define terms and concepts by captains

The third survey question inquired about the captains' level of confidence of applying investigation practices and principles to determine origin and cause. There were 13.33% (2) captains who responded that they had an excellent level of confidence in their ability. But a significant 46.67% (7) of the captains responded they had a good level of confidence in their abilities. Additionally, 33.33% (5) of the captains stated that they have fair level of confidence in their abilities for cause determination and only 6.67% (1) of the captains responded that their level of confidence in their ability was low. None (0%) of the captains responded with a confidence level of a slim to none chance of their ability to determine origin and cause of a fire.

Finally, the fourth survey question presented to captains addressed their perceived issues relating to the investigation process at the SGFPD. A significant amount of 86.67% (13) of the captains believes that the lack of investigation education and training for suppression personnel is a current issue. An additional 53.33% (8) of the captains responded that a lack of coordination between suppression and the FPO investigators as a problem. There were 33.33% (5) of the captains that responded that they needed more practical experience to apply what they know,

with the same amount of 33.33% (5) also responding that the breakdown in the chain of command presented an issues. Finally, 6.67% (1) of the captains chose each of the following three issues: lack of education and training for FPO, lack of tools to perform proper fire investigation, or "other" as their response. Once again the "other" did not leave any written response.

SUPPRESSION CHIEF OFFICER

The first survey question asked suppression chief officers concerning their knowledge of the steps to conduct a fire investigation and its relationship with suppression activities. There were 42.86% (3) of the suppression chief officers who responded that they are vaguely familiar with the steps. With an additional 28.57% (2) of the suppression chief officers responding that they don't know the steps for conducting a fire investigation at all. There was 0% (0) of the suppression chief officers who responded knowing the steps for conducting a fire investigation but not knowing how to actually apply them to a fire investigation. Only 14.29% (1) of the suppression chief officer stated that they know the steps of conduction a fire investigation and use it at fire scenes. The last 14.29% (1) of suppression chief officers responded by selecting "other" but did not leave a written response.

The second survey question presented 18 terms and concepts related to the fire investigation process to the suppression chief officer as show below in table in5. Again, this was to better understand their general investigation knowledge base.

Answer Choices	Responses
Spoliation	0.00% 0
Role Bias	28.57% 2
Expectation Bias	28.57% 2

Confirmation Bias	28.57% 2
Incendiary	71.43% 5
Ignition Source	100.00% 7
Point of Origin	100.00% 7
Point of Ignition	71.43% 5
Hypothesis	57.14% 4
Combustible	71.43% 5
Entrainment	28.57% 2
Arching through char	14.29% 1
"Drop Down"	42.86% 3
Fire Scene Reconstruction	28.57% 2
Fuel-controlled Fire	28.57% 2
Ventilation-controlled Fire	28.57% 2
Negative Corpus	0.00% 0
Scientific Method	42.86% 3
Total Respondents: 7	

Table 5: Ability to define terms and concepts by suppression chief officers

The third survey question inquired about the suppression chief officers' level of confidence in applying investigation practices and principles to determine origin and cause. None (0%) of the suppression chief officers responded with a confidence level of a slim to none chance in their ability to determine origin and cause of a fire. Again, none (0%) of the suppression chief officers responded that their confidence in their ability was low. There was a majority of 57.14% (4) of the suppression chief officers who stated that they have a fair level of confidence in their abilities for origin and cause determination. While 28.57% (2) responded that they had a good level of confidence and 14.29% (1) responded they had an excellent level of confidence in their ability to determine the origin and cause of a fire.

Finally, the fourth survey question presented to the suppression chief officers addressed their perceived issues relating to the current investigation process. A majority of 71.43% (5) responded that the biggest issue is the coordination of fire investigation activities between suppression and fire investigators. A major concern of 57.14% (4) of the suppression chief officers is the lack of investigation education and training for suppression personnel. Finally, 28.57 % (2) of the suppression chief officers responded the lack of investigation education and training for fire investigators is a current issue. Complete results can be found in Appendix E.

FPO

The first survey question asked FPOs about their knowledge of the steps to conduct a fire investigation and its relationship with suppression activities. A 100% (4) of the FPOs responded that they know the step of the fire investigation process and use it during the fire scene investigation.

The second survey question presented 18 terms and concepts related to the fire investigation process to the FPOs and asked if they are able to verbally define them as show below in table 6. This was done in order to better understand their general investigation knowledge base.

Answer Choices	Responses
Spoliation	100.00% 3
Role Bias	66.67% 2
Expectation Bias	66.67% 2
Confirmation Bias	66.67% 2
Incendiary	100.00% 3
Ignition Source	100.00% 3
Point of Origin	100.00% 3
Point of Ignition	100.00% 3

Hypothesis	100.00% 3
Combustible	100.00% 3
Entrainment	100.00% 3
Arching through char	66.67% 2
"Drop Down"	100.00% 3
Fire Scene Reconstruction	100.00% 3
Fuel-controlled Fire	100.00% 3
Ventilation-controlled Fire	100.00% 3
Negative Corpus	66.67% 2
Scientific Method	100.00% 3
Total Respondents: 3	

Table 6: Ability to define terms and concepts by FPOs

The third survey question inquired about the FPOs' level of confidence in applying investigation practices and principles to determine origin and cause. All 100% (4) of the FPOs responded that they had a good level of confidence in their ability to apply the fire investigation practices and principles to an investigation.

Finally, the fourth survey question presented to FPOs addressed their perceived issues relating to the investigation process at the SGFPD. There were three responses that showed a majority. First, 100% (4) of the FPOs responded that the lack of coordination between suppression and the FPO is a current issue. While 75% (3) of the FPOs responded that both the lack of investigation education and training for suppression personnel, and the lack of proper tools needed to perform a proper fire investigation is a current issue. An equal amount of 50% (2) responded that both, the need of more practical experience to apply their knowledge and skills, and the breakdown of the chain of command during a fire investigation are also current issues. Complete results can be found in Appendix F

Factors

The fourth ARP research question sought to identify the factors that contributed to the current issues experienced by suppression personnel and the FPOs during fire scene investigations. The data collected for this was obtained through several survey questions administered according to rank in an effort to identify issues experienced at each aspects of the fire investigation process. While all potential factors relating to the issues concerning the fire investigation process cannot be clearly defined in this research project, the fourth research question attempts to identify the broad factors that contribute to the current issues. Conversely, data will also reveal positive factors that influence our current fire investigation process.

There were three survey questions administered that focused on identifying factors that may contribute to the current issues experience during fire investigation process at SGFPD; (1) attendance of fire investigation training since rookie school, (2) number years since the last formal fire investigation class or training was attended, (3) familiarity level of leading national publications and industry standards related to fire investigation practices and training.

FIRE FIGHTER

The first survey question asked fire fighters if they had taken any formal fire investigation training or classes since they completed rookie school. A 61.11% (11) majority responded that they had not attended any formal investigation training since completion of rookie school. While the final 38.89% (7) responded that they have attended formal investigation training since rookie school.

The second survey question asked the fire fighters how long ago was the last formal investigation training or class they attended. There were 37.50% (6) of the fire fighters who responded that it was one year or less since their last class or training. While an additional

31.25% (5) of fire fighters responded that it had been 6 years since their last training or class they had attended, an additional 12.5% (2) responded that it had been 7 years. There were 6.25% (1) of fire fighters who each responded the last training or class attended as 2 years ago, 4 years ago, or 8 years ago.

The third survey question sought to identify the fire fighters' familiarity with publications related to fire investigation. In order to present the data in a more effective manner, the data is included in Table 7 below.

	Not familiar at all	Somewhat familiar, but really can't apply it effectively	Good working knowledge	Excellent working knowledge	Total
NFPA 921 Guide for Fire & Explosion Investigation	**55.56% 10**	**22.22% 4**	**16.67% 3**	**5.56% 1**	**18**
NFPA 1033 Standard for Professional Qualifications for Fire Investigator	**43.75% 7**	**37.50% 6**	**18.75% 3**	**0.00% 0**	**16**
NFPA 1001 Standard for Fire Fighter Professional Qualifications	**11.76% 2**	**29.41% 5**	**41.18% 7**	**17.65% 3**	**17**
IFSTA Introduction to Fire Origin and Cause	**33.33% 6**	**33.33% 6**	**33.33% 6**	**0.00% 0**	**18**
Fire Officer Principles and Practice	**16.67% 3**	**38.89% 7**	**38.89% 7**	**5.56% 1**	**18**

Table 7: Familiarity of fire fighters with the publications related to fire investigation

LIEUTENANT

The first survey question asked lieutenants if they had taken any formal fire investigation training or classes since they completed rookie school. Equal amounts of 45% (9) responded yes they have taken formal fire investigation training or classes since rookie school, while the same amount of 45% (9) responded that they had not. An additional 10% (2) lieutenants stated other but did not leave any written feedback as to why or what they intended to say.

