

INTERNATIONAL FIRE SERVICE JOURNAL OF LEADERSHIP AND MANAGEMENT



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The *International Fire Service Journal of Leadership and Management (IFSJLM)* is composed of peer-reviewed articles focusing exclusively on fire leadership and management topics. **To our knowledge, it is the only academic journal with this focus in the world.** *IFSJLM* is published by Fire Protection Publications (FPP) at Oklahoma State University (OSU). FPP is part of the College of Engineering, Architecture, and Technology at OSU and is the leading publisher in the world of fire-related education and training materials.

IFSJLM would not be possible without the financial support of the Dean of the College of Engineering, Architecture, and Technology and FPP. Their support represents a commitment to the continued professionalization of the American fire service.

As a further indication of the support of FPP to the international fire community, all issues of the *IFSJLM*, except the two most recent years, are available for reading **free of cost** at the Journal's website. Please go to <http://www.ifsjlm.org/PastEditions.htm> to read and/or download previous issues of the Journal.



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*Previous Recipients of the Dr. John Granito Award for
Excellence in Fire Leadership and Management Research*

RESEARCH SYMPOSIUM 2008 (RS08)

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RESEARCH SYMPOSIUM 2013 (RS13)

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RESEARCH SYMPOSIUM 2009 (RS09)

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Deputy U.S. Fire Administrator

RESEARCH SYMPOSIUM 2014 (RS14)

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Chairman of the Board of Directors of the
National Fallen Firefighters Foundation

RESEARCH SYMPOSIUM 2010 (RS10)

Dr. Lori Moore-Merrell

Assistant to the General President
International Association of Fire Fighters (IAFF)

RESEARCH SYMPOSIUM 2015 (RS15)

Dr. Denise Smith

First Responder Health and Safety Laboratory, Department
of Health and Exercise Sciences, Skidmore College and
Research Scientist University of Illinois Fire Service Institute,
Champaign, Illinois

RESEARCH SYMPOSIUM 2011 (RS11)

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RESEARCH SYMPOSIUM 2016 (RS16)

Dr. Sara A. Jahnke

Director and Principal Investigator,
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RESEARCH SYMPOSIUM 2012 (RS12)

Daniel Madrzykowski

Fire Protection Engineer
National Institute of Standards and Technology (NIST)

RESEARCH SYMPOSIUM 2017 (RS17)

Chief Ronald J. Siarnicki

Executive Director
National Fallen Firefighters Foundation

Dr. John Granito Award for Excellence in Fire Leadership and Management Research

The Dr. Granito Award

Fire Protection Publications (FPP) and the *International Fire Service Journal of Leadership and Management (IFSJLM)* headquartered on the campus of Oklahoma State University (OSU) are proud to announce the creation of the **Dr. John Granito Award for Excellence in Fire Leadership and Management Research (the Dr. Granito Award)**. The award will be presented at the *IFSJLM* Research Symposium that supports the *Journal* held annually in July at the IFSTA Validation Conference. The award honors Dr. John Granito. John has been one of the premier fire and public safety consultants in the United States. Just a few of his many Fire, Rescue, and Emergency Services research projects include: Oklahoma State University-Fire Protection Publications Line of Duty Death Reduction project (3 years); Centaur National Study (3 years); Research Triangle Institute/National Fire Protection Association/International City/County Management Association project (4 years); Fire Department Analysis Project (FireDAP) of the Urban Fire Forum (13 years); *Combination Department Leadership* project, University of Maryland, Maryland Fire & Rescue Institute (4 years); Worcester Polytechnic/International Association of Fire Fighters/International Association of Fire Chiefs/National Institute for Occupational Safety and Health *Fire Ground Performance Study*. He has participated in more than 400 fire department studies. John also has strong ties to academia. He served in a number of academic positions for almost 30 years, including 16 years at the State University of New York at Binghamton. He is Professor Emeritus and Retired Vice President for Public Service and External Affairs at SUNY Binghamton, which is consistently ranked in the top public universities by *U.S. News and World Report*. John has published numerous articles, chapters, and technical papers, served as co-editor of the 2002 book published by the International City/County Management Association entitled, *Managing Fire and Rescue Service*, and is a Section Editor of the NFPA® 2008 *Fire Protection Handbook*. Dr. Granito was the first recipient of the award that honors him and his service to the fire service and to academia. Each year the recipient of the Dr. Granito Award presents the Keynote Address at the annual *IFSJLM* Research Symposium. The Keynote Address is subsequently published as the lead article in the following year's volume of the *IFSJLM*.

Nomination Form

Fire Protection Publications (FPP) and the *International Fire Service Journal of Leadership and Management (IFSJLM)* headquartered on the campus of Oklahoma State University (OSU) are accepting nominations for the **Dr. John Granito Award for Excellence in Fire Leadership and Management Research (the Dr. Granito Award)**. The award is presented at the Research Symposium that supports the *International Fire Service Journal of Leadership and Management (IFSJLM)* held annually in July at the IFSTA Validation Conference.

The nominee should have made a significant contribution to the advancement of fire leadership and management through his/her scholarly/academic writing. The Dr. Granito Award is not necessarily a life-time achievement award, although such individuals certainly should be in a prominent position to be nominated. The nominee can be a person who,

although early in their career as a practitioner/scholar or academic, has made a seminal contribution to the fire leadership and management literature.

To nominate an individual for the Dr. Granito Award, please submit by 15 November of the current year: (1) this form (or a copy of it), (2) no more than a one-page single-spaced letter explaining why you believe the person is deserving of the award, and (3) a copy of the nominee's resume or curriculum vitae. Please send required materials in hard copy to: Dr. Granito Award, C/O Dr. Robert E. England, Founding Editor, *International Fire Service Journal of Leadership and Management*, P. O. Box 720846, Norman, Oklahoma 73070. Or, if you prefer, scan and complete the nomination form and send all materials electronically to: bob.england@okstate.edu.

I nominate _____ for the **Dr. John Granito Award for Excellence in Fire Leadership and Management Research**. To support the nomination, I have included a letter of recommendation and a resume or curriculum vitae (CV) of the nominee. (A nomination is not accepted without the supporting letter and resume/CV.)

Nominator Name: _____

Address: _____

Zip/Postcode: _____

Contact Information:

Telephone: _____

Email: _____

Message from Dr. Robert E. England

Founding Editor, *International Fire Service Journal of Leadership and Management (IFSJLM)*,
Fire Protection Publications, Oklahoma State
University

Welcome to Volume 11 of the *International Fire Service Journal of Leadership and Management*. Typically, readers should expect to see the annual volume

released no later than October 31. When the issue goes to press, however, is largely dependent on when external reviewers accept four or more articles for publication. Regardless of the number of articles, a volume will be available no later than the end of the calendar year.

We hope you enjoy Volume 11 of the *IFSJLM*.

Ninth Annual Dr. John Granito Award for Excellence in Fire Leadership and Management Keynote Address presented at Research Symposium 2017 (RS 17) by **Dr. Sara A. Jahnke**, Center for Fire, Rescue & EMS Health Research, National Development & Research Institutes, Leawood, KS.

Sara A. Jahnke, Ph.D., Center for Fire, Rescue & EMS Health Research, National Development & Research Institutes, Leawood, KS

Walker S. C. Poston, Ph.D., Center for Fire, Rescue & EMS Health Research, National Development & Research Institutes, Leawood, KS

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Health, Wellness, and Readiness in the Fire Service

Abstract

The past decade of research on the health of firefighters has identified several areas of need related to morbidity and mortality risks including cancer, cardiovascular disease, and injury. Data suggest that a number of occupational risk factors push firefighters toward poor health and increase their risks for a number of diseases and premature deaths. Underlying modifiable risk factors have emerged as playing a central role in increasing risks for poor health, including obesity, poor nutrition, low fitness, binge drinking, smokeless-tobacco use, poor sleep, and behavioral-health concerns. Understanding these risks, as well as prevention and intervention techniques, are necessary components to improving occupational health among this important population.

Keywords: *firefighter occupational health, firefighters and cardiovascular disease, firefighters and cancer*

Introduction

The past decade has seen a significant increase in research on the health of first responders, particularly firefighters. A keyword search of the term *firefighter* in PubMed, the database of peer-reviewed medical literature, reveals that two-thirds of the research has been done in the past 10 years. This is likely due to an increased interest in occupational health impacts of the job post-9/11, as well as the funding of health research through the Federal Emergency Management Agency's (FEMA's) Assistance to Firefighters Grants and Fire Prevention and Safety Research and Development Grants. A few areas of particular research interest include cardiovascular disease (CVD) and cancer, as well as the underlying modifiable risk factors that contribute to the development of these diseases.

Cardiovascular Disease (CVD)

In a report from the Centers for Disease Control (CDC) (2006), it was reported that the leading cause of on-duty deaths for firefighters was CVD, accounting for approximately half of fatalities annually. In addition, for every on-duty CVD fatality, there were approximately 17 nonfatal cardiac events to firefighters on duty each

year within the United States (US) (Karter & Molis, 2012).

Soteriades, Smith, Tsismenakis, Baur, and Kales (2011) presented a theoretical model of the development and progression of atherosclerosis among firefighters that suggests a multifactorial process that leads to on-duty cardiovascular events. In their model, the progression of atherosclerosis and acute cardiovascular events is the result of a trigger during strenuous duties among people with subclinical and/or existing coronary heart disease. While some of the components leading up to an event (e.g., genetics, smoke, and noise) cannot be changed, they also highlight a number of contributory factors (e.g., tobacco use, sedentary behavior, poor diet, sleep deprivation, and excessive alcohol use) that are modifiable.

Cancer

A number of cancers have been found to be associated with fire-fighting job tasks in the epidemiologic literature (see **Table 1**). While results are not always consistent across studies due to the challenges of studying cancer in epidemiologic literatures, two studies have

Table 1: Cancers Found to be Related to Fire-Fighting Activities

Bladder ^a
Brain ^b
Buccal Cavity and Pharynx ^{a,b}
Colon ^b
Intestine ^a
Kidney ^a
Leukemia ^b
Liver, Gall Bladder, Biliary ^a
Lung ^a
Malignant Melanoma ^b
Mesothelioma ^a
Multiple Myeloma ^b
Non-Hodgkin Lymphoma ^b
Oesophagus ^a
Prostate ^b
Rectum ^{a,b}
Skin ^b
Stomach ^b
Testis ^b

Sources: ^aDaniels et al., 2013. ^bLeMasters et al., 2006.

found compelling evidence for the relationship between cancer and fire-fighting activities. Lemasters et al. (2006) conducted a meta-analysis of studies on cancer among firefighters and then classified the cancers as probably, possibly, or unlikely related to cancer based on their meta-standardized mortality ratio, pattern of meta-relative risk, and heterogeneity of findings across studies. Daniels et al. (2013) subsequently published a retrospective cohort of firefighters from Philadelphia, San Francisco, and Chicago fire departments. They found several types of cancer to have statistically significant elevations when compared with the general population with regard to standardized mortality ratios, standardized incidence ratios for all cancers diagnosed, and standardized incidence ratios for first cancers diagnosed.

Similar to CVD, cancers have a number of risk factors that cannot be modified such as genetics (Braicu et al., 2017; Coyle, Boudreau, & Marcato, 2017; van den Berg, Beekman, Smith, Janssens, & Slagboom, 2017), age (National Cancer Institute, 2017), hormones (Fucic et al., 2010; Nainani, Paliwal, Nagpal, & Agrawal, 2014), and infectious agents (Daver et al., 2017). However, there are also several modifiable risk factors (Grundy et al., 2017), similar to those for CVD, that can lead to increased risk for cancers such as obesity,

tobacco use, excessive alcohol intake, low fitness, poor diet, disrupted sleep, and exposure to known and unknown carcinogens (Bolstad-Johnson et al., 2000) without proper and effective use of personal protective equipment (PPE).

Modifiable Risk Factors for CVD and Cancer

Of note, there are several underlying modifiable risk factors that are common antecedents to both CVD and cancer that represent known occupational health challenges for firefighters. Job tasks and daily schedules of fire-fighting activities often result in a number of unhealthy behaviors and make healthy choices particularly challenging for this population. Reducing rates of both CVD and cancer in the fire service will necessitate education and prevention efforts focused on improving these modifiable risk behaviors for firefighters.

Obesity

Evidence suggests that fire-fighting activities require a minimum of 12.0 metabolic equivalent units (METS) (Donovan et al., 2009). Achieving this level of fitness can be particularly challenging for some firefighters given the wide range of body composition in the fire service within the US. Obesity is emerging as one of the driving forces of negative occupational health risks in the fire service.

Body-composition cutoffs are used to examine different levels of morbidity and mortality risks, and they can be measured through a number of different field techniques. For instance, Body Mass Index (BMI) is calculated using the following formula: $BMI = (\text{weight in pounds} / (\text{height in inches} \times \text{height in inches})) \times 703$. Using the metric system, $BMI = (\text{weight in kilograms} / (\text{height in meters} \times \text{height in meters}))$. BMI scores are then used as cutoffs to estimate risk using the following classifications: (1) $BMI > 25$ and < 30 = overweight, (2) $BMI \geq 30$ and < 35 = Class I obese, (3) $BMI \geq 35$ and < 40 = Class II obese, and (4) $BMI \geq 40$ = Class III obese (National Heart, Lung, and Blood Institute [NHLBI] Obesity Education Initiative Expert Panel on the Identification, Evaluation, and Treatment of Obesity in Adults, 1998). Body fat can also be assessed through a variety of methods (e.g., calipers, bioelectrical impedance, hydrostatic weighing, and dual-energy X-ray absorptiometry [DEXA]) with a body-fat percentage higher than 25% for men and 30% for women serving as the cut-off percent for obesity (NHLBI Obesity Education Initiative Expert Panel on the Identification, Evaluation, and Treatment of Obesity in Adults, 1998). Finally, measures of waist circumference at the umbilicus can be used to determine abdominal obesity, the most lethal kind, with a waist circumference greater than 40 inches (101.6 cm) for men and greater than 35 inches (88.9 cm) for women being considered obese.