The second survey question asked lieutenants how long ago was the last formal investigation training or class they attended. Four of the response choices shared the same result of 17.65% (3) of the lieutenants indicating that the last formal training or class attended was 1

year or less, 3 years, 5 years, and 11 plus years ago. There were 11.76% (2) lieutenants that indicated it has been 4 years since their last formal training or class on fire investigation. An additional 5.88% (1) of the lieutenants each indicated 6 years, 9 years and finally 10 years since their last investigation training or class.

The third survey question sought to identify the lieutenants' familiarity with the following publications related to fire investigation. In order to present the data in a more effective manner, the data is included in Table 8.

	Not familiar at all	Somewhat familiar, but really can't apply it effectively	Good working knowledge	Excellent working knowledge	Total	Weighted Average
NFPA 921 Guide for Fire & Explosion Investigation	**45.00% 9**	**40.00% 8**	**15.00% 3**	**0.00% 0**	**20**	**2.25**
NFPA 1033 Standard for Professional Qualifications for Fire Investigator	**35.00% 7**	**40.00% 8**	**25.00% 5**	**0.00% 0**	**20**	**2.55**
NFPA 1001 Standard for Fire Fighter Professional Qualifications	**20.00% 4**	**5.00% 1**	**65.00% 13**	**10.00% 2**	**20**	**3.45**
IFSTA Introduction to Fire Origin and Cause	**25.00% 5**	**35.00% 7**	**40.00% 8**	**0.00% 0**	**20**	**2.90**
Fire Officer Principles and Practice	**15.00% 3**	**10.00% 2**	**65.00% 13**	**10.00% 2**	**20**	**3.55**

Table 8: Familiarity of lieutenants with the publications related to fire investigation

CAPTAIN

Again, the first survey question asked the captains to identify factors that may have contributed to current issues of the fire investigation process. The captains were asked if they had taken any formal fire investigation training since they completed rookie school. A majority of 56.25% (9) responded that they have attended some formal investigation training since completion of rookie school. While the final 37.5% (6) responded that they have not attended formal investigation training since rookie school. There was 6.25% (1) who responded other but did not leave any written explanation.

The second research question asked the captains how long ago was the last formal investigation training or class they attended. There were 25% (3) of the captains who responded that it was 10 years ago since their last formal training or class on fire investigation practices. The second highest results were both, 1 year or less, and 11 years plus respectively which received 16.67% (2) responses each. There were five responses that each received 8.33% (1) of the captains stating they had last taken training or classes: 2 years ago, 3 years ago, 5 years ago, 6 years ago, and finally 8 years ago.

The third survey question sought to identify the captains' familiarity with publications related to fire investigation. In order to present the data in a more effective manner, the data is included in Table 9.

	Not familiar at all	**Somewhat familiar, but really can't apply it effectively**	**Good working knowledge**	**Excellent working knowledge**	**Total**	**Weighted Average**
NFPA 921 Guide for Fire & Explosion Investigation	53.33% 8	46.67% 7	0.00% 0	0.00% 0	15	1.93
NFPA 1033 Standard for Professional Qualifications for Fire Investigator	53.33% 8	40.00% 6	6.67% 1	0.00% 0	15	2.00
NFPA 1001 Standard for Fire Fighter Professional Qualifications	7.14% 1	28.57% 4	57.14% 8	7.14% 1	14	3.57
IFSTA Introduction to Fire Origin and Cause	26.67% 4	20.00% 3	53.33% 8	0.00% 0	15	3.00
Fire Officer Principles and Practice	6.67% 1	33.33% 5	46.67% 7	13.33% 2	15	3.60

Table 9: Familiarity of captains with the publications related to fire investigation

SUPPRESSION CHIEF OFFICER

The first survey question asked suppression chief officers if they had taken any formal fire investigation training since they completed rookie school. A significant response of 57.14% (4) of the suppression chiefs stated that they had not taken any formal fire investigation classes or training since rookie school. While the remaining 42.86% (3) responded that they have received some formal fire investigation training since rookie school.

The second research question asked the suppression chief officers how long ago was the last formal investigation training or class they attended. A significant majority of 57.14% (4) of the suppression chief officers responded that they had not attended a formal fire investigation training or class in 11 plus years. An additional 28.57% (2) suppression chief responded that it had been 5 years ago, while 14.29% (1) responded that it has been 1 year or less since their last class or formal training related to fire investigation.

The third survey question sought to identify the suppression chiefs' familiarity with the following publications related to fire investigation. In order to present the data in a more effective manner, the data is included in Table 10.

	Not familiar at all	Somewhat familiar, but really can't apply it effectively	Good working knowledge	Excellent working knowledge	Total	Weighted Average
NFPA 921 Guide for Fire & Explosion Investigation	85.71% 6	14.29% 1	0.00% 0	0.00% 0	7	1.29
NFPA 1033 Standard for Professional Qualifications for Fire Investigator	57.14% 4	42.86% 3	0.00% 0	0.00% 0	7	1.86
NFPA 1001 Standard for Fire Fighter Professional Qualifications	14.29% 1	14.29% 1	42.86% 3	28.57% 2	7	3.71
IFSTA Introduction to Fire Origin and Cause	28.57% 2	28.57% 2	42.86% 3	0.00% 0	7	2.86
Fire Officer Principles and Practice	0.00% 0	14.29% 1	57.14% 4	28.57% 2	7	4.14

Table 10: Familiarity of suppression chiefs with the publications related to fire investigation

FPO

The first survey question asked the FPOs if they had taken any formal fire investigation training since they completed rookie school. A 100% (4) of the FPOs responded they have attended formal investigation training since rookie school.

The second research question asked the FPOs how long ago was the last formal investigation training they attended. A majority of 75% (3) of the FPOs responded that it was

one year or less since their last class or training. The last 25% (1) of FPOs responded that it had been 11years since their last formal fire investigation training or class.

The third survey question sought to identify the FPOs' familiarity with publications related to fire investigation. In order to present the data in a more effective manner, the data is included in Table 11.

	Not familiar at all	Somewhat familiar, but really can't apply it effectively	Good working knowledge	Excellent working knowledge	Total	Weighted Average
NFPA 921 Guide for Fire & Explosion Investigation	0.00% 0	0.00% 0	100.00% 4	0.00% 0	4	4.00
NFPA 1033 Standard for Professional Qualifications for Fire Investigator	0.00% 0	0.00% 0	100.00% 4	0.00% 0	4	4.00
NFPA 1001 Standard for Fire Fighter Professional Qualifications	0.00% 0	0.00% 0	100.00% 4	0.00% 0	4	4.00
IFSTA Introduction to Fire Origin and Cause	0.00% 0	0.00% 0	100.00% 4	0.00% 0	4	4.00
Fire Officer Principles and Practice	0.00% 0	50.00% 2	50.00% 2	0.00% 0	4	3.50

Table 11: Familiarity of FPOs with the publications related to fire investigation

The analysis of the data obtained through the research was used to develop SOG for fire investigation at the SGFPD. It was determined that three SOGs were required to effectively establish a systematic fire investigation program to address the preliminary investigation, fire investigator call-out, and the formal fire investigation. The first SOG developed was the *Preliminary Fire Investigation* (Appendix G) guideline to provide guidance to the IC during fire investigations. It was determined as well that an SOG to provide guidance to the IC when determining the need to call-out an investigator. The *Fire Investigator Call-out* (Appendix H) SOG will also provide direction for suppression personnel in preparing the fire scene for the arrival of the FPO. The final SOG developed was the formal investigation guidelines for the FPOs. The *Formal Fire Investigation* (Appendix I) guideline provides a systematic approach for the FPOs to conduct an effective and successful fire investigation.

Discussion

During the advent of the professional fire investigator, the application of knowledge and skills was questionable at best. However, with the release of NFPA 921 in 1992, which has become the recognized "standard of care" for both the fire investigation industry and courts (Lentini, 2007), a turning point for the fire investigation industry has taken place in both public and private applications. However, the acceptance of NFPA 921 as the "standard of care" and the implementation of NFPA 921 in practice, are two distinct pieces of the puzzle that have yet to be put together at the SGFPD. For these two pieces of the puzzle to be put together, both suppression and fire investigation personnel must have and maintain a good working knowledge of the concepts of NFPA 921. This must be done in conjunction with the development of their skills that are applicable to their roles and responsibilities.

The literature review supports the fact that a well-developed SOG integrated with a training program can provide a systematic framework in which knowledge and skills can be developed for effective fire investigations. The factors and issues affecting the fire investigation process at the SGFPD are not new to the fire service or the fire investigation industry. The literature review indicates throughout the history of fire investigation, the need to establish and maintain a scientific knowledge of fire science and the ability to apply it consistently and effectively has been a great challenge. Fortunately, the development of an investigation SOG can help to establish a systematic framework for the scope of the fire investigation (National Fire Protection Association, 2010, para. 17.2.4) process for both suppression and investigation personnel at the SGFPD. There were three aspects at the heart of this research that require a deeper reflection: requisite knowledge, requisite skills and the quality of training that were found to be major factors contributing to the SGFPD investigation issues.

In the course of this research it has become clear that the requisite knowledge and the requisite skills clearly defined by NFPA 1001 for fire fighters and NFPA 1033 for professional fire investigators are critical aspects that are lacking at the SGFPD. The fact is that most investigators begin their career with little or no formal investigation education or advanced math or science (Carpenter, Roby, & Torero, 2006). While the professional investigators requisite knowledge requirements are greater than suppression personnel, the same principles of NFPA 921 should be applied for determining origin and cause during all aspects of the fire investigation and will be judged accordingly. It must be remembered that NFPA 921 is the lens in which requirements of NFPA 1001 and NFPA 1033 are filtered. There have been around 270 cases from the United States, 49 from Canada, one from Australia, and one from New Zealand that have reference NFPA 921 in court decisions (Hewitt & McKenna, 2015). In the light of these cases, all aspects of the fire investigation process, from the preliminary to the formal investigation, will be scrutinized. Unfortunately at the SGFPD, the following research data finds that many suppression personnel are lacking a basic knowledge of NFPA 921.

The lack of knowledge of NFPA 921 for suppression personnel at the SGFPD may be the result of the belief that suppression personnel are not professional fire investigators, and therefor do not need advanced knowledge and skills. However, the general scope of NFPA 921 is to provide guidelines for the systematic investigation and analysis of fire and explosions (National Fire Protection Association, 2010) in determining origin and cause. The knowledge of NFPA 921 is applicable to suppression personnel based on the fact that the requirements of fire fighters to master the knowledge and skills related to basic fire investigation are required to obtain both Fire Fighter I and Fire Fighter II certifications (National Fire Protection Association, 2012) as defined in NFPA 1001.

It is interesting to note, that in spite of the lack of knowledge of NFPA 921, there are still a significant amount of suppression personnel who maintain a fair to excellent level of confidence in their ability to determine origin and cause. There were 50% (9) of the fire fighters, 85% (17) of the lieutenants, 93.33% (14) of the captains, and a 100% of the suppression chief officers who responded with a confidence level of fair to excellent in their ability to determine origin and cause during a fire investigation. It is contrary that a significant percentage of suppression personnel from fire fighter to chief officer who admittedly lack basic familiarity of NFPA 921 also profess significant levels of confidence in their investigation abilities. It is safe to assume that the knowledge and skills utilized are based on anecdotal experience and interpretations which have been assumed to be true (Faigman & Saks, 2008) and not based on the accepted "standards of care" for fire investigation that has plagued the fire investigation industry since its earliest inception.

The second aspect of developing a working knowledge of NFPA 921 is the ability of suppression personnel to apply that knowledge through practical application. The practical application of knowledge is defined in both NFPA 1001 and NFPA 1033 as the required requisite skills. The requisite skills can be understood as "the essential skills one must have to perform a specific task" (National Fire Protection Association, 2013, para. 3.3.11). In addition, the ongoing revisions of NFPA 921 would require an annual training program to take in account the updates. Annual training will improve the effectiveness of fire investigations and ensure that the SGFPD's investigation practices are meeting the current "standard of care". The simple fact is fire investigation training is not taking place at the SGFPD. The absence of training is leaving the majority of suppression personnel woefully ill prepared to conduct or assist in determining

origin and cause during a fire investigation. This is supported by the data collected during this research project and reinforced by the literature review.

The lack of training at the SGFPD is evident when 61.11% (11) of fire fighters have not taken formal fire investigation training since rookie school. It may be that it hasn't been very long since graduating from rookie school for some fire fighters. However, there were 45% (9) of lieutenants, 37.50% (6) of captains, and 57.14% (4) of suppression chief officers who have not taken any formal investigation classes since graduating from rookie school. Whether they're a chief officer or a fire fighter, each has specific roles and responsibilities during a fire investigation that require proficiency of skills based on the acquired knowledge of NFPA 921. If they are not receiving effective training, we can expect the current fire investigation issues will continue at the SGFPD.

Effective training would assist personnel in developing the ability to apply the basic tenet of fire investigation practices, the scientific method. The purpose of the scientific method is to form a working hypothesis by using a systematic methodology to evaluate and eliminate theories as to the circumstances and conditions that results in a final determination of the origin and cause of the fire (DeHaan & Icove, 2012). The knowledge and ability to practically apply the scientific method within an established systematic framework is foundational for effective fire investigation (National Fire Protection Association, 2010, para. 17.2.4) that should be reflected in an investigation SOG. It would be folly to conclude that an accurate determination of origin and cause can be determined lacking the knowledge and ability to apply the scientific method within a systematic methodology.

When considering the FPO data, it would seem they are meeting their knowledge and skill requirements, but feel that an SOG is needed to provide coordination between suppression

personnel and investigators during fire investigation. There were a 100% (3) of the FPOs who responded that clear guidelines are needed for fire investigations.

While professional fire investigators require continuing education, the question of the quality and effectiveness of that training should be considered. This is evident when considering the results of a 2009 legal case against the Phoenix Fire Department and the fire investigators reported by The Arizona Republic (Casey, 2014). The loss of the case by the City of Phoenix was based on the incompetency of the Phoenix investigators and the lack of training that allowed the use of discredited techniques that reflect a failure of the principles and practices set forth in NFPA 921. Additionally, experiments conducted by Steve Carman, Senior Special Agent for Alcohol, Tobacco, and Fire Arms (ATF), to determine a trained fire investigator's ability to the locate the area of origin (Carman, 2008) resulted in a 25% success rate when cells were allowed to burn for three minutes. This is the same success rate as a random guess!

Recommendations

There were three recommendations based on the results of this ARP related to the implementation and evaluation of a final version of a new SGFPD fire investigation guideline: training, implementation, and evaluation. These recommendations were made as a result of the time limitation discussed in the procedures section of this paper for the full development of SGFPD fire investigation guidelines.

Training

- The training component development should be based on the identified skills and educational requirements for the implementation of the investigation guidelines.

- The development of a training process similar to the JPR requirements in NFPA 1033 and NFPA 1001 that required mastery of the knowledge and skill aspects per the draft SGFPD investigation guidelines.
- FIW for each rank needs to be developed based on the recommended JPR as derived from the fire investigation guidelines.
- The FIW should involve written and practical application tests.
- FIW will be updated annually by January 31st.

Implementation

- The implementation of the fire investigation guidelines will take place after successful completion of assigned FIW to ensure the knowledge and skills are acquired for the effective implementation of the SGFPD investigation guidelines.
- The FIW training should take place on duty and begin each February 1st of each year.
- Training should be done in conjunction with the structure or framework established by the SGFPD investigation guidelines as a systematic and comprehensive application of respective investigation roles and responsibilities.
- All FIW assignments should be completed within three months of the start of training.
- In addition, cross training between the suppression and fire investigation personnel should take place to develop a more effective unified investigation process.
- After the FIW are completed, one final review meeting should take place of each respective group to answer any questions or concerns regarding the new fire investigation guidelines. After all the final review meetings are completed, the policy will take effect on that date department wide.

Evaluation

- The data collected during the situational analysis survey would be used as a benchmark to evaluate the progression and advancement of the general knowledge and skills to assess the effectiveness of training workbook.
- In addition, a pre-test written assessment and practical skills test should be given at the beginning of each new FIW as an additional tool to measure the effectiveness of training and identify any issues for revisions to the FIW as needed.
- After each fire investigation a simple questionnaire should be available online for all personnel to provide positive and negative feedback for improvement of the guidelines.
- All feedback and evaluations should be assessed by the Chief of Fire Prevention for the improvement of the fire investigation guidelines, FIW and training methods.

The introduction of well-developed fire investigation guidelines at the SGFPD will have significant impact on the current fire investigation practices. It would present a clear direction in solidifying the suppression and investigation activities with the education and training to bring about the adaptive change needed for effective fire investigations at the SGFPD.

Future researchers will benefit from a deeper look at potential adaptive and technical challenges facing suppression personnel in their understanding of the impact of salvage and overhaul on the fire investigation process. Understanding the impact of suppression and overhaul activities by suppression personnel is critical for an effective and successful fire investigation. The research can help suppression crews broaden their perspectives of comprehensive fire scene suppression operations, in which they play significant role in a successful fire investigation.

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Appendix A

Fire Investigation Situational Analysis Survey

1. Have you taken any formal fire investigation training since rookie school?

- Yes
- No
- Other (please specify)

2. How long ago was the last formal fire investigation class or training you attended?

3. What are your thoughts about the current fire investigation practices at the SGFPD?

- No problems, working just fine
- I'm not sure what my role and responsibilities are related to the investigation process
- We need to establish clear guidelines for fire investigations
- Other (please specify)

4. Do you know the required steps to conduct a fire investigation and its relationship with fire suppression activities?

- No
- Vaguely
- Yes, but I really don't know how to apply it to a fire investigation
- Yes, and I use it during fire scenes
- Other (please specify)

5. What is your confidence level in your ability to apply fire investigation practices and principles to determine the origin and cause at a fire investigation?