Studies of the fire service find high rates of overweight and obesity compared to the general population (Poston, Haddock, et al., 2011). In a population-based study of both career and volunteer firefighters (Poston, Haddock, et al., 2011), findings show that rates of overweight and obesity combined (BMI \geq 25) were at 79.5% for career firefighters and 78.4% for volunteer firefighters. These rates are higher than the general US population, which is estimated to be at 68.0% (Flegal, Carroll, Ogden, & Curtin, 2010). Similarly, while rates of obesity based on BMI in the general population are around 33.8% (Flegal et al., 2010), rates for career firefighters were 33.5% and 43.2% for volunteer firefighters. Similarly, rates of obesity measured by body-fat percentage (47.7% and 54.3% respectively) and waist circumference (career 30.5%, volunteer 45.2%) also were high for both career and volunteer firefighters.

Obesity is associated with a number of poor long-term occupational outcomes among firefighters. For instance, Kuehl et al. (2012) found that obese firefighters were approximately 300% more likely to file a worker's compensation claim than those who were not obese. Soteriades, Hauser, Kawachi, Christiani, and Kales (2008) found that for each one unit increase in BMI, there was a 5% increase in disability risk for firefighters. Work by Holder, Stallings, Peeples, Burrell, and Kales (2006) examining heart-presumption pensions found that obesity status increased the risk of a noncoronary heart-disease retirement by 300%.

Obesity also negatively impacts immediate occupational outcomes. Poston, Jitnarin, Haddock, Jahnke, and Tuley (2011) found that Class II and Class III firefighters missed nearly five times the number of work days as their normal-weight peers. This missed work was associated with excess costs for lost worked days for overweight, Class I obese, and Class II/III obese firefighters annually (\$74.41, \$254.00, and \$1,682.90 respectively). Obese firefighters also have increased risk for musculoskeletal injuries. In a prospective cohort (Jahnke, S. A., Poston, Haddock, & Jitnarin, 2013b), it was found that being obese based on waist circumference was associated with a risk of a musculoskeletal injury nearly three times of those with a waist circumference under 40 inches (101.6 cm). When using BMI as a marker, those in the obese range were more than five times as likely as healthy-weight peers to incur an injury.

There are a number of risk factors specific to the fire-service occupational environment that likely lead to the increased risk of obesity among firefighters. C. Haddock, Poston, and Jahnke (2011) outlined a number of factors, such as the nutritional environment in the firehouse, the metabolic impact of shift work and interrupted sleep, lack of support for physical activity, the impact of repeated exposures to trauma, and time constraints that make healthy behaviors a particular challenge. Many of these modifiable risk factors are discussed further in the sections that follow.

Nutritional Environment

Several components of the fire-service norms and structures make healthy eating difficult for firefighters. Meals and eating habits within the firehouse are typically structured to be a bonding experience where making individual food choices or rejecting the *family* aspect of meal times is seen as a rejection or a sign of poor camaraderie and weak relationships among the crew (Haddock, C., Poston, & Jahnke, 2011). Portion sizes also tend to be rather large, which has been attributed in part to the irregular eating patterns that are necessitated by emergency responses that interfere with meal times.

Alcohol Use

Excessive consumption of alcohol also may contribute to poor health outcomes and high rates of obesity. In a national study of firefighters, the second leading caloric contributor was alcohol consumption (Day, Poston, Haddock, & Jahnke, 2017). These *empty calories*, on top of the standard firefighter diet, likely add to weight-management challenges.

Science defines an alcoholic *drink* as one 12-ounce (355 mL) beer, 5 ounces (148 mL) of wine, or 1.5 ounces (44 mL) of hard liquor/spirits (National Institute on Alcohol Abuse and Alcoholism [NIAAA], 2016). Binge drinking is defined as five or more drinks at a time for men and four or more drinks for women based on blood-alcohol content (NIAAA, 2016). In a study of firefighters in the central US, C. K. Haddock et al. (2012) found that 56% of career firefighters and 45% of volunteer firefighters reported binge drinking in the past 30 days. A national sample of firefighters found similar rates, with 50.2% of firefighters reporting a binge in the past 30 days (Haddock, C. K., Day, Poston, Jahnke & Jitnarin, 2015). On off-duty days, firefighters in the study consumed an average of 551.4 kilocalories (kcal) per day, with the range from 12.5 kcal to 3,404 kcal per day.

High rates of binge drinking have been attributed to several factors inherent to work in the fire-service environment (Jahnke, S., Poston, & Haddock, 2014). One cause is the shift schedule that firefighters work. Most firefighters work an average of 10 days a month and have rotating days on duty, so the only peers with the same off-duty schedule are other firefighters on the same shift. According to firefighters, free time often is spent socializing with other shift members at eating and/or drinking establishments. Firefighters reported that these times build camaraderie on the off-duty days that contribute to crew bonding while on duty. Another cause identified by firefighters was using alcohol as a stress-management technique to handle their reactions to the repeated exposure to traumas that they witness while running calls on their shifts. Thus, alcohol was used as a way to unwind from stressful runs. Finally, firefighters identified alcohol use and binge drinking as strongly steeped in the traditions of the fire service.

Physical Activity

While the need for high levels of fitness among firefighters is consistently recognized, data suggest that many firefighters exhibit low fitness (Poston, Haddock, et al., 2011). Firefighters often face challenges with consistently engaging in exercise, and there is concern about risk of injury. Both S. A. Jahnke, Poston, Haddock, and Jitnarin (2013a) and Poplin, Harris, Pollack, Peate, and Burgess (2012) found that training and physical activity were the leading causes of injury while on duty, accounting for approximately a third of injuries. Fireground injuries were the second most common injuries. However, firefighters who engaged in physical activity while at work had an increased risk for fitness injuries (most were mild) and were found to be half as likely to experience much more serious non-exercise injuries (Jahnke, S. A., Poston, Haddock, & Jitnarin, 2013a).

Given the necessity of fitness for firefighters to be prepared and ready for fire-fighting tasks, exercise injury prevention needs to be a central focus for on-duty exercise. While a “warm-up” is not possible when responding to calls, it is important that firefighters properly warm up before workouts. Exercise scaling, i.e., varying the level of intensity, load, repetitions, etc., based on each firefighter’s current fitness level, should be encouraged as a norm among the crew where firefighters are encouraged to push themselves, but not to the point that they are trying to perform at a level above what is safe for them. The importance of proper form for all exercises also should be highlighted to reduce risk and encourage safe movements. Programming also should focus on functional exercises, and training should be done at a level of intensity similar to that required for emergency responses so fitness training can translate to the fireground setting and mimic common fireground tasks. Finally, proper hydration should be a mandatory component for any fitness programming, because it is a core component to safe performance, both in the gym and on the fireground.

Tobacco Use

Tobacco use is widely recognized for its deleterious health effects and its relationship to both morbidity and mortality. The fire service has been vocal and proactive in its denouncement of cigarette use, which is reflected in current low rates of smoking among firefighters. For example, in a population-based sample of firefighters in the US Midwest, only 13.6% of career and 17.4% of volunteer firefighters reported being current smokers (Haddock, C. K., Jitnarin, Poston, Tuley, & Jahnke, 2011). These rates are below those among males in the same region (16.9 to 24.3%). This positive trend, however, does not extend to smokeless tobacco use. While between 5 to 10% of males in the US are current smokeless users, between 15 to 20% of career and volunteer firefighters report current smokeless use (Jit-

narin, Haddock, Poston, & Jahnke, 2013). Firefighters using smokeless tobacco tended to be younger and have shorter tenure in the fire service than their non-using peers, and only 15.7% of these users reported using smokeless tobacco due to departmental restrictions on smoking (Jitnarin et al., 2013).

Sleep

Consistent and restful sleep is a noted concern for firefighters (National Fallen Firefighters Foundation [NFFF], 2016), particularly given the importance of circadian rhythms as the underlying mechanism for nearly all functions and cycles operating in the body (Drake, Roehrs, Richardson, Walsh, & Roth, 2004; Puttonen, Härmä, & Hublin, 2010). Disrupted sleep and poor-sleep practices have been found to lead to a host of psychological concerns (e.g., increased risk for depression, post-traumatic stress disorder [PTSD], or anxiety), diseases (e.g., increased risk for cancer, CVD, or obesity), and injury (e.g., car crashes) (Barger et al., 2015; Carey, Al-Zaiti, Dean, Sessanna, & Finnell, 2011; Drake et al., 2004; Elliot & Kuehl, 2007).

Firefighters face particular challenges because many work in busy stations that receive calls throughout the night, and they often share sleeping quarters with colleagues. Shift schedules also can contribute to sleep challenges given that many departments are moving toward longer shifts, and firefighters often link shifts or work overtime. Barger et al. (2015) found that 37% of firefighters reported symptoms consistent with one or more sleep disorders. Often these sleep disorders are exacerbated by the occupational environment and task requirements that firefighters face. For example, factors associated with increased excessive daytime sleepiness included working a 48/96 shift, having a shared sleeping area, and having a second job outside of fire-fighting duties (Haddock, C. K., Poston, Jitnarin, & Jahnke, 2013).

Given the importance of sleep to overall health, fire departments should be proactive in supporting positive sleep environments, educating firefighters about the effective use of caffeine and napping, and encouraging healthy-sleep behaviors as much as possible within the fire station, particularly in very busy firehouses.

Behavioral Health

Not surprisingly, firefighters are an occupational group at high risk for behavioral-health concerns given that their jobs are to respond to a wide host of traumatic calls (Jahnke, S. A., Poston, Haddock, & Murphy, 2016). A saying within the fire service is “Your worst day is my every day” (Couturié, 2006), which highlights the challenges of repeated exposure to trauma. While past work has focused on specific diagnoses such as PTSD, depression, and anxiety (Boffa et al., 2017; Katsavouni, Bebetos, Malliou, & Beneka, 2016; Pinto, Henriques, Jongenelen, Carvalho, & Maia, 2015),

there is a growing understanding that the cumulative effect of trauma exposure among firefighters and other first responders can lead to a variety of concerns and symptoms that, while not always falling within a specific diagnostic category, can cause significant impairment (Andersen & Papazoglou, 1970; Jahnke, S. A., et al., 2016).

Prevention and Intervention

Given the host of occupational health challenges inherent to the job of the firefighter, a focus on modifiable risk factors to improve outcomes is necessary among this important occupational group. Specific areas for intervention and prevention include the following:

- Eliminating all tobacco use within the fire service;
- Improving nutrition practices and the nutrition environment within the firehouse with a focus on reducing processed foods and excess sugar;
- Focusing on fitness across domains and with an emphasis on functional movements that are easily transferable to the fire environment;
- Eliminating and reducing toxin exposures when possible, as much as possible, through use of PPE;
- Conducting regular, relevant physical ability testing for firefighters as a way to monitor readiness across the career span and intervene when necessary; and
- Investing in appropriate medical surveillance and intervention for firefighters who are or become high risk for health concerns.

As firefighter Steve Mast so aptly highlighted with his statement that the importance of these efforts cannot be understated because “When we hit the fire ground, your risk factors become my risks” (personal communication, June 2, 2007).

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Articles presented in this section of the *Journal* labeled **Fireground News** provide information useful to the well-being, safety, and/or professionalization of the fire service. As Editor of the *International Fire Service Journal of Leadership and Management (IFSJLM)*, I decide which articles are published in **Fireground News**. Usually, but not always, the articles were first presented as papers at the IFSJLM Research Symposium (RS) held annually in July at the International Fire Service Training Association Validation Conference.

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Improving the Response of a Medium-Size Fire Department to Mass-Casualty Incidents (MCIs) through Lecture, Facilitated Scenario, and a Life-Sized Scripted Simulation¹

Abstract

The purpose of this research was to evaluate whether a small, closely scripted mass-casualty simulation could improve responders' readiness to respond to an actual incident. Using Loudoun County Fire and Rescue (LCFR) as the test site, the authors conducted a department-wide mass-casualty incident (MCI) simulation that was required to (1) be reliable and valid, (2) be scalable to three fire-suppression units and three emergency medical services (EMS) transport units, (3) focus on the most important MCI staff positions, and (4) maintain a no-fail approach for all participants. A three-phase, 4.5-hour (270-minute) lesson plan was developed that consisted of a lecture, triage-treatment-transportation processing facilitated exercise, and life-sized MCI simulation using 15 live and mannequin patients. Eighteen duplicate evolutions of the MCI simulation were conducted with every department shift completing the simulation. The lesson plan (i.e., lecture, facilitated scenario, and life-sized scripted simulation) resulted in the identification of (1) 12 lessons learned/recommendations for conducting a large-scale MCI simulation, (2) 33 lessons learned/recommendations to improve MCI operations in the department, (3) three suggestions to change the regional EMS Multiple Casualty Incident Manual, and (4) four recommendations to improve future MCI operations.

Keywords: mass casualty, triage, training, emergency medical services (EMS)

Introduction

Following several mass-casualty incidents (MCIs), the Loudoun County Department of Fire, Rescue, and Emergency Management² identified a lack of member knowledge and practice in managing MCIs. Department emergency medical services (EMS) leaders also became aware of their own lack of knowledge and application of the recently revised Northern Virginia (NOVA) regional *EMS Multiple Casualty Incident Manual*. As such, the EMS Division developed a department-wide mass-casualty simulation.

The purpose of the research project was to evaluate whether a small, closely scripted mass-casualty simulation could improve responders' readiness to respond to an actual incident. A simulation was chosen for several reasons: "Simulation provides a positive training and education method for prehospital medical staff. It provides opportunities to train assessment, treatment and implementation of procedures and devices under realistic conditions" (Abelsson, Rystedt, Suserud, &

Lindwall, 2014). The National Registry Practice Analysis identifies an MCI as one of the most infrequently managed events by EMS providers (National Registry of Emergency Medical Technicians [EMTs], 1994). Billittier, Lerner, Moscati, and Young (1998) also identified the fact that EMS providers "frequently make inappropriate, transportation, triage, and destination decisions" (p. 22).

The research team sought to develop a mass-casualty *lesson plan* that would use a *crawl-walk-run* approach to learning. Participants would be taught in a progressive cognitive and psychomotor approach that supported their learning to specific objectives. Consistent with the Cone of Learning, participants would be active in saying, describing, and performing their roles in an MCI response (see International Fire Service Training Association [IFSTA], 2012). The Cone of Learning indicates that participants remember "90 percent of what they say while doing what they are

talking about” (IFSTA, 2012, p. 34). The simulation also adheres to the concept of intensity in Thorndike’s Laws of Learning, which states “if a stimulus (experience) is vivid and real, it will likely change or have an effect on the learning” (IFSTA, 2012, p. 37)

Methods

The MCI simulations spanned a nine-day period. The morning session began at 0700 hours, and the afternoon session began at 1230 hours. Each session lasted 4.5 hours in duration separated into three phases. **Phase 1** consisted of a mass-casualty operations lecture. Lasting one hour, this lecture focused on the role of each responding apparatus consistent with the *EMS Multiple Casualty Incident Manual*. The lecture also focused on the effective paper tracking of patients as they were triaged and tagged prior to transportation. Participants participated in a group phone call to the Regional Healthcare Coordination Center (RHCC) to understand how to obtain bed capacities at hospitals for MCIs.

Phase 2 consisted of a guided walk-through of the triage-treatment-transportation processing steps necessary in an MCI. Designated by the researchers as the *Teddy Bear Drill*, approximately 30–40 small stuffed animals (i.e., patients) spread across an open apparatus bay were presented to the participants as a simulated MCI. Each stuffed animal was labeled with simulated demographic information and injuries. Participants were infused into the incident incrementally and directed to assume their response roles consistent with the *EMS Multiple Casualty Incident Manual*. Facilitators prompted each crew if it seemed unsure of its role and responsibility. Participants placed the appropriate color triage ribbon on each stuffed animal. Additional responders portered the patients to predeployed colored tarps where disaster tags were applied. Lastly, the transportation of the patients was coordinated by the Transportation Group. Using a crew from an ambulance, patients were assigned to EMS transport units (and to hospitals) through an actual phone call with the RHCC and tracking of the patients on paper forms. Patients were considered transported when an ambulance crew carried the patient to a designated area outside the apparatus bay. This phase continued until all patients were processed and transported. A debriefing was conducted with each group leader to describe their experiences. Spot checks of patient accountability were conducted to ensure participants effectively tracked each patient.

Phase 3 consisted of an actual response to a simulated bus accident on the training academy grounds. The incident involved a retired school bus placed against another passenger vehicle. The scenario used live role-players and heavy mannequins for a total of 15 patients. Participants were dispatched to the incident incrementally via a designated radio channel. Facilitators were present to ensure that each unit followed the appropriate response role.

Response roles consisted of a Triage Unit, a Treatment Unit, and a Transportation Group. Units were also assigned to porter and transport patients. Facilitators prompted each crew if it was unsure of its roles and responsibilities. The Treatment-Unit participants placed the appropriate color triage ribbon on each live role-player or mannequin. Additional responders portered patients to treatment areas and ambulances. The Transportation Group contacted the RHCC and tracked patients as they were transported from the incident scene. Mannequins and role-players were loaded into ambulances and transported to a designated location several hundred yards (kilometers) away on the training grounds. This location served as the hospital for simulation purposes. It also produced a time delay as ambulances would transport and then return to the scene for additional patients. This phase continued until all patients were processed and transported.

At the conclusion of Phase 3, the researchers conducted a facilitated debriefing. During this debriefing, each group or unit leader was asked to evaluate the simulation and provide feedback. Each unit leader was asked to provide his/her thoughts on how the MCI simulation was managed. All participants (i.e., nonofficers) were also permitted to provide thoughts and feedback. This information was collected by one of the researchers. While the debriefing was underway, an electronic survey was circulated to the participants. The results were compiled using Excel[®] and developed into tables and charts. Each evolution of the MCI lesson plan lasted 75 minutes for Phase 1, 45 minutes for Phase 2, and 90 minutes for Phase 3. Breaks, setups, and movement of participants through each phase accounted for an additional 30–60 minutes (for a total of up to 4.5 hours or 270 minutes) for each evolution. A total of nineteen (19) evolutions (the original and 18 evolutions) were conducted over a ten-day period.

Survey Results

Three-hundred and ten (310) participants responded to the survey and the Post-MCI Simulation Evaluation. This number included 9 chiefs, 20 captains, 45 lieutenants, 212 technicians and firefighters, and 24 personnel who identified themselves as “paramedics.” It is possible that some participants completed the evaluation more than once because some participants attended the simulation multiple times.

Survey results show that 306 participants (98%) agreed with the statement, “The simulation was well organized and executed.” Most participants (96%) agreed that “The simulation was the appropriate length.” In fact, several participants’ comments suggested that the simulation should have been longer. Other comments included: “more prep time with each role,” “we could [have] run more scenarios,” and “could we have more time with the simulation?”

Data in **Table 1** show that overwhelmingly survey participants (98 to 99%) agreed with the statements

Table 1: Responses to Three Survey Statements

Statements	Agree	Disagree	No Opinion	No Response	Total
Q3: The lecture on MCI responsibilities was beneficial.	308 (99.3%)	0	2 (0.6%)	0	310
Q5: The “Teddy Bear Drill” on Patient Processing was beneficial.	304 (98.0%)	0	5 (1.6%)	1 (0.3%)	310
Q7: The large-scale MCI Practical Simulation was beneficial.	305 (99.3%)	1 (0.3%)	4 (1.2%)	0	310

that the MCI lecture on responsibilities (Q3, 99%), the “Teddy Bear Drill” on patient processing (Q5, 98%), and the large-scale simulation (Q7, 99%) were beneficial. At the conclusion of the debriefing, the group was asked, “Do you feel more prepared to manage an MCI right now than you did before this simulation?” Most participants stated that they did feel more prepared and believed that they better understood their roles. Survey results confirmed these debriefing findings: 98% percent (303) of the participants agreed with the statement “I feel more capable to respond to an MCI.” Eighty-five percent of the participants (263) also agreed with the statement, “There should be another simulation next year with more patients, more apparatus, and interaction with law enforcement.”

Survey Questions 12 through Question 14 asked for open-ended responses from the participants. Question 12 asked, “The simulation might be better if . . . ?” Seventy-four (74) responses were provided. Opinions varied, but the most common were collapsed into similar responses. Nine people suggested that more resources and victims should have been employed. Five individuals wanted a chance to rotate through each MCI position. Four participants wanted a review of START (Simple Triage and Rapid Treatment), which is the standard triage scheme used in the NOVA region), while four others wanted the simulation to be longer. Two people even stated, “I would change nothing. This is the perfect introduction to an MCI response.”

Question 13 queried, “What I learned most from this simulation was . . . ?” One hundred and ten (110) people answered this question. After responses were collapsed into similar themes, 15 individuals stated that they learned the roles and responsibilities of each unit on a MCI, 5 group members learned that great communication is *essential*, and 2 participants responded that they learned the most about what forms to complete. The remaining 88 responses were unique to each individual.

Finally, Question 14 asked, “My overall feeling about the simulation is . . . ?” One hundred and nineteen (119) responses were offered. Again, these opinions were collapsed into similar responses where possible. Seventy-three participants believed that the simulation was “great,” “very good,” or “good.” Thirty-two participants stated that the simulation was “beneficial.” Five

participants thought the simulation was “well planned and organized.” One participant stated that the simulation “was rushed.”

As noted earlier, at the end of Phase 3 (i.e., the MCI simulation) of the project, a facilitated debriefing discussion was conducted among all participants. A number of important *lessons learned* emerged from this discussion. Often these lessons learned are translated into *recommendations*, so the two terms are often used synonymously in the section that follows where these lessons learned/recommendations are outlined.

Discussion of Lessons Learned/Recommendations

This study highlights the benefits of the use of a simulation to conduct MCI training to a medium-sized career fire department. “Next to real-life experiences, simulations are the best way to evaluate students’ knowledge” (Parvensky, 1995, p. 53). As a result of research presented in this article, several lessons were learned about the logistics, organization, and operation of a life-sized MCI lesson and simulation. Perhaps the most important of these lessons was that the MCI simulation was reproducible and valid (see also Radestad et al., 2012). This MCI training and simulation activity was conducted nearly *identically* twice per day over a nine-day period.

The remainder of this section summarizes the lessons learned/recommendations emerging from this study in three areas: (1) conducting an effective MCI training lesson plan, (2) improving MCI response and operations, and (3) improving the use of a mass-casualty supply unit (MCSU) during a MCI.

Lessons Learned/Recommendations for Conducting an Effective MCI Training Lesson Plan

Emerging from the three-phase research project, 12 lessons learned or recommendations for conducting an effective MCI training lesson plan were identified. These recommendations are summarized in **Table 2**. Project facilitators were critical to the reliability and consistency of each of the three phases. These leaders were able to ensure that essential benchmarks were met, that participants understood and identified critical decisions, and that the simulation was valid and reliable across *each* group.

Table 2: Lessons Learned/Recommendations for Conducting a Large MCI Simulation

1	Strong training for facilitators is needed.
2	Facilitator training must be role specific, and facilitators must stay in those roles throughout the different evolutions.
3	Mass Casualty Supply Unit (MCSU) and Medical Ambulance Bus (MAB) familiarity is required if these assets are used in a simulation.
4	Every position and form within the regional <i>EMS Multiple Casualty Incident Manual</i> does not need to be utilized.
5	All System members must participate in MCI simulations.
6	The initial focus of an MCI simulation must be operations, not patient care.
7	To ensure that the appropriate MCI response assignments occur, script the initially responding units.
8	For a live-patient simulation, use heavy mannequins and live actors.
9	Every MCI callback participant received Virginia Office of EMS Certification in MCI Management Level 2.
10	When providing the initial dispatch over the radio, remember to announce "This is an exercise."
11	MCI role vests are used for participants, and other colored vests are used for facilitators.
12	Short orientation sessions to units and equipment that participants may not be familiar with are necessary.

Strong training for facilitators is critical prior to any simulation (Rådestad et al., 2012). Initially, training for facilitators consisted of no more than a two-hour session. This session outlined the objectives of the lesson plan, facilitator roles, logistics to execute the phases, and scheduling procedures. The training did not detail the critical benchmarks and tasks of each position in the MCI response. Furthermore, facilitator training must be role specific, and facilitators must stay in those roles throughout the iterations. In one case, a facilitator did not understand the operations of a role and provided incorrect directions to participants. This situation required the researchers to correct the facilitator and the participants in the midst of the simulation.

The design of the simulation was another strength identified by the facilitators and research-project participants. Scripting was essential to control decision-making, infuse resources to obtain a consistent response, and replicate critical benchmarks (Pan American Health Organization, 2011). The *NOVA EMS Multiple Casualty Incident Manual* defines specific response roles for each unit. Scripting ensured that the appropriate MCI response assignments occurred. Without direction of responding units to their appropriate roles, Phase 3 could have been executed differently for each evolution.

To create an identical scenario for each evolution, a role-player quickly arrived on the scene after the first fire-suppression unit and EMS unit arrived. This role-player assumed Command and assigned these two initial units to the Triage Unit and Transportation Group, respectively. When the battalion chief or EMS Supervisor arrived, Command assigned this unit to the "EMS

Branch." This process focused the response on MCI operations and placed units in the roles that they had discussed and practiced in Phase 1 and Phase 2 of the research project.

To reinforce each participant's MCI role, a facilitator would quickly give the appropriate MCI vest to each participant. These facilitators would also be available to provide prompts to the participants. The use of different-colored MCI role vests for simulation participants and facilitators cannot be overstated. Like a real incident, participants had difficulty identifying who filled the roles of the MCI response (Morris, 1986). This procedure helped *script* the simulation and guide the participants. It also made their roles apparent to all other participants. Early in the simulations, participants often misconstrued facilitators as patients or responders. This problem was corrected by placing all facilitators in orange traffic vests. The orange vests eliminated confusion and made the facilitators identifiable but *invisible* to the participants.

Another important aspect of the simulation design was the use of heavy mannequins and live role-players as victims. Six life-size mannequins and nine role-players were used as victims in Phase 3. The use of mannequins and real people slowed down the movement and packaging of patients. Some of the 100- to 200-pound mannequins required significant physical effort by the crews to move and package. In addition, live ambulatory role-players required confining to prevent them from roaming the scene (Mistovich, Hafen, & Karren, 2010). The use of mannequins and live personnel provided an air of realism to the simulation.