- Slim to none
- Low
- Fair
- Good
- Excellent

6. Choose each of the following aspects of a fire investigation framework that you could use further education and training? (Select all that apply)

- Observation of the fire scene during arrival or during suppression activities
- Scene safety related to fire investigation activities
- Identification, protection, and collection of evidence on a fire scene
- The security and control of the fire scene related to the fire investigation process
- Coordination of investigation activities between suppression operations and the fire investigator
- Overhaul and Salvage related to the fire investigation activities
- Origin determination
- What my role and responsibilities are related to fire investigations
- Cause determination
- Legal aspects related to the fire investigation process
- Area of origin reconstruction
- Classifications of fire
- Interviewing witnesses or occupants
- The systematic process of the fire investigation
- Fire Scene Reconstruction
- Photography
- I don't need any further fire investigation education and training
- Other (please specify)

7. How familiar are you with the following publications related to fire investigation?

	Not familiar at all	Somewhat familiar, but really can't apply it effectively	Good working knowledge	Excellent working knowledge	Total
NFPA 921 Guide for Fire & Explosion Investigation					
NFPA 1033 Standard for Professional Qualifications for Fire Investigator					
NFPA 1001 Standard for Fire Fighter Professional Qualifications					
IFSTA Introduction to Fire Origin and Cause					
Fire Officer Principles and Practice					

8. Select any issues you perceive related to the current fire investigation process at SGFPD?

- Lack of investigation education and training for suppression personnel
- Lack of investigation education and training for the fire investigators
- Lack of coordination of fire investigation activities between suppression and the investigators
- Breakdown of the unity of the chain of command
- I just don't know what I'm supposed to do related to fire investigations
- Don't have the tools I need to perform proper fire investigations
- I need more practical experience to apply what I know
- Other (please specify)

9. Which of the following terms or concepts would you be able to verbally define?

- Spoliation
- Role Bias
- Expectation Bias
- Confirmation Bias
- Incendiary
- Ignition Source
- Point of Origin
- Point of Ignition
- Hypothesis
- Combustible
- Entrainment
- Arching through char
- "Drop Down"
- Fire Scene Reconstruction
- Fuel-controlled Fire
- Ventilation-controlled Fire
- Negative Corpus
- Scientific Method

10. Do you have any suggestions for the development and implementation of fire investigation guidelines for SGFPD?

Appendix B

Fire Fighter Fire Investigation Situational Analysis Survey

Have you taken any formal fire investigation training since rookie school?

Answered: 18 Skipped: 0

Answer Choices	Responses
Yes	**38.89% 7**
No	**61.11% 11**
Other (please specify)	**0.00% 0**
Total	**18**

What are your thoughts about the current fire investigation practices at the SGFPD?

Answered: 18 Skipped: 0

Answer Choices	Responses
No problems, working just fine	**44.44% 8**
I'm not sure what my role and responsibilities are related to the investigation process	**16.67% 3**
We need to establish clear guidelines for fire investigations	**38.89% 7**
Other (please specify)	**0.00% 0**
Total	**18**

How long ago was the last formal fire investigation class or training you attended?

Answered: 16 Skipped: 2

Answer Choices	Responses
1 year or less	37.50% 6
2 years	6.25% 1
3 years	0.00% 0
4 years	6.25% 1
5 years	0.00% 0
6 years	31.25% 5
7 years	12.50% 2
8 years	6.25% 1
9 years	0.00% 0
10 years	0.00% 0
11+ years ago	0.00% 0
Total	16

How familiar are you with the following publications related to fire investigation?

Answered: 18 Skipped: 0

	Not familiar at all	Somewhat familiar, but really can't apply it effectively	Good working knowledge	Excellent working knowledge	Total
NFPA 921 Guide for Fire & Explosion Investigation	55.56% (10)	22.22% 4	16.67% 3	5.56% 1	18
NFPA 1033 Standard for Professional Qualifications for Fire Investigator	43.75% 7	37.50% 6	18.75% 3	0.00% 0	16
NFPA 1001 Standard for Fire Fighter Professional Qualifications	11.76% 2	29.41% 5	41.18% 7	17.65% 3	17
IFSTA Introduction to Fire Origin and Cause	33.33% 6	33.33% 6	33.33% 6	0.00% 0	18
Fire Officer Principles and Practice	16.67% 3	38.89% 7	38.89% 7	5.56% 1	18

Choose each of the following aspects of a fire investigation framework that you could use further education and training? (Select all that apply)

Answered: 18 Skipped: 0

Answer Choices	Responses
Observation of the fire scene during arrival or during suppression activities	38.89% 7
Scene safety related to fire investigation activities	11.11% 2
Identification, protection, and collection of evidence on a fire scene	50.00% 9
The security and control of the fire scene related to the fire investigation process	16.67% 3
Coordination of investigation activities between suppression operations and the fire investigator	33.33% 6
Overhaul and Salvage related to the fire investigation activities	38.89% 7
Origin determination	55.56% 10
What my role and responsibilities are related to fire investigations	44.44% 8
Cause determination	44.44% 8
Legal aspects related to the fire investigation process	22.22% 4
Area of origin reconstruction	38.89% 7
Classifications of fire	16.67% 3
Interviewing witnesses or occupants	27.78% 5
The systematic process of the fire investigation	33.33% 6
Fire Scene Reconstruction	55.56% 10
Photography	38.89% 7
I don't need any further fire investigation education and training	5.56% 1
Other (please specify)	0.00% 0
Total Respondents: 18	

Do you know the steps to conduct a fire investigation and its relationship with fire suppression activities?

Answered: 18 Skipped: 0

Answer Choices	Responses
No	**33.33% 6**
Vaguely	**33.33% 6**
Yes, but I really don't know how to apply it to a fire investigation	**22.22% 4**
Yes, and I use it during fire scenes	**11.11% 2**
Other (please specify)	**0.00% 0**
Total	**18**

What is your confidence level in your ability to apply fire investigation practices and principles to determine the origin and cause at a fire investigation?

Answered: 18 Skipped: 0

Answer Choices	Responses
Slim to none	**11.11% 2**
Low	**38.89% 7**
Fair	**33.33% 6**
Good	**11.11% 2**
Excellent	**5.56% 1**
Total	**18**

Which of the following terms or concepts would you be able to verbally define?

Answered: 15 Skipped: 3

Answer Choices	Responses
Spoliation	**20.00%** **3**
Role Bias	**20.00%** **3**
Expectation Bias	**13.33%** **2**
Confirmation Bias	**26.67%** **4**
Incendiary	**86.67%** **13**
Ignition Source	**86.67%** **13**
Point of Origin	**93.33%** **14**
Point of Ignition	**86.67%** **13**
Hypothesis	**73.33%** **11**
Combustible	**86.67%** **13**
Entrainment	**13.33%** **2**
Arching through char	**40.00%** **6**
"Drop Down"	**40.00%** **6**
Fire Scene Reconstruction	**53.33%** **8**
Fuel-controlled Fire	**60.00%** **9**
Ventilation-controlled Fire	**66.67%** **10**
Negative Corpus	**20.00%** **3**
Scientific Method	**46.67%** **7**
Total Respondents: 15	

Select any issues you perceive related to the current fire investigation process at SGFPD?

Answered: 17 Skipped: 1

Answer Choices	Responses
Lack of investigation education and training for suppression personnel	64.71% 11
Lack of investigation education and training for the fire investigators	5.88% 1
Lack of coordination of fire investigation activities between suppression and the investigators	29.41% 5
Breakdown of the unity of the chain of command	11.76% 2
I just don't know what I'm supposed to do related to fire investigations	11.76% 2
Don't have the tools I need to perform proper fire investigations	11.76% 2
I need more practical experience to apply what I know	47.06% 8
Other (please specify)	5.88% 1
Total Respondents: 17	

Do you have any suggestions for the development of fire investigation guidelines for SGFPD?

Answered: 2 Skipped: 16

I have no suggestions

8/31/2015 11:16 AM

The results should be utilized to help fire suppression personnel better understand the circumstances that led up to the fire. Educational and prevention programs should be established with information obtained from investigation.

8/17/2015 3:51 PM

Appendix C

Lieutenant Fire Investigation Situational Analysis Survey

Have you taken any formal fire investigation training since rookie school?

Answered: 20 Skipped: 0

Answer Choices	Responses
Yes	45.00% 9
No	45.00% 9
Other (please specify)	10.00% 2
Total	20

What are your thoughts about the current fire investigation practices at the SGFPD?

Answered: 20 Skipped: 0

Answer Choices	Responses
No problems, working just fine	50.00% 10
I'm not sure what my role and responsibilities are related to the investigation process	5.00% 1
We need to establish clear guidelines for fire investigations	35.00% 7
Other (please specify)	10.00% 2
Total	20

How long ago was the last formal fire investigation class or training you attended?

Answered: 17 Skipped: 3

Answer Choices	Responses
1 year or less	17.65% 3
2 years	0.00% 0
3 years	17.65% 3
4 years	11.76% 2
5 years	17.65% 3
6 years	5.88% 1
7 years	0.00% 0
8 years	0.00% 0
9 years	5.88% 1
10 years	5.88% 1
11+ years ago	17.65% 3
Total	17

How familiar are you with the following publications related to fire investigation?