The value of the *no-fail* approach while conducting the simulation was apparent to the research authors and the participants. In the debriefing discussion outlined previously, participants reiterated the benefit of the facilitators' presence. Many participants stated that they believed that the simulation was focused on student learning. The scalable nature of the MCI simulation cannot be overstated. The simulation focused on the initial six units (i.e., three ambulances and three suppression units) responding to a MCI. The initial actions of these first units will positively or negatively impact the effective response to an incident. This conclusion is consistent with Hsu et al. (2005) who identified the concept that implementing initial actions is an essential competency of disaster training.

Lessons Learned/Recommendations to Improve MCI Response and Operations

Through facilitated discussions and observations by the research-project authors, several lessons learned or recommendations were identified to improve MCI response and operations. These recommendations encompass six subcategories: (1) command, (2) triage, (3) treatment, (4) transportation, (5) MCSU operations, and (6) *EMS Multiple Casualty Incident Manual* suggestions.

Command lessons learned/recommendations.

Table 3 lists eleven command recommendations to improve the response to an MCI. These lessons learned focus on the appropriate implementation of incident command practices, effective communications, and operational discipline.

As noted previously, the donning of role-specific MCI command vests was essential to the success of the research project (Streger, 1998). Confusion readily occurred when personnel did not wear vests designating their response roles. During the simulations, valuable time was taken identifying who filled which roles. In addition, unnecessary communications often occurred between personnel who were unsure of response roles. Vests eliminated much of the confusion.

Personnel must be familiar with appropriate command terms used in the project. During Phase 3, personnel often became confused between the designation of a unit and a group. Command personnel also incorrectly designated the EMS Branch as EMS Group and Medical Group as Medical Branch.

Some command recommendations focused on communication. Personnel must understand appropriate reporting chains in the Incident Command System (ICS). Early in the simulation, Command was established. Shortly thereafter, the EMS Branch was designated to a Command officer to manage the MCI response. On several occasions, units reporting to the EMS Branch called Command directly for resource requests and situation updates. As Command was a facilitator, the unit was directed back to the EMS Branch with these requests and updates to reinforce the appropriate reporting lines.

The chief officer should manage the EMS Branch like an Incident Commander (IC) managing an entire incident. The most successful EMS Branch Directors were experienced battalion chiefs and captains who managed the EMS Branch as if managing an actual

Table 3: Command Lessons Learned/Recommendations for Improving MCI Operations

1	It is essential that personnel wear MCI vests.
2	Personnel must be familiar with the appropriate command terms.
3	Personnel must understand appropriate reporting chains in the ICS structure.
4	The EMS Branch Manager must manage like an Incident Commander managing an entire incident.
5	The EMS Branch Director must manage from his/her vehicle and not roam the scene.
6	The EMS Branch Director does not manage from the Transportation Group.
7	The NOVA Consolidated Command Board is used to manage the EMS Branch.
8	The EMS Branch Director does not become concerned with the exact numbers of patients in each group throughout the incident.
9	Patients are not numbered on an MCI.
10	Unit officers must listen closely to their radios to avoid missing important radio communications.
11	Unit officers must be disciplined and not get involved in patient care or movement.

incident. These participants (although inexperienced in the specifics of MCI management) followed basic principles of managing any incident. They communicated through the chain-of-command, managed resources, and requested regular updates. The EMS Branch Director should use the NOVA Consolidated Command Board to manage the EMS Branch.

In preparation for the simulation discussed in this article, the researchers determined that providing training in the use of all five command boards was not feasible. Furthermore, the EMS Branch would often be filled by a battalion chief or experienced captain. These individuals were familiar with the standard day-to-day command board. Through all 18 evolutions, there were recurrent successes using this board. Participants were able to effectively track and assign units. They were also able to readily establish triage, treatment, and transportation groups using this command board.

Strong incident management is critical for a MCI (Mack, 1999). This situation was also an important theme across the command recommendations. EMS Branch Directors did not need to become concerned with the exact numbers of patients in each group throughout the incident. Several of these Directors did become very frustrated in this project because they attempted to track the number of patients in each group. In some cases, they even tried to track the number of immediate, delayed, and minor-injury patients. As patients moved between these groups (and their triage designations changed), these numbers constantly changed.

Lessons learned in this research also suggest that patients should not be numbered in an MCI. In the present study, participants did attempt to number patients as they moved through the different groups. For example, Triage radioed Treatment and said, "Send a crew to pick up Patient No. 1 and Patient No. 2 for transport." The numbering of patients quickly became confusing, and the numbering became incorrect. A more appropriate transmission would be "Send a crew to treatment to pick up one Red and one Yellow Patient for transport."

Lessons learned also suggested the following recommendation: An EMS Branch Director should manage from his or her vehicle and not roam the scene. Successful EMS Branch Directors did not roam the scene. They positioned in a command vehicle where they could see the progression from triage to treatment to transportation. They often remained in their command vehicles using their mobile radios and command boards. This vantage point provided a quiet, comfortable, and fixed location for the management of the Branch. Also, some inexperienced EMS Branch Directors positioned their command locations with the Transportation Group. This situation interfered significantly with the operations of the Transportation Group. The EMS Branch Director was also drawn into their operations, neglecting overall management of the

Branch. In short, an EMS Branch Director should not manage from the Transportation Group.

As a final command lesson learned/recommendation, the need for discipline across the unit-officer level is a *must*. Unit officers must listen closely to their radios to avoid missing important radio communications. Throughout the scenarios, several officers did not listen closely to their radios and, as a result, missed vital communications. Officers often became so focused on their tactical work (i.e., triage) that they neglected to hear inquiries from their supervisors or receive safety information. Furthermore, unit officers must be disciplined and not get involved in patient care or movement. Unit officers wanted to help facilitate the movement or care of patients. Many would often become involved in packaging or patient care. This situation severely detracted from their situational awareness, command, and control of their units or groups; the result was ineffective communications.

Lessons learned/recommendations for triage.

Six triage lessons learned/recommendations were identified to improve the response to a MCI (see **Table 4**). Triage must be well known by the crews before an incident. START is the standard triage scheme used in the NOVA region. During nearly every evolution, at least one or more patients were triaged incorrectly.

According to START, the scenario consisted of three red-tagged patients, three yellow-tagged patients, six green-tagged patients, and three black-tagged patients. During most of the evolutions, participants poorly triaged patients. Red-tagged patients were occasionally triaged as black-tagged patients, despite having intact respiratory efforts. Participants also tended to over-triage casualties based upon their injury type instead of using START. The scenario consisted of several walking wounded with minor injuries. In the school bus accident scenario, one patient complained of chest pain. Although this patient could walk, several crews triaged this patient as yellow. Yellow-tagged patients were often over-triaged based upon their injuries not RPM (respiration, pulse, mental status).

Another lesson learned/recommendation was the appropriate application of triage ribbons. When attaching a triage ribbon to a patient, it must be visible. The triage category of a patient must be visible to approaching responders. This visibility permits responders to quickly determine to which treatment area to porter a patient or whether the patient requires immediate transportation. When attaching a triage ribbon to a patient, this project suggests that it is best to tie a large amount of ribbon to improve visibility.

Some recommendations for the appropriate management of patients with minor injuries (i.e., walking wounded) were also identified. For example, one lesson learned was that a responder must be assigned to control and contain the patients with minor injuries early in the incident. Without proper oversight, patients

Table 4: Triage Lessons Learned/Recommendations for Improving MCI Operations

1	START procedures must be well known by the crews before an incident operation.
2	When attaching the triage ribbon to a patient, it must be visible.
3	Personnel will tend to over-triage casualties based upon their injury types instead of using START procedures.
4	Walking-wounded patients should not be placed next to the expectant patients.
5	A responder should be assigned to control and contain the patients with minor injuries early in the incident.
6	Patients found dead should be tagged with black treatment tags after all other patients have been transported.

with minor injuries will seek their own care and/or leave the scene. In one evolution, the patients with minor injuries were collected but were told to cross a roadway in the simulation area. Even in a simulation area, this procedure was unsafe because heavy apparatus and ambulances were approaching. Also, patients with minor injuries should not be placed next to patients tagged with a black-colored ribbon. This placement can have an adverse effect on them (Caroline, Elling, & Smith, 2012) by creating emotional injuries and increasing the stress of the patients with minor injuries.

Another triage recommendation included the application of disaster tags to deceased patients. The Triage Unit should consider tagging deceased patients (with black tags) after all other patients have been removed to the treatment areas. Accountability of all patients at an MCI is important. After all patients have been transported, consider tagging all expectant (black tag) patients. Attempt to obtain as much identifiable information as possible on the removable portion of the tag (name, possible age, injury, clothing, etc.). Then, place the bottom portion of the treatment tag on a destination form (i.e., dead at scene). Any incident creating a large number of patients can become a potential crime scene. Thorough documentation of the deceased at the scene is an essential portion of any EMS report.

Lessons learned/recommendations for treatment.

Table 5 identifies three lessons learned, and thus recommendations, to improve an MCI response in patient-treatment areas. First, an immediate-treatment area should not be established when patients can be rapidly removed from the incident. If there are immediate-treatment patients and EMS units available for transport, move these patients directly from Triage to Transportation. Many MCIs are characterized by a relatively small number of immediate-treatment

patients. By rapidly transporting these patients from the scene, a benefit occurs. There is no need to establish a logistically intensive immediate-treatment area. Treatment areas should only be established when you cannot place a patient directly into an ambulance. Use the approach of *GET THE RED OUT* to quickly move immediate-treatment patients from the scene. Although rapid transport is indicated, these patients must still be tagged in Transportation for appropriate tracking before leaving the scene.

A second recommendation (i.e., lesson learned) suggests that the detachable bottom portion of the disaster tag must be completed (at a minimum) in the treatment area. During evolutions of the MCI simulation, disaster tags were frequently incomplete, illegible, or did not match the patient. These tags must be completed as thoroughly as possible. The top portion can be completed while transporting the patient, but the bottom portion must be left with the Transport Recorder. This process also means that victims should not be asked to complete their own tags.

Third, most firefighters and officers were unfamiliar with the capabilities, equipment, and basic operation of the MCSUs and the medical ambulance bus (MAB). Personnel must be trained on these resources to know their capabilities.

Lessons learned/recommendations for transportation group. Nine lessons learned/recommendations to improve an MCI response were identified in the operations of the Transportation Group. These lessons learned are summarized in **Table 6**. The Transportation Group must ensure that no patient leaves the scene before being tagged. The Transportation Group tracks and coordinates the dispersion of patients to hospitals (Mack, 1999). If patients leave the scene before being tracked, it could be impossible to identify from where (and by what unit) they were transported. Patients who

Table 5: Treatment Lessons Learned/Recommendations for Improving MCI Operations

1	When there are red-tagged patients and EMS units available for transport, move these patients directly from Triage to Transportation.
2	In the treatment area, the detachable bottom portion of the disaster tag must be completed (at a minimum).
3	Most firefighters and officers were unfamiliar with the capabilities, equipment, and basic operation of the Mobile Ambulance Bus (MAB) and the Mass Casualty Supply Units (MCSUs).

Table 6: Transportation Group Lessons Learned/Recommendations for Improving MCI Operations

1	The Transportation Group must ensure that no patient leaves the scene before being tagged.
2	The first-arriving EMS Unit should remove its ambulance cot to use as a workstation.
3	The second-arriving ambulance to enter the triage area should find a red-tag patient, check out, and leave the scene.
4	The Medical Communications Coordinator (MCC) and Transport Recorder (TR) must stay together, communicate, and remain disciplined in their roles.
5	The Transportation Group Supervisor must keep a “Big Picture” view of transportation operations.
6	Based upon ambulance staffing, the Transportation Group Supervisor should consider assigning more than one patient to each ambulance.
7	Participants should peel off the bottom of the disaster tag — not tear it off.
8	Initially arriving ambulances should place any extra equipment (especially backboards) in a cache on scene.
9	Ambulances dedicated to transporting patients must not become committed in the treatment areas.

self-transport cannot be controlled, but patients being transported by EMS resources should be tracked and directed to appropriate hospitals.

The NOVA regional *EMS Multiple Casualty Incident Manual* assigns the first-arriving EMS unit to assume the role of Transportation Group. The first-arriving EMS unit should remove its ambulance cot to use as a workstation. Unit personnel should obtain the necessary transportation forms (at a minimum, Transport Recorder Sheets and Medical Communications Forms) and position themselves at an appropriate patient-exit point (PEP). There are two added benefits of removing the cot from the ambulance. First, this procedure effectively removes the crew and ambulance from being assigned an individual patient to transport. Second, the ambulance could be used as a stationary holding area for patients with minor injuries who may wander from the scene or need protection from inclement weather.

As the Transportation Group, the first ambulance crew assumes the roles of the Medical Communications Coordinator (MCC) and Transport Recorder (TR). The MCC and TR must stay together, communicate, and remain disciplined in their roles. They must remain organized and track the capacity of hospitals and patients transported, respectively. These two crew members must maintain discipline and not complete each other's tracking forms. When personnel complete each other's forms, they quickly become confused and begin to duplicate tracking. The MCC and TR must communicate concerning each unit, its patients, and its destination.

Another recommendation was to peel off the disaster tag stub — *do not tear it off*. The bottom of the disaster tag will tear off, but if it is torn off, the edges become flush with the sticker portion. This situation made it difficult to peel the adhesive portion off for attachment to the Transport Recorder Form. In simulations, this procedure became especially important in

cold weather with decreased manual dexterity.

Another lesson learned that led to a recommendation is the effective staffing of the Transportation Group. In addition to an MCC and a TR, a Transportation Group Supervisor is effective. The Transportation Group Supervisor must keep a *Big-Picture* view of transportation operations. In successive MCI simulations, the minimum number of personnel (for a medium-sized MCI) is three personnel. This number provides for a Transportation Group Supervisor, an MCC, and a TR and allows the Transportation Group Supervisor to provide radio communication for the group, supervise the transportation process, and corral arriving and departing ambulances.

As the Transportation Group starts to setup and track patients, they may not be fully operational before additional ambulances begin arriving at the scene. Upon arrival, the second-arriving ambulance should check in with the Transportation Group Supervisor. Then, the personnel should be directed to enter the triage area and obtain a patient who needs immediate care. After checking out and providing a transport stub to the Transportation Group, they should transport the patient (or patients). *GET THE RED OUT* is the moniker to quickly transport patients who need immediate care from the scene.

It is important to emphasize that ambulances are dedicated to transporting patients. They must not become committed in the treatment areas. EMS providers must exercise discipline and remain dedicated to their assigned roles in an MCI. On an MCI response, ambulances will be in short supply, and ambulance personnel must remain focused on transporting patients. Based upon ambulance staffing, the Transportation Group Supervisor should consider assigning more than one patient to each ambulance. An ambulance consisting of one firefighter and two paramedics may be capable of transporting *two* patients who need

immediate care. Although this number is not optimal, two experienced paramedics are capable of treating two patients who need immediate care in an MCI. In addition, a training unit of three personnel may also be capable of transporting one patient who needs immediate care and one patient who can be delayed. However, never delay transport of red-tag patients as the first priority.

Lessons learned/recommendations to improve use of MCSUs during a MCI. Four recommendations were identified to improve the use of MCSUs during an MCI response. **Table 7** summarizes these lessons learned. First, staffing an MCSU for immediate response can drastically improve an MCI response. An MCI has the need to send predetermined supplies to a scene based on the number and type of patients (Maniscalco & Christen, 1999). In successive evolutions, a three-person engine crew was assigned to deploy the MCSU resources into a treatment area. This rapid deployment and establishment of a treatment area provided important resources quickly. The handling and packaging of patients occurred more effectively when the MCSU was staffed.

Second, resources for MCSUs and MABs should be requested early in an incident. Lessons learned from this project led the authors to recommend developing automatic dispatch policies that always dispatch the MCSU with a MAB. Such a policy will provide resources to establish treatment areas quickly.

Third, the MCSU must be positioned close to the scene. These units directly support the establishment of the treatment areas. They must be positioned close to the treatment areas for easy setup. In addition, time should not be wasted on shuttling equipment to a distant treatment area.

Finally, the personnel staffing the MCSUs and MABs should have specifically labeled unit vests. During various evolutions, personnel assigned to these units were not easily identifiable. This identification was important

when equipment was needed from a MCSU or when crews needed direction when loading patients on a MAB.

NOVA regional EMS Multiple Casualty Incident Manual suggestions to improve an MCI response.

Through the multiple evolutions of the MCI training, three changes to the NOVA regional *EMS Multiple Casualty Incident Manual* were identified, as summarized in **Table 8**. First, the current set of NOVA EMS MCI Regional Command Boards was not familiar to most simulation participants. In multiple MCI simulations, most officers were also unfamiliar with the use of the NOVA EMS MCI Regional Command Boards. This situation included newly trained officers, paramedics, and senior command officers. The treatment, triage, and transportation areas operated on a very tactical level and performed most of their tracking with paper forms rather than command boards.

Second, the NOVA EMS Branch Board should be replaced with the NOVA Consolidated Command Board. The NOVA regional *EMS Multiple Casualty Incident Manual* suggests that the EMS Branch role should be filled by a Battalion Chief. These command officers are familiar with the daily use of the NOVA Consolidated Command Board. In multiple simulations, Battalion Chiefs and other trained officers were able to use the NOVA Consolidated Command Board to easily (and familiarly) assign and track units. However, these individuals were unfamiliar with and uncomfortable using the EMS Branch Board.

Third, the content of the NOVA regional *EMS Multiple Casualty Incident Manual* should differentiate the command roles for small and large MCIs. Effective MCI operations for a 15-patient incident did not require every position described in the *EMS Multiple Casualty Incident Manual*. Furthermore, in simulation preparation, it was difficult to identify the required roles. The *EMS Multiple Casualty Incident Manual* should consider describing the required MCI command roles

Table 7: Mass-Casualty Resource Lessons Learned/Recommendations for Improving MCI Operations

1	Staffing a MCSU would drastically improve an MCI response.
2	It is important to request the MCSU early in an incident and whenever the MAB is dispatched.
3	It is important to position the MCSU close to the scene.
4	MCSU and MAB personnel should have specifically labeled unit vests.

Table 8: NOVA EMS Multiple Casualty Incident Manual Suggestions to Improve a MCI Response

1	The current set of NOVA MCI Command Boards were not familiar to most participants.
2	EMS Branch Board No. 5 should be replaced with the NOVA Consolidated Command Board.
3	The content of the NOVA <i>EMS Multiple Casualty Incident Manual</i> should differentiate the command roles for both small and large MCIs.

based upon the number of patients, geographic dispersion of patients, or other factors.

Limitations of Study

This study is limited in several ways. First, each evolution was closely guided and scripted. At the beginning of Phase 3 (the simulation) of the project, participants were assigned by the IC, who was one of the researchers. The close scripting and assignments drove the actions of the participants and thus limited autonomy and incorrect actions. The researchers believed that this scripting was essential to make the simulation reproducible and to focus on the most important early actions of an MCI response.

The small number of casualties and responding apparatus in the final scenario could also be considered a limiting factor. The researchers believed that most of the local MCIs consisted of 10 to 15 patients (Johnson & Calkins, 1999). The number of apparatus for each iteration averaged three suppression units and three EMS units with one battalion chief. An actual MCI response would warrant a much larger response. The number of apparatus could not be expanded because in-service crews and apparatus were utilized in the research project. The apparatus and crews used did allow, however, the project to focus on the most important MCI staff positions.

The simulation design also focused on MCI operations, not patient care. An effective MCI response starts with effective communication and coordination (Johnson & Calkins, 1999). Detailed patient-symptom descriptions can detract from the focus on the MCI operation. In these scenarios, the care provided (and required) was very limited to encourage participant focus on operations (i.e., triage, communication, patient tracking, transportation, etc.). With the focus on MCI response and roles, other considerations of a large-incident response such as hazard mitigation, fire suppression, presence of hazardous materials, or threats of violence were not included.

MCI Training Recommendations Emerging from the Study for the Loudoun County Fire and Rescue

Five future recommendations for MCI training were identified for Loudoun County Fire and Rescue. First, future MCI training and simulations must be repeated in all future volunteer and career EMT-Basic and Firefighter Level I Courses. A strong MCI response can only be ensured when every responder understands the roles and responsibilities of an appropriate response. This understanding is especially true when any responder can be assigned to an essential role such as one with the Transportation Group or Triage Unit.

Second, fire and rescue system member participation in MCI training must be a requirement. As a combination fire and EMS organization, volunteers are a large portion of the response in Loudoun County. Participation by volunteer personnel must be strongly encouraged to ensure a consistent response. One way to encourage this participation is to award the Virginia Office of EMS Mass-Casualty Incident Management Certificate for participation in MCI training.

Third, START triage training must be reinforced and retrained regularly. Providers of multiple experience and certification levels struggled to remember START. START triage must be retrained (at least) biannually.

Fourth, another MCI training and simulation must be developed and scheduled on a larger scale. The MCI simulation conducted in this lesson plan consisted of 15 patients. A future simulation must increase the number of patients or complexity of the incident. For example, the department could conduct a larger MCI simulation with (at least) **30 live patients**, increasing both size and complexity. Another scenario could include a slightly larger MCI simulation with **20 live patients in two geographically separated locations**. This scenario would require coordination remotely (via radio) among EMS, Treatment, and Transportation Branches. The scenario would also require a Staging component. A third MCI scenario could involve an active-shooter scenario with law enforcement.

Complexity could also be increased in other ways. Scripting of the simulation and facilitators could be significantly decreased or removed. This situation would provide a more realistic simulation because responders would have to identify and take the correct actions without guidance. Additional jurisdictions could be added to the response simulation. This situation would evaluate the ability of responders to work together in a large MCI response.

A fifth and final recommendation is to evaluate future actual MCI incidents in comparison to these recommendations. The authors should evaluate all MCIs and provide lessons learned. These reports should be published in department-wide reports to promote organizational learning.

Conclusions

Findings offered in this article suggest that a closely scripted mass-casualty simulation can improve first responders' readiness to perform successfully to an actual incident. Focusing on the initial-response positions, using facilitators, and using a *no-fail* approach can teach participants how to confidently implement an effective MCI response strategy. Furthermore, conducting a closely scripted simulation over 18 iterations identified recommendations for conducting a future MCI simulation, improving response to actual MCIs, and improvement of the regional *EMS Multiple Casualty Incident Manual*.

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Endnotes

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²Loudoun County, VA, has been one of the fastest growing counties in the nation since the late 1990s (County of Loudoun, 2016). The Loudoun County Fire and Rescue (LCFR) is a career fire-rescue department located approximately 30 miles from Washington, DC. With nearly 500 field personnel, LCFR is part of a large combination fire-rescue system, which includes 17 individual volunteer fire and rescue companies operating from 24 fire and rescue stations.

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Exploring the Retention Calculus: The Motives, Expectations, and Satisfaction of South Carolina Volunteer Firefighters

Abstract

A large majority of fire departments across the United States (US) depend on volunteer firefighters for emergency responses. Over the last decade, suburban and rural populations have soared, while the numbers of volunteer firefighters have fallen by over 10%, suggesting that improvements in recruitment and retention are necessary to counteract that trend. This article presents the results of a mixed methods research design that evaluates volunteer firefighters' motives to join, their expectations to continue service, and their contemporary satisfaction with service. The project evaluates how these different factors affect volunteers' prospective service length. Results suggest that a values orientation is the most prevalent influence affecting firefighters' commitment to the volunteer fire service, but that personal enhancement and understanding goals were best able to systematically explain variance in the prospective service period. The findings presented here are used to outline recommendations to improve recruitment and retention of volunteer firefighters and reduce levels of insularity in recruitment networks.

Keywords: *volunteer fire service, volunteer firefighter, recruitment, retention*

Introduction

Many, if not most, fire-service leaders do not oversee departments that service compact urban areas. High rates of automobile ownership, easy availability of peripheral land, and a lack of central planning authority have made urban sprawl particularly prevalent within the United States (US) (Hamidi & Ewing, 2014). Since 1950, the population levels of US cities have remained relatively stagnant while their surrounding suburbs and rural areas have experienced sharp increases in numbers of residents (Nechyba & Walsh, 2004). These rural municipalities and thinly inhabited counties pose significant challenges with respect to essential public services like fire protection. First, the lack of population density means that an arguably thin tax base exists from which to provide anticipated services. It also means that fire departments may have extensive boundaries to cover — regions that if adequately defended would account for sizeable rosters of career firefighters.

The longstanding solution to this problem has been reliance upon volunteer firefighters to either deliver these services (i.e., *wholly volunteer* departments) or provide ranks of support for career fire-service leaders to organize (i.e., *mostly volunteer* departments). Thus, in those areas of the country that have been growing over recent decades, adequate fire protection is typically dependent on the availability and willingness of volunteers.

As is the case throughout the US, South Carolina (SC) fire chiefs must maintain a work force that is capable of mitigating a multitude of emergencies. In those communities that lack the tax base necessary to fund rosters of career firefighters, this work is done by volunteer firefighters. Critically, the numbers of these volunteers *are declining*.

According to Karter and Stein (2013), 1.1 million US firefighters were active in 2011, and of these, nearly 69% (756 thousand) were volunteers. The US population has increased by 32% since 1985, but the corresponding number of volunteer firefighters has declined by more than 10%. Stocker (2004) similarly observes an 11% decline in volunteers between 1983 and 2001, when he indicates that 785,000 were serving. This evidence of decline suggests that the number of volunteer firefighters has dropped to its lowest recorded value in the last quarter of a century. Thus, the current trend in volunteerism represents a significant threat to the safety of the American public; we need to better understand and counteract this trend.

SC's fire service is a representative context of this phenomenon. SC lacks a major metropolitan area, but it does possess several large cities. Its urban municipalities have either been stable, or in decline, but the suburban areas reflect the national trend of growing sprawl. SC suburbs and surrounding rural areas have shown continuous growth from those citizens who are

lured by more affordable housing (despite the longer commutes that relocation entails). The recent US Census data (US Census Bureau, 2013) suggests that SC closely approximates the national statistics in nearly every recorded demographic category. When considering the balance of these various criteria, SC offers an excellent opportunity to better understand the problem of declining numbers of volunteer firefighters.

One should note, however, that a decline in voluntary group membership is an issue that has broad reach. This topic clearly is not limited to fire protection. As Putnam's (1995, 2000) *social capital* perspective suggests, American's membership in social groups of all types have been dwindling along with the movement away from the urban core.

The process of recruiting and maintaining rosters of volunteer firefighters is very much related to this concept of social capital. Volunteer fire service typically is a family tradition, and these familial connections operate as ties that bind past, current, and future rosters. Nevertheless, these traditional paths of recruitment have consequences. Volunteer rosters tend to be insular in nature — white male firefighters with strong local family ties. Given the ongoing declines in membership, however, fire chiefs must now consider how to break out of existing networks and recruit more broadly. These leaders must at the same time ensure that they meet the expectations of their current rosters of volunteers. Together, then, fire chiefs for wholly or mostly volunteer departments are facing a number of difficult constraints. They are operating in low-resource environments, servicing communities with dwindling social capital, and attempting to retain and expand insular volunteer networks.