Answered: 20 Skipped: 0

	Not familiar at all	Somewhat familiar, but really can't apply it effectively	Good working knowledge	Excellent working knowledge	Total	Weighted Average
NFPA 921 Guide for Fire & Explosion Investigation	45.00% 9	40.00% 8	15.00% 3	0.00% 0	20	2.25
NFPA 1033 Standard for Professional Qualifications for Fire Investigator	35.00% 7	40.00% 8	25.00% 5	0.00% 0	20	2.55
NFPA 1001 Standard for Fire Fighter Professional Qualifications	20.00% 4	5.00% 1	65.00% 13	10.00% 2	20	3.45
IFSTA Introduction to Fire Origin and Cause	25.00% 5	35.00% 7	40.00% 8	0.00% 0	20	2.90
Fire Officer Principles and Practice	15.00% 3	10.00% 2	65.00% 13	10.00% 2	20	3.55

Choose each of the following aspects of a fire investigation framework that you could use further education and training? (Select all that apply)

Answered: 20 Skipped: 0

Answer Choices	Responses
Observation of the fire scene during arrival or during suppression activities	50.00% 10
Scene safety related to fire investigation activities	15.00% 3
Identification, protection, and collection of evidence on a fire scene	60.00% 12
The security and control of the fire scene related to the fire investigation process	30.00% 6
Coordination of investigation activities between suppression operations and the fire investigator	35.00% 7
Overhaul and Salvage related to the fire investigation activities	25.00% 5
Origin determination	65.00% 13
What my role and responsibilities are related to fire investigations	30.00% 6
Cause determination	45.00% 9
Legal aspects related to the fire investigation process	30.00% 6
Area of origin reconstruction	40.00% 8
Classifications of fire	15.00% 3
Interviewing witnesses or occupants	20.00% 4
The systematic process of the fire investigation	35.00% 7
Fire Scene Reconstruction	45.00% 9
Photography	30.00% 6
I don't need any further fire investigation education and training	10.00% 2
Other (please specify)	5.00% 1
Total Respondents: 20	

Do you know the steps to conduct a fire investigation and its relationship with fire suppression activities?

Answered: 20 Skipped: 0

Answer Choices	Responses
No	15.00% 3
Vaguely	45.00% 9
Yes, but I really don't know how to apply it to a fire investigation	15.00% 3
Yes, and I use it during fire scenes	25.00% 5
Other (please specify)	0.00% 0
Total	20

What is your confidence level in your ability to apply fire investigation practices and principles to determine the origin and cause at a fire investigation?

Answered: 20 Skipped: 0

Answer Choices	Responses
Slim to none	0.00% 0
Low	15.00% 3
Fair	65.00% 13
Good	20.00% 4
Excellent	0.00% 0
Total	20

Which of the following terms or concepts would you be able to verbally define?

Answered: 20 Skipped: 0

Answer Choices	Responses
Spoliation	15.00% 3
Role Bias	10.00% 2
Expectation Bias	5.00% 1
Confirmation Bias	5.00% 1
Incendiary	70.00% 14
Ignition Source	90.00% 18
Point of Origin	100.00% 20
Point of Ignition	80.00% 16
Hypothesis	75.00% 15
Combustible	100.00% 20
Entrainment	20.00% 4
Arching through char	30.00% 6
"Drop Down"	35.00% 7
Fire Scene Reconstruction	30.00% 6
Fuel-controlled Fire	75.00% 15
Ventilation-controlled Fire	75.00% 15
Negative Corpus	10.00% 2
Scientific Method	30.00% 6
Total Respondents: 20	

Select any issues you perceive related to the current fire investigation process at SGFPD?

Answered: 19 Skipped: 1

Answer Choices	Responses
Lack of investigation education and training for suppression personnel	52.63% 10
Lack of investigation education and training for the fire investigators	10.53% 2
Lack of coordination of fire investigation activities between suppression and the investigators	36.84% 7
Breakdown of the unity of the chain of command	5.26% 1
I just don't know what I'm supposed to do related to fire investigations	15.79% 3
Don't have the tools I need to perform proper fire investigations	26.32% 5
I need more practical experience to apply what I know	52.63% 10
Other (please specify)	0.00% 0
Total Respondents: 19	

Do you have any suggestions for the development of fire investigation guidelines for SGFPD?

Answered: 0 Skipped: 20

Appendix D

Captain Fire Investigation Situational Analysis Survey

Have you taken any formal fire investigation training since rookie school?

Answered: 16 Skipped: 0

Answer Choices	Responses
Yes	56.25% 9
No	37.50% 6
Other (please specify)	6.25% 1
Total	16

What are your thoughts about the current fire investigation practices at the SGFPD?

Answered: 15 Skipped: 1

Answer Choices	Responses
No problems, working just fine	13.33% 2
I'm not sure what my role and responsibilities are related to the investigation process	13.33% 2
We need to establish clear guidelines for fire investigations	73.33% 11
Other (please specify)	0.00% 0
Total	15

How long ago was the last formal fire investigation class or training you attended?

Answered: 12 Skipped: 4

Answer Choices	Responses
1 year or less	16.67% 2
2 years	8.33% 1
3 years	8.33% 1
4 years	0.00% 0
5 years	8.33% 1
6 years	8.33% 1
7 years	0.00% 0
8 years	8.33% 1
9 years	0.00% 0
10 years	25.00% 3
11+ years ago	16.67% 2
Total	12

How familiar are you with the following publications related to fire investigation?

Answered: 15 Skipped: 1

	Not familiar at all	Somewhat familiar, but really can't apply it effectively	Good working knowledge	Excellent working knowledge	Total	Weighted Average
NFPA 921 Guide for Fire & Explosion Investigation	53.33% 8	46.67% 7	0.00% 0	0.00% 0	15	1.93
NFPA 1033 Standard for Professional Qualifications for Fire Investigator	53.33% 8	40.00% 6	6.67% 1	0.00% 0	15	2.00
NFPA 1001 Standard for Fire Fighter Professional Qualifications	7.14% 1	28.57% 4	57.14% 8	7.14% 1	14	3.57
IFSTA Introduction to Fire Origin and Cause	26.67% 4	20.00% 3	53.33% 8	0.00% 0	15	3.00
Fire Officer Principles and Practice	6.67% 1	33.33% 5	46.67% 7	13.33% 2	15	3.60

Choose each of the following aspects of a fire investigation framework that you could use further education and training? (Select all that apply)

Answered: 15 Skipped: 1

Answer Choices	Responses
Observation of the fire scene during arrival or during suppression activities	33.33% 5
Scene safety related to fire investigation activities	20.00% 3
Identification, protection, and collection of evidence on a fire scene	46.67% 7
The security and control of the fire scene related to the fire investigation process	33.33% 5
Coordination of investigation activities between suppression operations and the fire investigator	60.00% 9
Overhaul and Salvage related to the fire investigation activities	20.00% 3
Origin determination	53.33% 8
What my role and responsibilities are related to fire investigations	46.67% 7
Cause determination	53.33% 8
Legal aspects related to the fire investigation process	66.67% 10
Area of origin reconstruction	26.67% 4
Classifications of fire	13.33% 2
Interviewing witnesses or occupants	46.67% 7
The systematic process of the fire investigation	40.00% 6
Fire Scene Reconstruction	26.67% 4
Photography	6.67% 1
I don't need any further fire investigation education and training	6.67% 1
Other (please specify)	0.00% 0
Total Respondents: 15	

Do you know the steps to conduct a fire investigation and its relationship with fire suppression activities?

Answered: 15 Skipped: 1

Answer Choices	Responses
No	6.67% 1
Vaguely	40.00% 6
Yes, but I really don't know how to apply it to a fire investigation	40.00% 6
Yes, and I use it during fire scenes	13.33% 2
Other (please specify)	0.00% 0
Total	15

What is your confidence level in your ability to apply fire investigation practices and principles to determine the origin and cause at a fire investigation?

Answered: 15 Skipped: 1

Answer Choices	Responses
Slim to none	0.00% 0
Low	6.67% 1
Fair	33.33% 5
Good	46.67% 7
Excellent	13.33% 2
Total	15

Which of the following terms or concepts would you be able to verbally define?

Answered: 15 Skipped: 1

Answer Choices	Responses
Spoliation	33.33% 5
Role Bias	6.67% 1
Expectation Bias	6.67% 1
Confirmation Bias	0.00% 0
Incendiary	93.33% 14
Ignition Source	100.00% 15
Point of Origin	100.00% 15
Point of Ignition	86.67% 13
Hypothesis	66.67% 10
Combustible	86.67% 13
Entrainment	13.33% 2
Arching through char	13.33% 2
"Drop Down"	26.67% 4
Fire Scene Reconstruction	60.00% 9
Fuel-controlled Fire	46.67% 7
Ventilation-controlled Fire	53.33% 8
Negative Corpus	0.00% 0
Scientific Method	20.00% 3
Total Respondents: 15	

Select any issues you perceive related to the current fire investigation process at SGFPD?

Answered: 15 Skipped: 1

Answer Choices	Responses
Lack of investigation education and training for suppression personnel	86.67% 13
Lack of investigation education and training for the fire investigators	6.67% 1
Lack of coordination of fire investigation activities between suppression and the investigators	53.33% 8
Breakdown of the unity of the chain of command	33.33% 5
I just don't know what I'm supposed to do related to fire investigations	13.33% 2
Don't have the tools I need to perform proper fire investigations	6.67% 1
I need more practical experience to apply what I know	33.33% 5
Other (please specify)	6.67% 1
Total Respondents: 15	

Do you have any suggestions for the development of fire investigation guidelines for SGFPD?

Answered: 3

Skipped: 13

Start training officers on investigation practices. Actual classes and not a computer only class.

8/17/2015 6:34 PM

To make sure all officers have proper introductory and continual training and education prior to and after guidelines are implemented.

8/14/2015 5:52 PM

Our fire investigators should hold training classes for fire ground officers to help bring new concepts and knowledge into use.

8/14/2015 12:27 PM

Appendix E

Suppression Chief Officer Fire Investigation Situational Analysis Survey

Have you taken any formal fire investigation training since rookie school?

Answered: 7 Skipped: 0

Answer Choices	Responses
Yes	42.86% 3
No	57.14% 4
Other (please specify)	0.00% 0
Total	7

What are your thoughts about the current fire investigation practices at the SGFPD?

Answered: 7 Skipped: 0

Answer Choices	Responses
No problems, working just fine	14.29% 1
I'm not sure what my role and responsibilities are related to the investigation process	0.00% 0
We need to establish clear guidelines for fire investigations	71.43% 5
Other (please specify)	14.29% 1
Total	7

How long ago was the last formal fire investigation class or training you attended?

Answered: 7 Skipped: 0

Answer Choices	Responses
1 year or less	14.29% 1
2 years	0.00% 0
3 years	0.00% 0
4 years	0.00% 0
5 years	28.57% 2
6 years	0.00% 0
7 years	0.00% 0
8 years	0.00% 0
9 years	0.00% 0
10 years	0.00% 0
11+ years ago	57.14% 4
Total	7

How familiar are you with the following publications related to fire investigation?

Answered: 7 Skipped: 0

	Not familiar at all	Somewhat familiar, but really can't apply it effectively	Good working knowledge	Excellent working knowledge	Total	Weighted Average
NFPA 921 Guide for Fire & Explosion Investigation	85.71% 6	14.29% 1	0.00% 0	0.00% 0	7	1.29
NFPA 1033 Standard for Professional Qualifications for Fire Investigator	57.14% 4	42.86% 3	0.00% 0	0.00% 0	7	1.86
NFPA 1001 Standard for Fire Fighter Professional Qualifications	14.29% 1	14.29% 1	42.86% 3	28.57% 2	7	3.71
IFSTA Introduction to Fire Origin and Cause	28.57% 2	28.57% 2	42.86% 3	0.00% 0	7	2.86
Fire Officer Principles and Practice	0.00% 0	14.29% 1	57.14% 4	28.57% 2	7	4.14

Choose each of the following aspects of a fire investigation framework that you could use further education and training? (Select all that apply)

Answered: 7 Skipped: 0

Answer Choices	Responses
Observation of the fire scene during arrival or during suppression activities	28.57% 2
Scene safety related to fire investigation activities	28.57% 2
Identification, protection, and collection of evidence on a fire scene	42.86% 3
The security and control of the fire scene related to the fire investigation process	42.86% 3
Coordination of investigation activities between suppression operations and the fire investigator	57.14% 4
Overhaul and Salvage related to the fire investigation activities	57.14% 4
Origin determination	57.14% 4
What my role and responsibilities are related to fire investigations	57.14% 4
Cause determination	28.57% 2
Legal aspects related to the fire investigation process	57.14% 4
Area of origin reconstruction	71.43% 5
Classifications of fire	14.29% 1
Interviewing witnesses or occupants	57.14% 4
The systematic process of the fire investigation	14.29% 1
Fire Scene Reconstruction	42.86% 3
Photography	42.86% 3
I don't need any further fire investigation education and training	14.29% 1
Other (please specify)	0.00% 0
Total Respondents: 7	

Do you know the steps to conduct a fire investigation and its relationship with fire suppression activities?

Answered: 7 Skipped: 0

Answer Choices	Responses
No	28.57% 2
Vaguely	42.86% 3
Yes, but I really don't know how to apply it to a fire investigation	0.00% 0
Yes, and I use it during fire scenes	14.29% 1
Other (please specify)	14.29% 1
Total	7

What is your confidence level in your ability to apply fire investigation practices and principles to determine the origin and cause at a fire investigation?

Answered: 7 Skipped: 0

Answer Choices	Responses
Slim to none	0.00% 0
Low	0.00% 0
Fair	57.14% 4
Good	28.57% 2
Excellent	14.29% 1
Total	7

Which of the following terms or concepts would you be able to verbally define?

Answered: 7 Skipped: 0

Answer Choices	Responses
Spoliation	0.00% 0
Role Bias	28.57% 2
Expectation Bias	28.57% 2
Confirmation Bias	28.57% 2
Incendiary	71.43% 5
Ignition Source	100.00% 7
Point of Origin	100.00% 7
Point of Ignition	71.43% 5
Hypothesis	57.14% 4
Combustible	71.43% 5
Entrainment	28.57% 2
Arching through char	14.29% 1
"Drop Down"	42.86% 3
Fire Scene Reconstruction	28.57% 2
Fuel-controlled Fire	28.57% 2
Ventilation-controlled Fire	28.57% 2
Negative Corpus	0.00% 0
Scientific Method	42.86% 3
Total Respondents: 7	

Select any issues you perceive related to the current fire investigation process at SGFPD?

Answered: 7 Skipped: 0

Answer Choices	Responses
Lack of investigation education and training for suppression personnel	57.14% 4
Lack of investigation education and training for the fire investigators	28.57% 2
Lack of coordination of fire investigation activities between suppression and the investigators	71.43% 5
Breakdown of the unity of the chain of command	14.29% 1
I just don't know what I'm supposed to do related to fire investigations	0.00% 0
Don't have the tools I need to perform proper fire investigations	0.00% 0
I need more practical experience to apply what I know	14.29% 1
Other (please specify)	14.29% 1
Total Respondents: 7	

Do you have any suggestions for the development of fire investigation guidelines for SGFPD?

Answered: 1 Skipped: 6

More Training

8/20/2015 8:34 AM

Appendix F

Fire Prevention Officer Fire Investigation Situational Analysis Survey

Have you taken any formal fire investigation training since rookie school?

Answered: 4 Skipped: 0

Answer Choices	Responses
Yes	100.00% 4
No	0.00% 0
Other (please specify)	0.00% 0
Total	4

What are your thoughts about the current fire investigation practices at the SGFPD?

Answered: 3 Skipped: 1

Answer Choices	Responses
No problems, working just fine	0.00% 0
I'm not sure what my role and responsibilities are related to the investigation process	0.00% 0
We need to establish clear guidelines for fire investigations	100.00% 3
Other (please specify)	0.00% 0
Total	3

How long ago was the last formal fire investigation class or training you attended?

Answered: 4 Skipped: 0

Answer Choices	Responses
1 year or less	75.00% 3
2 years	0.00% 0
3 years	0.00% 0
4 years	0.00% 0
5 years	0.00% 0
6 years	0.00% 0
7 years	0.00% 0
8 years	0.00% 0
9 years	0.00% 0
10 years	0.00% 0
11+ years ago	25.00% 1
Total	4

How familiar are you with the following publications related to fire investigation?

Answered: 4 Skipped: 0

	Not familiar at all	Somewhat familiar, but really can't apply it effectively	Good working knowledge	Excellent working knowledge	Total	Weighted Average
NFPA 921 Guide for Fire & Explosion Investigation	0.00% 0	0.00% 0	100.00% 4	0.00% 0	4	4.00
NFPA 1033 Standard for Professional Qualifications for Fire Investigator	0.00% 0	0.00% 0	100.00% 4	0.00% 0	4	4.00
NFPA 1001 Standard for Fire Fighter Professional Qualifications	0.00% 0	0.00% 0	100.00% 4	0.00% 0	4	4.00
IFSTA Introduction to Fire Origin and Cause	0.00% 0	0.00% 0	100.00% 4	0.00% 0	4	4.00
Fire Officer Principles and Practice	0.00% 0	50.00% 2	50.00% 2	0.00% 0	4	3.50

Choose each of the following aspects of a fire investigation framework that you could use further education and training? (Select all that apply)

Answered: 4 Skipped: 0

Answer Choices	Responses
Observation of the fire scene during arrival or during suppression activities	50.00% 2
Scene safety related to fire investigation activities	100.00% 4
Identification, protection, and collection of evidence on a fire scene	75.00% 3
The security and control of the fire scene related to the fire investigation process	75.00% 3
Coordination of investigation activities between suppression operations and the fire investigator	75.00% 3
Overhaul and Salvage related to the fire investigation activities	75.00% 3
Origin determination	50.00% 2
What my role and responsibilities are related to fire investigations	50.00% 2
Cause determination	50.00% 2
Legal aspects related to the fire investigation process	75.00% 3
Area of origin reconstruction	50.00% 2
Classifications of fire	50.00% 2
Interviewing witnesses or occupants	75.00% 3
The systematic process of the fire investigation	50.00% 2
Fire Scene Reconstruction	50.00% 2
Photography	50.00% 2
I don’t need any further fire investigation education and training	0.00% 0
Other (please specify)	0.00% 0
Total Respondents: 4	

Do you know the steps to conduct a fire investigation and its relationship with fire suppression activities?