This research sheds some new empirical light on how these different dilemmas play out in the context of SC. The study adopts Clary, Snyder, Ridge, Stukas and Haugen's (1998) six goals associated with volunteerism and targets three critical concepts related to volunteer fire service: (1) motives to join, (2) expectations to continue service, and (3) current satisfaction with service. This study evaluates how initial/naïve motives transform into contemporary/informed expectations and then determines how these motives, expectations, and satisfaction are related to volunteer firefighters' anticipated service periods.

Motives, Expectations, and Satisfaction

Clary et al.'s (1998) description of the six generalized motives identifies those factors that should systematically be related to volunteers' prospective service periods. The authors ascribe the following abstract volunteer motives:

1. **Values** — Altruism or the concern for the welfare of others;
2. **Understanding** — Opportunities to learn, practice, and apply skills and abilities;

3. **Career** — Improvements in volunteers' job prospects or career enhancements;
4. **Social** — Solidarity and therapeutic motivations like combating isolation, reducing depression, and lessening loneliness and emotional deprivation;
5. **Protective** — Guilt relief and evaluation of personal resources compared to others; and
6. **Enhancement** — Increase in self-esteem, self-improvement, and/or self-confidence.

Clary et al.'s (1998) factors consider volunteerism from a generic perspective (e.g., volunteering at the library, a soup kitchen, a parent-teacher association, or a local recreational organization was considered as the same action). This research seeks to understand the extent to which these six factors emerge within a typical volunteer firefighter's decision calculus (i.e., one that is likely to differ given the close proximity to danger). The underlying hypothesis is that these six items operate as prospective naïve motives to join the fire service, but that they also become fully informed expectations that must be met in order for the volunteer to continue within the fire service.

Conceptualizing Motives, Expectations, and Satisfaction

Keeping firefighters on the roster is critical. Therefore, in addition to understanding initial motives to join, we must also understand contemporary expectations to continue service. A *motive* is the reason an individual chooses to perform a particular act, or one's impetus for action (Mills, 1940; Dwyer, Bono, Snyder, Nov, & Berson, 2013). One can think of the motive concept as the initial driving force that encourages a person to engage in some form of behavior. In terms of the research presented here, the goal is to improve our understanding of the possible rationales that drive members of the public to participate within the fire service.

Motives to join the service are both naïve and malleable. Individuals that watch a fire truck roll by with lights flashing and sirens blaring might assume that it is on the way to rescue a child from a burning building. These citizens probably do not consider the countless number of hours firefighters spend in training, checking equipment, and readying apparatus to respond to emergencies. By comparison, the time preparing to respond far exceeds the amount spent on scene. This disparity of perception clearly is evident in the motives of volunteer firefighters. Those that decide to volunteer so that they can rescue the child from a fire simply may never get that opportunity.

Naïve motives to join will eventually morph into informed *expectations* of what volunteer fire service actually entails. Thus, the simple identification of motives to join is insufficient to the task found here. We may fully understand these original motives, but without an understanding of volunteers' subsequent expect-

tations for continued service, fire chiefs lack systematic knowledge about their capacity to retain members. In fact, given the large training curve involved in the fire service, it may be more critical to understand expectations to serve and prevent the losses of well-trained and experienced volunteers.

No one can fully appreciate, or know what to expect, when they first join the volunteer fire service. Once they serve, expectations are developed that may diverge sharply from their initial motives to join. Quite simply, naïve motives bring volunteers to the fire-service organization, expectations are what they learn through indoctrination and participation in the organization, and *satisfaction* of those expectations is what actually keeps them in place. The extent to which the organization meets the firefighter's expectations will drive his or her current satisfaction level and engender a willingness to continue serving the department and local community.

Wholly Volunteer Versus Mostly Volunteer Departments

This study considers only wholly volunteer and mostly volunteer departments where the numbers of volunteer firefighters are critical to meeting operational demands. The expectation is that substantive differences may exist in the recruitment and retention of firefighters across these two institutional structures. In contexts where volunteers and career personnel work side-by-side (Ganesh & McAllum, 2012), volunteers may receive limited training by comparison, operate with a more limited knowledge of the discipline, and possess limited authority despite the significant consequences of their tasks. It may also be that volunteers in departments with professional staffs have weaker ties to the organization, since the possibility exists that the department may hire someone to support the organization in their absence. Generally, the expectation is that firefighters in mostly volunteer departments will exhibit a diminished level of commitment versus those in wholly volunteer departments.

Demographics and Insularity

Maret (1983) suggests that the recruitment of volunteers is a demanding task and that attrition over time is a serious challenge for any organization. This situation is especially true within the fire service where the most obvious constraint is the aging cycle. The highly strenuous job of fire fighting makes it more difficult, and at some point impossible, for individuals to contribute to the organization. As such, this study controls for the maturation of volunteers within the analysis.

Given the general insularity of the fire service (Chetkovich, 1997; Yarnal, Dowler, & Hutchinson, 2004), race and gender effects are likewise critical to understanding this particular topic. The typical volunteer firefighter (Thompson, 1993; Perkins, 1987, 1989) is a white male who has a family legacy of participation in the fire service. In addition to this legacy effect, aspects of social

reciprocity and civic responsibility also act as coercive influences. In small communities, these *family firefighters* likely experience stronger pressure to join and continue their service.

This insular social network and the rural nature of these departments make diversity in terms of race, ethnicity, and gender, a scarce trait. It is thus important that an attempt is made to parse any disparities associated with non-legacy, minority, and female volunteers. Evidence of racial and/or gender discrimination and harassment clearly exist in the fire service (Chetkovich, 1997; Jahnke et al., 2012), but the ongoing decline of the rosters of volunteer fire departments means that fire chiefs must recruit outside of the insular network of family firefighters. Along those lines, an attempt is made to leverage systematic disparities in the volunteer service associated with nonlegacy, female, and minority volunteers.

Social Capital, Risks, and Equipment

Putnam (1995, 2000) identifies a macro-level decline in existing amounts of American social capital. Levels of civic engagement (e.g., voter turnout, religious observation, labor union membership, parent/teacher associations, and even bowling leagues) have been cast as being in an extended state of erosion. These trends would suggest that fewer individuals may be willing to serve their communities without remuneration, but we must consider other closely related explanations for volunteer service.

The *human capital* model (Becker, 1962; Becker & Tomes, 1986; Wilson & Musick, 1999; Freeman, 1996) suggests that individuals with greater resources, such as discretionary time, are most likely to participate in volunteer organizations. Correspondingly, those individuals with greater demands upon their time resources should be less likely to participate (i.e., declines in the ranks of volunteer firefighters could be a function of increasing demands elsewhere). In this analysis, familial commitments, such as spousal relationships and the demands of child rearing, are viewed with concern. These commitments not only make it less likely that an individual may join the volunteer fire service, but they should also be an underlying explanation of retention — volunteer commitments may erode under growing demands for family time.

Another systematic explanation of volunteer participation can be found in the high-risk exposure of fire fighting that may be an instrumental factor within the retention calculus. Motives to join the fire service can be tied to some individuals who are seen as risk seekers (Barlow, Woodman, & Hardy, 2013), but the realization of those risks may be substantively different than anticipated. It is likely that the acts of witnessing and experiencing risks in the form of close calls and/or injuries will influence one's willingness to continue to serve. The underlying relationship might run in either a positive or negative direction. On one hand, risk exposure could provide the satisfaction that risk takers seek

in the first place and therefore improve retention (Aksoy & Weesie, 2012). Alternatively, it could discourage more risk-averse volunteers from future participation because of the rational fear of serious injury or death.

Finally, it is important to examine the influence of departmental incentive structures on the volunteer calculus. Volunteer firefighters often make use of warning lights, sirens, and radios in their personal vehicles as part of their service to the organization. The possession of these devices can be seen as more than merely possessing the tools of one's trade. Warning lights, sirens, and radios represent technological challenges to learn and develop skills, but they also serve as powerful symbols of volunteers' time commitment and their exposure to heightened levels of risk on behalf of the community. For those departments that do not allow equipment prior to the completion of training, it tends to identify the volunteer firefighter as an indoctrinated member of the department. This type of symbolism can be very meaningful and influence volunteers' commitment to the organization in terms of eventual service length. Consequently, an effort is made to determine to what extent this symbolism affects retention.

Research Design

To better understand the dilemma of recruitment within the contemporary environment of declining volunteer firefighter rosters, this project utilizes a mixed methods framework. A qualitative concept mapping exercise initially identified the range of motives and expectations that volunteer firefighters consider upon joining and continuing their service. These factors were then used to construct a quantitative study of volunteer firefighters' prospective service length. Respondents' prospective service estimates are modeled to better understand how fire-service leaders can employ their scarce resources to promote roster stability. The remainder of this discussion of the research design used in the study is organized into two sections: (1) sample derivation and (2) analyses, estimations, and control variables.

Sample Derivation

To translate Clary et al.'s (1998) six factors to the fire service, a snowball sampling technique was used (Handcock & Gile, 2011). Ultimately, 25 volunteer firefighters from seven different SC departments in six different counties were interviewed.¹ New referrals continued until the research saturation point was achieved. At the conclusion of each structured interview, the research participant built a series of free-response concept maps (Kelly, 1955; Brown, 1992; Focht, Langston, & DeShong, 2001) using index cards with each card defining a single motive to join or a contemporary expectation of service. Larger cards equated to more important motives/expectations, and colored dots represented the level of satisfaction with each contemporary expectation. New response cards were added

until each respondent reached a saturation point or the point at which no new information was forthcoming (Glaser & Strauss, 1967).

The qualitative analysis revealed 26 unique responses that were seen as important either as a motive to join or an expectation to continue serving. Ten of the response items were eventually deemed duplicative or idiosyncratic, leaving 16 individual response items (see **Table 1**) that could be associated with the Clary et al. (1998) generalized volunteerism framework.

The results of the qualitative analysis informed the creation of a survey instrument designed to provide empirical leverage about motives, expectations, and corresponding levels of satisfaction. The survey instrument was distributed to a random, representative sample of volunteer firefighters in the state of SC. Because this research considers two separate institutional structures — wholly volunteer and mostly volunteer departments — the study adopted a stratified random sampling frame (Baker, 2002). The *US Fire Administration's National Fire Department Census* (2013) and the *SC State Firefighters Association* (2013) Membership Database were used to identify departments and establish the number of volunteer firefighters within each department.

The state of SC had 362 departments separated by the two strata — 115 mostly volunteer and 247 wholly volunteer. The initial population estimates suggested that there were 5,110 firefighters in mostly volunteer departments and 8,224 in wholly volunteer departments. The percentage of each stratum's composition and the magnitude of the overall population were used to calculate the number of requested respondents.

To operationalize the sampling strategy, fitted lists of random roster positions were emailed to each department. One crucial adjustment was made to the sampling frame in order to ensure the representativeness of the sample with respect to race and gender. Given the small number of females and minority participants (Thompson, 1993; Perkins, 1987, 1989) within the fire service, an oversample of these categories of volunteers was conducted. The participation announcement asked each department to forward the survey to all the females and minority volunteer firefighters. In the analysis that follows, survey responses are weighted to reflect the oversample of underrepresented categories within the population.

To record respondent observations, a webpage was created that listed each department and the random numbers associated with the volunteer firefighters' positions on the department's roster. The webpage served as a reference for departments participating in the survey. Respondents could only access the instrument through a dedicated hyperlink. Only the correspondence sent directly to each department contact contained the hyperlink. The reference website and research announcements did not contain the link to the survey and directed anyone interested to discuss their

Table 1: Volunteer Firefighters' Responses According to Volunteerism Factors

Response Item	Factor	Motive-to-Join				Expectation-to-Serve				Satisfaction			
		Min	Max	μ	σ	Min	Max	μ	σ	Min	Max	μ	σ
Helping Others	Values	3	4	3.90	.30	1	4	3.86	.42	1	4	3.77	.52
Civic Responsibility	Values	1	4	3.78	.49	2	4	3.80	.47	1	4	3.74	.58
Serving as Role Model	Values	1	4	3.31	.89	1	4	3.47	.74	1	4	3.42	.82
Feeling of Accomplishment	Enhancement	1	4	3.62	.63	2	4	3.68	.53	1	4	3.64	.59
Member Valued Public Service	Enhancement	1	4	3.64	.56	1	4	3.66	.57	1	4	3.56	.65
Excitement	Enhancement	1	4	3.53	.72	1	4	3.53	.69	1	4	3.49	.76
Obtaining Training	Understanding	1	4	3.31	.68	1	4	3.67	.56	1	4	3.56	.63
Acquiring/Applying Skills	Understanding	1	4	3.10	.92	1	4	3.29	.85	1	4	3.28	.89
Fellowship	Social	2	4	3.54	.62	1	4	3.60	.59	1	4	3.53	.65
Close Friend/Family Member	Social	1	4	3.01	1.13	1	4	3.00	1.06	1	4	3.08	1.09
Acquaintance	Social	1	4	2.93	1.09	1	4	2.92	1.09	1	4	2.93	1.11
Possess Sufficient Resources	Protective	1	4	3.14	.95	1	4	3.31	.83	1	4	3.21	.86
Payback Community	Protective	1	4	3.09	.94	1	4	3.14	.92	1	4	3.17	.97
Networking with Community	Career	1	4	2.63	1.00	1	4	2.87	.98	1	4	2.82	1.03
Gaining Full-time Employment	Career	1	4	2.33	1.16	1	4	2.56	1.18	1	4	2.51	1.28
Supplemental Income	Career	1	4	1.71	.99	1	4	1.89	1.10	1	4	2.04	1.23

Notes: Regression results from representative sample of South Carolina volunteer firefighters with oversample for nonwhite male firefighters. Mean Scores: 4.0 = high importance/satisfaction; 3.0 = moderate importance/satisfaction; 2.0 = low importance/satisfaction; 1.0 = no importance/satisfaction.

department's participation with their chief or training officer. All correspondence with department contacts and survey participants emphasized that only randomly selected firefighters should complete the survey, and it directed respondents not to forward the hyperlink to others.

After the initial email to the list of department contacts, responses from the departments indicated that the number of volunteer firefighters within the census was overestimated. For example, a department might receive instructions to forward the survey link to its 3rd, 44th, and 120th roster slots, and it might only have 30 volunteers. When appropriate, random numbers were regenerated based upon the department's actual number of volunteers. At the inception of this research, available census estimates suggested that there were 13,334 volunteer firefighters in SC. The study's revised population estimate suggests that there is a maximum of 8,465 volunteer firefighters in the state. The number of volunteer firefighters serving was only 63% of the projection found in state and national databases, suggesting that the problem of declining numbers of volunteers is perhaps worse than originally believed.

With some further investigation, it was discovered that 42 of the departments that could be contacted via telephone in fact had fewer volunteer firefighters. A number reported having less than 50% of the anti-

pated roster size. Again, when appropriate, the roster sampling strategy was revised to align with the corrected department information. A total of 284 respondents (i.e., a raw 19% response rate) were received from the revised 1,517 requested roster positions. Of the 284 initial respondents, listwise deletion was used to eliminate mostly incomplete responses to yield our final sample of 217 respondents (a refined 14% response rate).

Analyses, Estimations, and Control Variables

The analysis that follows proceeds along two lines of inquiry. First, volunteer firefighter responses regarding the six volunteerism factors (see Table 1) are evaluated using error bar plots that contrast motives with expectations and satisfaction. This evaluation provides new leverage on the relative import of Clary et al.'s (1998) categories within the context of the volunteer fire service. Then a continuous variable of firefighters' assessment of their remaining service period is modeled. That continuous variable is estimated with weighted least squares, and we evaluate four separate specifications. The first is a baseline model specification that only comprises the alternative explanations for firefighters' estimated service period discussed previously. The second specification introduces controls for

the six generalized motives to join, followed by a third specification associated with expectations to serve and a fourth specification for contemporary levels of satisfaction. These models thus provide knowledge about whether naïve motives, informed expectations, or contemporary satisfaction best explain SC volunteer firefighter retention. In each specification, the analysis controls for the respondents' mean response-item value within each of the six categories of motives, expectation, and satisfaction.

To control for aspects of firefighters' age and past service, an interactive variable of age cohort and current years of service to the department (see **Figure 1**) was created. The mean value and standard deviation of respondents' age ($\mu = 43$; $\sigma = 14$) was utilized to create four separate intervals (18 to 29; 30 to 43; 44 to 57; and 58+). Next, these four categories were interacted with the respondents' existing years of service. As expected, findings show a declining slope for each subsequent age cohort. One should note, however, that the slope of each category is positive, meaning that those with greater service anticipate longer service to their department. This relationship can even be found for the oldest (58+) age cohort, suggesting that the ties that bind one to the volunteer fire service

are fairly robust. Those respondents who had contributed significant amounts of service to the department appear to anticipate volunteering as long as possible.

The established lack of diversity within the volunteer fire service made it critical to incorporate both gender and race as alternative control variables. The oversampling technique used to generate the representative sample allowed for the evaluation of the influence of race and gender upon anticipated service to the department.² Qualitative results suggested that family legacy frequently was an influential motive to join. As such, white-male family firefighters serve as the baseline, or null category, and separate controls were included that identify those volunteers who did not possess a family history of fire fighting. The nonlegacy, female, and minority controls take the form of dichotomous variables.

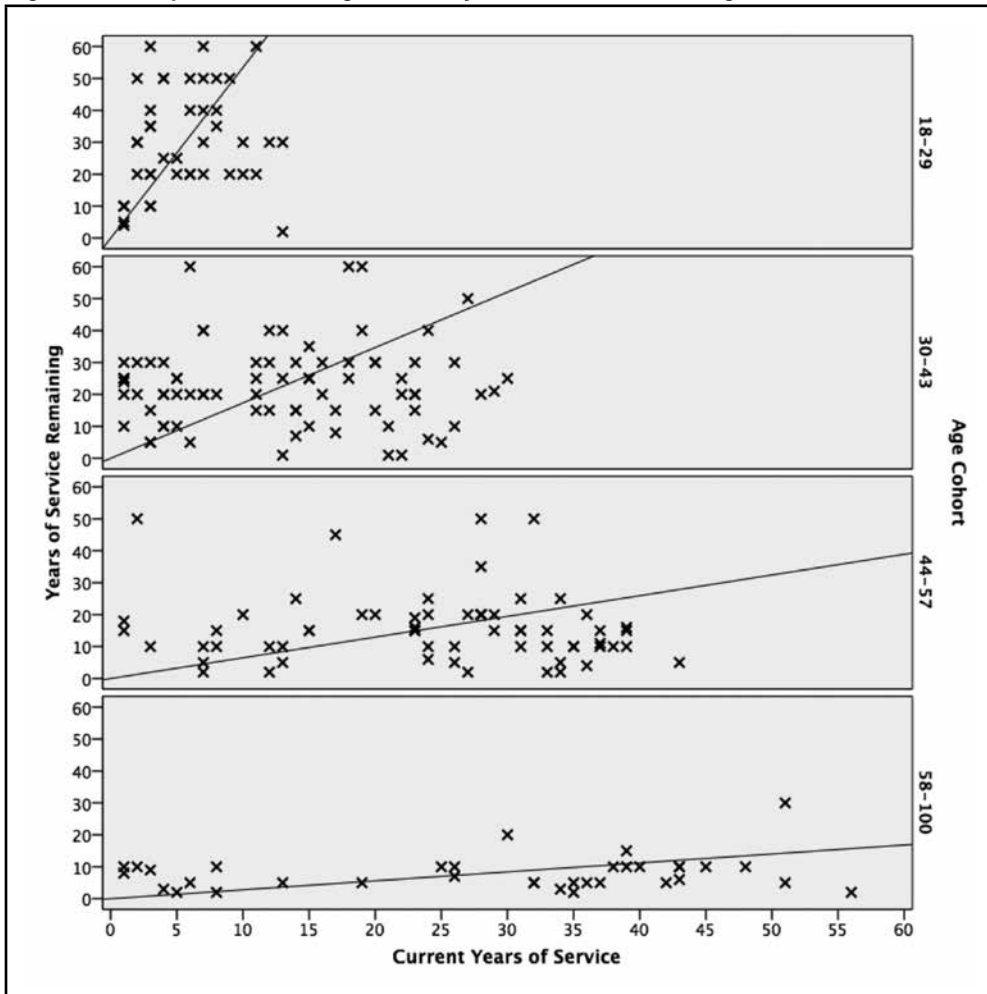
To evaluate the effects of social capital, the models control for the number of other civic groups in which the firefighters participated. Effects related to family obligations, close calls, and the presence of equipment in a respondent's vehicle were also included in the analysis. The variable associated with family obligations is an ordinal variable (0 = not married/no children; 1 = married/no children; 2 = not married/have children; or 3 = married/have children).

The control variable for close calls is an ordinal variable (0 = not witnessed or experienced close call; 1 = witnessed close call where a firefighter was nearly injured severely or killed; 2 = personally experienced close call where respondent was nearly injured severely or killed). The control variable for equipment in a vehicle is a dichotomous variable that controls for the presence of an emergency light, siren, and/or radio in a personal vehicle.³

Naïve Motives to Informed Expectations to Satisfaction

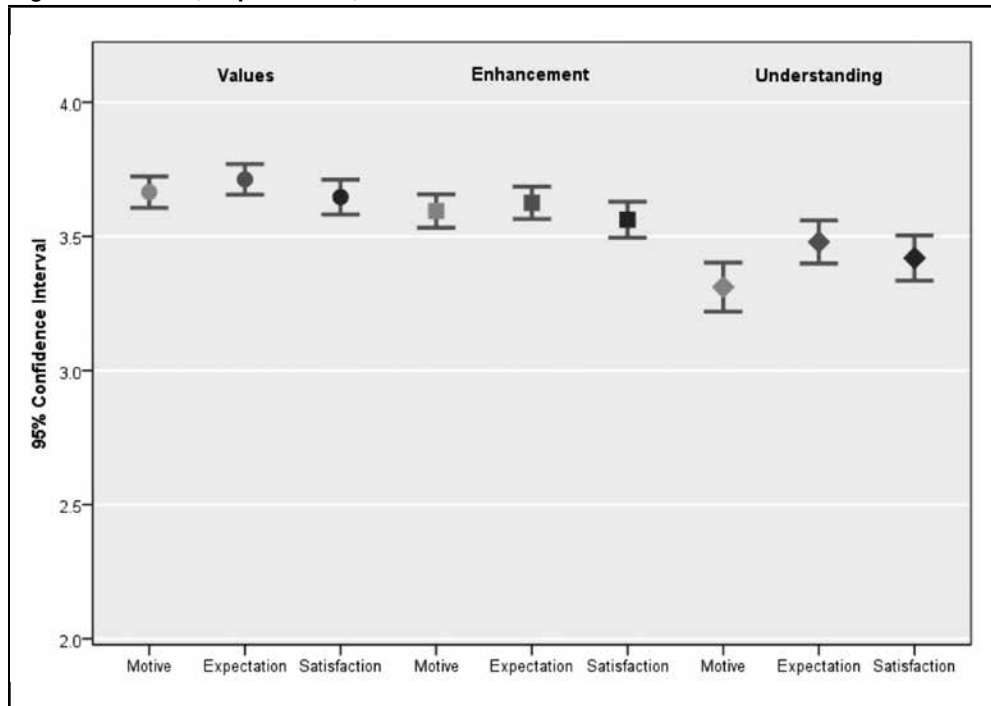
Figures 2 and 3 demonstrate the assessed importance and satisfaction associated with the Clary et al. (1998) volunteerism factors. The robustness of values within SC firefighters' assessments clearly is apparent within these data.

Figure 1: Anticipated Remaining Service by Current Service and Age Cohort.



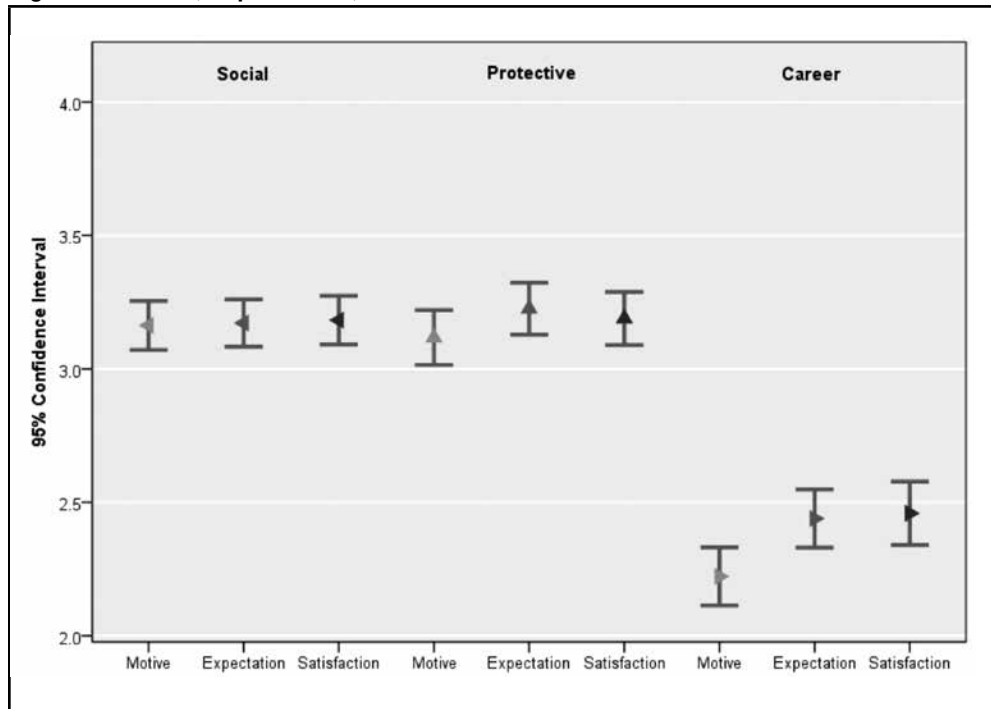
Notes: Cohorts established with the mean value and standard deviation of respondent's age ($\mu = 43$; $\sigma = 14$).

Figure 2: Motives, Expectations, and Satisfaction for Volunteerism Factors: Tier 1



Notes: Mean scores: 4.0 = high importance/satisfaction; 3.0 = moderate importance/satisfaction; 2.0 = low importance/satisfaction; 1.0 = no importance/satisfaction.

Figure 3: Motives, Expectations, and Satisfaction for Volunteerism Factors: Tier 2



Notes: Mean scores: 4.0 = high importance/satisfaction; 3.0 = moderate importance/satisfaction; 2.0 = low importance/satisfaction; 1.0 = no importance/satisfaction.

Values is the highest ranking category and predominantly a function of response items associated with *helping others* and *civic responsibility*. Both of these items exhibit relatively little deviation (see Table 1). The emphasis on values increases slightly from the naïve motive to the informed expectation stage, suggesting that training and experience tend to reinforce

associated with being veteran firefighters. These enhancement responses also increase slightly with service in the organization and are marginally diminished in terms of current satisfaction. The divergence again is relatively minute, so it appears that SC volunteer departments are performing reasonably well on this criterion.

this values orientation. Simply stated, volunteer firefighters in SC appear to be highly motivated by public service to their fellow citizens, and that commitment does not seem to erode with actual service.