Answered: 4 Skipped: 0

Answer Choices	Responses
No	0.00% 0
Vaguely	0.00% 0
Yes, but I really don't know how to apply it to a fire investigation	0.00% 0
Yes, and I use it during fire scenes	100.00% 4
Other (please specify)	0.00% 0
Total	4

What is your confidence level in your ability to apply fire investigation practices and principles to determine the origin and cause at a fire investigation?

Answered: 4 Skipped: 0

Answer Choices	Responses
Slim to none	**0.00%** **0**
Low	**0.00%** **0**
Fair	**0.00%** **0**
Good	**100.00%** **4**
Excellent	**0.00%** **0**
Total	**4**

Which of the following terms or concepts would you be able to verbally define?

Answered: 3 Skipped: 1

Answer Choices	Responses
Spoliation	100.00% 3
Role Bias	66.67% 2
Expectation Bias	66.67% 2
Confirmation Bias	66.67% 2
Incendiary	100.00% 3
Ignition Source	100.00% 3
Point of Origin	100.00% 3
Point of Ignition	100.00% 3
Hypothesis	100.00% 3
Combustible	100.00% 3
Entrainment	100.00% 3
Arching through char	66.67% 2
“Drop Down”	100.00% 3
Fire Scene Reconstruction	100.00% 3
Fuel-controlled Fire	100.00% 3
Ventilation-controlled Fire	100.00% 3
Negative Corpus	66.67% 2
Scientific Method	100.00% 3
Total Respondents: 3	

Select any issues you perceive related to the current fire investigation process at SGFPD?

Answered: 4 Skipped: 0

Answer Choices	*Responses*
Lack of investigation education and training for suppression personnel	**75.00% 3**
Lack of investigation education and training for the fire investigators	**0.00% 0**
Lack of coordination of fire investigation activities between suppression and the investigators	**100.00% 4**
Breakdown of the unity of the chain of command	**50.00% 2**
I just don't know what I'm supposed to do related to fire investigations	**0.00% 0**
Don't have the tools I need to perform proper fire investigations	**75.00% 3**
I need more practical experience to apply what I know	**50.00% 2**
Other (please specify)	**0.00% 0**
Total Respondents: 4	

Do you have any suggestions for the development of fire investigation guidelines for SGFPD?

Answered: 3 Skipped: 1

Na

8/24/2015 8:38 A.M.

More training and better communication

8/18/2015 3:00 P.M.

When complete this report should be required reading and include testing for all suppression staff.

8/14/2015 9:36 A.M.

Appendix G

	St. George Fire Protection District *Policies & Procedures*	
Type:	**Guideline**	Date Created: **10/10/15**
Number:	**Draft**	Date Revised: **00/00/00**
Title:	**Preliminary Fire Investigation**	Page 1 of 5

The purpose of the guideline is to provide structure for the Incident Commander and suppression crews during a working fire and the preliminary investigation.

The responsibility for determining the area of origin and cause of the fire belongs to the Incident Commander/ Company Officer during the preliminary fire investigation.

Response to the Scene

- While responding to the fire scene, the company officer should be cognizant of any situations that may indicate an attempt to delay the first alarm response of the incoming units.
- All personnel should pay attention to suspicious vehicles that may be leaving the fire scene. The license plate, a description of the vehicle(s), or description of the occupant(s) should be noted and the information given to the incident commander.
- All personnel should pay attention to suspicious person(s) who may be a bystander at the fire scene and note any unusual behavior, dress, or appearance. Any information should be given to the incident commander.

Arrival on the Scene

- During size-up, make mental note of the flame and smoke location in the fire building.
- Identify locations of self-ventilation from the fire building.
- Note information that includes if there was a need to force entry or were doors open or windows broken. These are very important observations that indicate whether the building was secured on arrival of the first-in units.
- Pay attention to fires that appear to be separate and unrelated to each other and may possibly indicate multiple fires intentionally set. Take note of the locations and notify the incident commander of the locations and observations.
- Shut down power at the main breaker outside if possible and not the interior breaker panel. The purpose of this is to leave the individual breakers in the positions after the fire to determine which may have tripped. This assists in “arc mapping” as an indicator for origin and cause.

	St. George Fire Protection District *Policies & Procedures*	
Type:	**Guideline**	Date Created: **10/10/15**
Number:	**Draft**	Date Revised: **00/00/00**
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During Suppression Activities

- Particular attention should be given to the conditions, presence, or absence of the normal content of the structure:
    - Do normal items appear to be missing?
    - Are the contents ransacked?
    - Does the interior appear to be vandalized?

- Any indication of unusual fire behavior:
    - Flare ups after an area is controlled?
    - Multiple locations of fire.

- Any blocking or obstruction of normal means of entry should be noted.

- While some overhaul may be required for the extinguishment of the fire, every effort should be made to avoid any unnecessary damage during extinguishment operations. Utilization of the thermal imaging camera will assist in this task to minimize unnecessary damage to the structure.

After Initial Fire Suppression

After the fire is suppressed, and before comprehensive salvage and overhaul operations are started, a preliminary investigation directed by the Incident Commander should begin to determine the origin, cause and circumstances surrounding the fire.

All non-essential personnel should refrain from entering the fire scene to preserve vital evidence in its original location and condition.

The company officers should stop firefighters from removing sheetrock and plaster from the studs. The reason for this is that the investigator will need to examine the fire patterns. The interpretations of the fire patterns are valuable for identifying the potential ignition source of the fire and point of origin.

It is also the company officer's responsibility to minimize the removal of furnishings, appliances, bedding and other building contents to prevent destruction of evidence and allow for the observation of smoke and fire patterns on the contents of the structure.

All non-essential personnel should refrain from entering the fire scene to assist in preservation of the fire scene integrity.

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Exterior

- Begin with an exterior survey of the entire fire scene:
  - Ensure all safety issues are addressed
  - Ensure the entire scene is secure and unnecessary personnel exit the secured area
  - Survey the surrounding area and a 360 degree of the exterior fire building.
    - Examine all exterior equipment and electrical connections
    - Note all areas the fire self-ventilated, to include windows and doors
  - Identify and secure potential evidence on the exterior of the fire building

Interviews

Interview the occupants/witnesses:

- Collect personal information:
  - Name
  - Address
  - D.O.B.
  - Phone numbers (cell and home)

- Take statements of events to include:
  - General statement as of their observations
  - Any information on how they believe the fire may have started

Cause Determination

- Determining the origin of the fire:
  - Generally work from areas of least damage toward area of the most damage
  - Evaluate heat, burn and smoke patterns
  - Identify the room of origin
  - Determine area of origin

- Non-essential fire personnel should not enter the suspected AREA OF ORIGIN until the formal investigation is complete at any time unless requested

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In examining the area of origin, attempt to determine if there are competent ignition/heat sources and fuel present in the area of origin. The competent ignition source and fuel can be used to determine an ignition factor, but does not indicate a cause of a fire just because a readily ignitable fuel and a potential ignition source are present.

Identify possible fuel sources that were first ignited such as:

- Food on a stove
- Trash
- Bedding
- Any other combustible materials

Identify possible ignition sources such as:

- Open flames
- Electrical sources
- Lighter or matches
- Candles

Indicators of an Incendiary fire:

- Any incendiary type device:
  - If any incendiary device is found, do not touch or move device
  - Secure the area to establish a safe distance of protection (as required by device)
  - Notify the Incident Commander immediately

- Trailers:
  - Used to spread the fire from one area to another
  - Can be used on stairways, across floors as well as any interior or exterior surfaces
  - Materials may include:
    - Ignitable liquids or combustible materials
    - Paper/newspaper
    - Clothing or other rags

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- Multiple fires:
  - Non-related fires that are burning simultaneously with different areas of origin
  - Fires in different rooms of the structure that are not related
  - Fires on different stories of the structure that are not related

Determine if there was a natural sequence or accidental sequence that brought the ignition source and the fuel source together such as:

- Food on the stove
- Electrical equipment malfunction
- Discarded smoking materials
- Unattended candle

Conclusion of Investigation

The conclusion of the preliminary investigation will state one of the four causes below:

- Accidental – are those which the proven cause does not involve any deliberate human act
- Natural – lighting, acts of Mother Nature with no human interventions
- Incendiary – deliberately set by individuals
- Undetermined – where cause is unknown

If the fire is determined to be Natural or Accidental, the investigating officer can note their findings in their fire report. Witness testimony can corroborate or support findings during the preliminary.

If any indication of an incendiary fire is found, the officer needs to notify the Incident Commander immediately to request a Fire Investigator.

If the cause is unknown and of serious nature, or witness statements and preliminary investigation findings are inconsistent, notify the Incident Commander to request a Fire Investigator.

Appendix H

	St. George Fire Protection District *Policies & Procedures*	
Type:	**Guideline**	Date Created: **10/11/15**
Number:	**Draft**	Date Revised: **00/00/00**
Title:	**Fire Investigator Call-out**	Page 1 of 3

The purpose of this guideline is to provide direction for the incident commander when calling for a fire investigator ***after*** a preliminary fire investigation has been conducted.

If the following circumstances are found during the preliminary investigation by the Incident Commander, a Fire Investigator may be requested. Although not all-inclusive of the situations encountered, any of the following may be used as determining factor to request a Fire Investigator to respond to the scene:

- Deaths or serious injuries
- When reasonable belief exists that the fire is of incendiary origin
- Second alarm or greater incidents
- Fires for which the cause cannot be determined by the preliminary investigation
- Explosion, whether intentional or accidental
- Hazardous Material incidents where Incident Command feels an in depth investigation is required to determine causative factors and responsibility
- Any places of worship and family planning centers
- Any unique or complicated situation involving a suspicious or consequential fire

A fire investigator is not needed for the following situations:

- Minor burns, electrical accidents, and minor accidental burns
- Minor fires where cause is determined to be accidental
- Minor grass, fence, or trash fires with no witnesses or suspects
- Car fires originating in the engine compartment during vehicle operation, abandoned autos, or vehicle arsons with no identified suspects

If the Incident Commander determines an Investigator is required, the fire scene is now to be considered a crime scene until the investigation is concluded by the SGFPD fire investigator. Incident command should ***contact communications to make the request as soon as possible***.

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Fire Scene

Once the determination for calling out a Fire Investigator has been made based on the preliminary investigation, the incident commander shall do the following:

- Protect and maintain custody of the fire scene until the arrival of a Fire Investigator
- All non-essential personnel should refrain from entering the fire scene to preserve vital evidence in its original location and condition
- The company officers should stop firefighters from removing sheetrock and plaster from the studs. The reason for this is that the investigator will need to examine the fire patterns. Fire patterns are the measurable or visible effects that remain after the fire. The interpretations of the fire patterns are valuable for identifying the point of origin
- It is also the company officer's responsibility to minimize the removal of furnishings, appliances, bedding and other building contents to prevent destruction of evidence that may be required for the fire investigator
- Discontinue any activities which may alter/contaminate the fire scene, or interfere with a subsequent origin and cause investigation
- Have adequate lighting in place for interior and exterior investigation
- Continue ventilation of smoke and gases from fire building

Evidence

- Any evidence discovered during the preliminary investigation or firefighting operations should not be disturbed. Evidence cannot be used in court unless the Fire Investigator can establish a chain of custody by proving who found the evidence, where it was found and that the evidence was not tampered with while in official custody.
- A firefighter must be posted to maintain custody and prevent damage to evidence.
- It is vital that fire personnel are prevented from unnecessarily walking through a fire area, walking on, obscuring evidence, or picking up and moving evidence.
- If it is essential that evidence be moved or if firefighting operations may damage evidence, the evidence must be covered or its location noted on a drawing or a photograph before moving it carefully to a secure location.

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Arrival of Fire Investigator

- Command will turn over jurisdiction of the fire scene to the Fire Investigator as soon as possible after the fire is stabilized. The Fire Investigator retains jurisdiction of the fire scene until it is released back to the incident commander.
- Incident Command will maintain contact with the Fire Investigator during the investigation.
- The Fire Investigator may request from Incident Commander any equipment or personnel necessary for the investigation. Command will make every effort to meet such requests, to the extent possible under the prevailing circumstances.
- All personnel will cooperate with the Fire Investigator for the protection of the fire scene and preservation of physical evidence for the determination of origin and cause once life safety and fire control are achieved.

Appendix I

	St. George Fire Protection District *Policies & Procedures*	
Type:	**Guideline**	Date Created: **10/12/15**
Number:	**Draft**	Date Revised: **00/00/00**
Title:	**Formal Fire Investigation**	Page 1 of 5

The purpose of the guideline is to provide a framework for the Fire Prevention Officer during the formal fire investigation in determining origin and cause.

The responsibility for determining the area of origin and cause of the fire belongs to the FPO Investigator during the formal fire investigation.

The scope of the fire investigation conducted by St. George Fire Investigators is limited to *Origin and Cause* per authority of the Fire Chief. However, any investigations of criminal activities during or after the formal fire investigation will be conducted in conjunction with the East Baton Rouge Sheriff's Office and/or the State Fire Marshal's Office.

The FPO investigator will maintain authority of the fire scene relating to the investigation processes and non-emergency suppression crew activities upon their arrival and until the conclusion of the formal fire investigation in which the scene will be turned over to the suppression Incident Commander.

Prior to arrival on Scene

- Ensure all investigation Personal Protection Equipment is present and in working condition.
- Ensure all investigation equipment is in working order and ready for use.

Arrival on the Scene

- Make contact with the Incident Commander to assume command of the fire investigation.
- Ensure the scene is secure and that all immediate safety/suppression issues are addressed.
- Collect preliminary investigation information from the Incident Commander.
- Ensure the electrical meter has been pull from the exterior panel.
- Request any additional resource as determined.

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Interviews

Identify all potential witnesses on scene to include the first-in company officer.

- Interview the first-in company officer:
  - Fire conditions on arrival
  - Anything unusual or out of the ordinary
  - Persons on scene at the time of arrival
  - Any entry issues
  - How the power was shut down (interior breaker of exterior main)
  - General comments

Interview the occupants/witnesses:

- Verify personal information:
  - Name
  - Address
  - D.O.B.
  - Phone numbers (cell and home)

- Take statements of events to include:
  - General statement as of their observations
  - Any information on how they believe the fire may have started

Exterior Examination

- Begin with a 360 degree exterior survey of the entire fire scene.
- Ensure all safety issues are addressed as identified.
- Ensure the entire scene is secure and unnecessary personnel exit the secured area.
- Photograph the exterior to include the surrounding area and a 360 degree of the exterior fire building:
  - Photograph all exterior equipment and electrical connections
  - Photograph all areas the fire self-ventilated, to include windows and doors
- Make any field notes or sketches as needed.
- Identify and collect potential evidence on the exterior of the fire building.

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Interior Investigation

- Begin photographing in a systematic manner moving in a consistent direction through the fire building.
- Particular attention should be given to the conditions, presence, or absence of the normal content of the structure:
    - Do normal items appear to be missing?
    - Are the contents ransacked?
    - Does the interior appear to be vandalized?
- Photograph the breaker panel in the condition found
- Photograph all electric/gas appliances and equipment in the building

Origin and Cause Determination

- Determining the room of origin:
    - Generally work from areas of least damage toward area of the most damage
    - Evaluate heat, burn and smoke patterns
    - Identify the room of origin
    - Non-essential fire personnel should not enter the suspected ROOM OF ORIGIN until the formal investigation is complete unless requested
    - Extensive photographs of the room should be taken in condition found

- Room of Origin Reconstruction:
    - Map or photograph location of furniture, appliances, any evidence or any other pertinent item found in the room of origin
    - Measure and sketch room
    - Carefully removed debris being cognizant of potential evidence in the debris
    - Place debris in a secure area to be gone through later
    - Clean as best possible and replace any furniture, appliances, or equipment that may have been moved during suppression, overhaul, or investigation activities

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- Determine point of origin:
  - Using the Scientific Method identify the area of origin
  - In examining the area of origin, attempt to determine if there are competent ignition/heat sources and fuel present in the area of origin
  - The competent ignition source and fuel can be used to determine an ignition factor, but does not indicate the cause of the fire just because a readily ignitable fuel and a potential ignition source are present
  - Once the point of origin is determined, identify the cause that brought the fuel and the ignition source together

- Identify possible fuel sources that were first ignited such as:
  - Food on a stove
  - Trash
  - Bedding
  - Any other combustible materials

- Identify possible ignition sources such as:
  - Open flames
  - Electrical sources
  - Lighter or matches
  - Candles

Possible Indicators of an Incendiary fire:

- Any incendiary type device:
  - If any incendiary device is found, do not touch or move device
  - Secure the area to establish a safe distance of protection (as required by device)

- Trailers:
  - Used to spread the fire from one area to another
  - Can be used on stairways, across floors as well as any interior or exterior surfaces

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Determine if there was a natural sequence or accidental sequence that brought the ignition source and the fuel source together such as:

- Food on the stove
- Electrical equipment malfunction
- Discarded smoking materials
- Unattended candle

Conclusion of Investigation

The conclusion of the formal fire investigation will state one of the four cause determinations below:

- Accidental – are those which the proven cause does not involve any deliberate human act
- Natural – lighting, acts of Mother Nature with no human interventions
- Incendiary – deliberately set by individuals
- Undetermined – where cause is unknown

If the fire is determined to be Natural or Accidental, the FPO investigator can note their findings in their investigation fire report. Witness testimony can corroborate or support findings during the preliminary

If any indication of an incendiary fire is found, the FPO investigator will need to contact the State Fire Marshal's Office and/or the East Baton Rouge Sheriff's Office to further investigator criminal activities.