The prevailing level of satisfaction associated with values response items did show a marginal decline. Generally, it appears that these departments are meeting expectations, but the heightened level of import assigned to values means that fire-service leadership must seek ways to ensure that the altruistic goals of volunteers to aid their fellow citizens are not encumbered. It also may be critical to frame volunteers' participation from a civic-responsibility perspective. The relative satisfaction expressed on this scale suggests that SC departments are effective in promoting the values orientation of the fire service, but it is important to maintain that perspective given the evidence of declining rosters.

The need for recognition of volunteer firefighters' service can also be found within the enhancement goal category. This set of items tends to capture aspects of self-actualization and includes *feeling of accomplishment* and being a *member of a valued public service*. This goal likewise comprises respondents' desire for *excitement*, which is thought to be underreported because of the behavioral norms

Both public-oriented values and personal enhancement appear to be at the top of the list of reasons for joining and continuing service, but the third most notable factor is associated with learning and understanding (i.e., *obtaining training and acquiring/applying skills*). This subset of responses is somewhat unique to the preceding categories (see Table 1). It appears that learning and skill development are not as prominent as motives to join, but they are considerations that are cultivated through one's training and participation in the fire service. Notice the more substantial assessment of import from the motive to expectation stage. The increase is right at the 95% confidence interval, indicating that the difference is substantial and meaningful. Responses associated with values, enhancement, and understanding are all relatively high and stable, but the desire to learn new skills is somewhat of a lagging indicator. As shown in the section that follows (an analysis of volunteer firefighter retention), understanding performs quite differently than either values or enhancement considerations. Skill development that leads to understanding thus represents a valuable strategic opportunity for fire-service leaders to promote roster stability.

Volunteers' consideration of values, enhancement, and understanding comprise a primary tier of importance, and to a certain extent, there is some amount of overlap between the three concepts. Understanding gathered through training and skills development clearly affects the means through which a volunteer can help others and how they interpret their own accomplishments. These highly important and highly satisfying response items appear critical to successful retention efforts. The remaining three categories (i.e., social, protective, and career goals), however, represent subordinate influences within the volunteer calculus (see Figure 3).

Social-oriented influences (i.e., *fellowship, close friend/family member, and acquaintances*) are in a clearly defined secondary tier of importance and relative satisfaction. This particular finding may be somewhat surprising given the traditional images of the family firefighter (Thompson, 1993; Perkins, 1987, 1989) and tight insular networks of firefighters. The lack of meaningful variation across the different stages of service suggests that these firefighters did not necessarily volunteer to make friends and socialize with others. The desire for *fellowship* performs relatively better in this set of responses, and that item could conceivably be tied to a process of self-actualization and enhancement found earlier. In either event, this research demonstrates that on whole, social factors take a back seat to the promotion of values, personal enhancement, and understanding goals. In real terms, more gatherings and cookouts may not be an effective response to shrinking rosters.

Likewise, protective-oriented responses lie within this same tier. Unlike social responses, some evidence of maturation can be found throughout volun-

teer service (e.g., *possessing sufficient resources to volunteer*). This relationship suggests that volunteer firefighters may not subscribe to the protective-oriented guilt relief described by Clary et al. (1998), but some do begin to evaluate relative levels of resources upon serving. *Payback to the community for own success* probably is more closely related to the protective factor described by Clary et al. (1998), but respondents reported a much smaller increase in import of this item.

The lowest tier of importance and satisfaction is comprised of career responses, which makes sense given that the opportunity for a career position may not be available (i.e., wholly volunteer departments) or are extremely limited (i.e., mostly volunteer departments). Nevertheless, career responses experience significant increases in importance with training and exposure to the fire service. *Networking with business and community leaders* is more influential than *gaining full-time employment*, although both are assessed to be more important over time. Satisfaction levels approach their corresponding expectation levels, which suggest that respondents do not consider their career goals to necessarily go unfulfilled.

The final career-response item is associated with *supplemental income*. Although it is somewhat more important while serving, it is, by far, the least important and least satisfying of all response items. Respondents report that *supplemental income* is relatively more satisfying than it is important. This finding was also encountered during the qualitative interviews, wherein the large majority of snowball respondents reported that they appreciated any remuneration, but it was not necessary for them to join or continue their service. This finding suggests that fire-service leaders should not necessarily devote substantial amounts of resources to the creation of financial incentives. As discussed in the following section, these sums may be more fruitful when applied to training and helping volunteers acquire new skill sets. From a larger perspective, however, these results are substantively important as they demonstrate that the volunteer fire service will not be able to buy its way out of its current retention problem.

Understanding Volunteer Firefighter Retention

To better understand how these different factors affect SC volunteer firefighters' prospective length of service, a number of different regression models were estimated. Model results can be found in **Table 2**, which provides some useful insights on how fire-service leaders can strategically approach their retention efforts.

Beginning with the baseline model specification of alternative control variables, estimates show that there are meaningful differences between wholly volunteer and mostly volunteer departments. The significant parameter result ($p < 0.05$ one-tailed) suggests that those departments with paid staff have a systematically weaker relationship (i.e., four years shorter) with

Table 2: Weighted Least Squares Estimates of Volunteer Firefighters' Anticipated Service Period

Control Variable	Baseline			Motive-to-Join			Expectation-to-Serve			Satisfaction		
	β	(s.e.)	ρ	β	(s.e.)	ρ	β	(s.e.)	ρ	β	(s.e.)	ρ
Values				2.69	2.65	.31	3.42	2.93	.24	.92	2.52	.72
Enhancement Goals				2.73	2.30	.24	3.02	2.51	.23	5.51	2.34	.02
Understanding Goals				-2.87	1.67	.09	-3.15	1.87	.09	-3.59	1.86	.06
Social Goals				.27	1.68	.87	.09	1.89	.96	-.04	1.83	.98
Protective Goals				-.28	1.42	.85	-.22	1.43	.88	.76	1.38	.58
Career Goals				2.57	1.52	.09	2.18	1.44	.13	1.43	1.32	.28
Mostly Volunteer Department	-4.02	2.12	.06	-3.84	2.11	.07	-4.03	2.16	.06	-4.25	2.11	.05
Age 18-29 * Years of service	.99	.40	.02	.79	.41	.06	.81	.41	.05	.96	.40	.02
Age 30-43 * Years of service	.07	.14	.64	.04	.14	.77	.07	.15	.65	.05	.15	.74
Age 44-57 * Years of service	-.08	.10	.41	-.12	.10	.24	-.12	.10	.22	-.10	.10	.32
Age 58-100 * Years of service	-.31	.08	.000	-.32	.09	.000	-.35	.08	.000	-.35	.08	.000
Nonlegacy	3.33	1.77	.06	2.29	1.98	.25	2.46	1.98	.21	2.65	1.94	.17
Female	-9.04	4.15	.03	-9.30	4.12	.03	-9.44	4.12	.02	-9.04	4.08	.03
Minority	-6.59	3.29	.05	-9.16	3.46	.01	-9.08	3.45	.01	-8.58	3.33	.01
Family Obligations	-2.56	0.70	.000	-2.27	0.71	.002	-2.34	.70	.001	-2.10	.71	.003
No. of Other Civic Groups	-2.70	1.04	.01	-2.50	1.06	.02	-2.45	1.06	.02	-2.06	1.05	.05
Close Calls	.40	0.72	.58	.47	0.73	.52	.58	0.77	.45	.73	0.72	.31
Equipment in vehicle	2.27	1.77	.20	1.65	1.84	.37	1.17	1.82	.52	1.26	1.83	.49
Constant Value	31.04	3.06	.000	15.78	10.55	.14	14.40	10.59	.18	13.84	8.74	.12
Observations		217			217			217			217	
Adjusted R ²		.35			.36			.36			.37	

Notes: Weighted regression results from representative sample of South Carolina volunteer firefighters with oversample for nonwhite male firefighters. Probabilities represent two-tailed tests. Mostly volunteer is a dichotomous variable. Years of service variables are interacted with the age ranges indicated. Nonlegacy (no family history of fire fighting), Female, and Minority are dichotomous variables. No. of Other Civic Groups represents other civic groups respondent participates in at time of survey. Family Obligations represent an ordinal variable (0 = Not Married/No Children, 1 = Married/No Children, 2 = Not Married/Have Children, 3 = Married/Have Children). Close Calls represents an ordinal variable (0 = No Witnessed or Experienced Close Call, 1 = Witnessed Close Call, 2 = Experienced Close Call, 3 = Witnessed and Experienced Close Call), Equipment in vehicle is a Dichotomous Variable.

respondents' prospective service length. This result is intuitive, and it is reasonably consistent across the different model specifications. The result simply suggests that the ties that bind volunteers to the department are weaker when the prospect of a career employee fulfilling their duties is present.

As expected, the findings show systematic relationships associated with the interaction of the age cohorts and reported years of service. These relationships are confined to the earliest and last age cohorts. The youngest set of firefighters (18–29) had a positive relationship versus each year of service (i.e., for each year of current service they anticipate one more year of

service). Those in the 58 and older group had a negative relationship that can be associated with physical decline. In this instance, each year of service is associated with a third less year of prospective service.

While these demographic relationships may not be that substantively important, they do serve as a critical set of control variables that help one discern other relationships. One critical finding involves the insularity of SC volunteer departments. Parameters associated with female and racial/ethnic minority firefighters were each negative, sizeable, and significant. Female firefighters anticipated a nine-year shorter service period. While part of that result could be a function of

biological considerations, such as child rearing, the roughly seven-year difference associated with minority firefighters suggests that the underlying issue is more likely one of insularity and acceptance.

Unfortunately, this finding with respect to gender and race is not unanticipated (Chetkovich, 1997; Yarnal et al., 2004). Perhaps the more surprising result is found for nonlegacy firefighters who had a positive and significant ($p < 0.05$ one-tailed) parameter estimate. Family firefighters are often thought of as the foundation of volunteer departments. In SC, the evidence shows that nonlegacy firefighters may be relatively more committed to the service. This factor is a fortunate relationship for fire-service leaders because it indicates that they do not necessarily have to rely on existing recruiting networks. They can reach outside of the existing network and find loyal contributors, but these estimates also suggest that leaders must be focused on diversity and equality in order to retain them.

The results presented here also reveal that social capital and family commitments act to constrain the prospective service period. For each additional obligation to another civic group, the volunteer's commitment is roughly two to three years shorter to the fire department. The difference in family obligations is significant at the highest probability level and reasonably large (-2.5 for married; -5 for children; -7.5 for married and children). Remarkably, no evidence is found that risk exposure affects firefighters' commitment to service. The null result in this instance may be a function of systematic underreporting due to behavioral norms, or it may be tied to the strong-values orientation of volunteers to the local community.

The final estimate on the inclusion of equipment in vehicles is not particularly robust ($p < 0.10$ one-tailed), but we found it to be a curious relationship. Unreported estimate results found no evidence that departmental provision of the equipment had any effect upon the service period. However, the included equipment parameter did tend to perform rather well within unweighted model specifications. Because the unweighted samples provide relatively more leverage to the female and minority oversample, this relationship could indicate that equipment may represent an opportunity to reach out to more diverse volunteers. The result found here is not particularly robust, but it may represent a unique opportunity for fire-service leaders to consider and evaluate.

Attention now turns to the full model specifications that comprise the Clary et al. (1998) volunteerism controls for volunteers' initial motives, informed expectations and contemporary levels of satisfaction. The broadest available conclusion is that the model controlling for current levels of satisfaction performs best. This conclusion is meaningful because it indicates that volunteer firefighters' commitments may not be overly complex or path dependent. Essentially, these results suggest that volunteers come into the organization with naïve goal orientations, and their goals tend to evolve.

Neither motives nor expectations appear to take the form of a binding contract that governs their commitment to their departments.

In terms of initial motives, only two parameter results exhibit significantly different behavior — social goals and career goals ($p < 0.05$ one-tailed). Naïve goals associated with building social ties *adversely* affect firefighters' commitments to their department. The effect is roughly -3 years per response item interval (e.g., from low importance to moderate importance). Those with naïve career goals, however, exhibit systematically longer service periods in roughly the same magnitude (between 2 and 3 years). The recruitment of those seeking a social network does not seem to be particularly effective. The newness seems to wear off, and the available social rewards may be waning. Those who have a sincere interest in the fire service as a career seem to be slightly better candidates, although there may be some risk of them becoming disgruntled if opportunities do not eventually materialize.

The model associated with expectations to serve is largely consistent with the motives specification, but the parameter strength associated with career-minded volunteers falls just beyond the traditional significance level (now $p < 0.10$ one-tailed). The lesson seems to be that motives do evolve into informed expectations (see Figures 2 and 3), but the observed variance in *assessments of import* on different factors is not closely tied to projected service periods. Instead, it is the more straightforward *expressions of satisfaction* that matter.

When looking at contemporary satisfaction, some substantively interesting results emerge. First, the fact that firefighters expressed a level of satisfaction within the enhancement category is a critical indicator of their future commitments. For each increase on the response item, one can anticipate an additional 5.5 years of service. Plainly, those volunteer firefighters whose service contributes to feelings of accomplishment and an association with a valued public service are more committed. One should not overlook the emphasis on excitement, which if anything, is underreported in these results. If volunteers' service breaks up levels of monotony elsewhere in their lives, then they are more likely to continue their service. Thus, fire-service leaders seeking to maintain and expand rosters should emphasize the meaning and value of volunteers' service and perhaps not trample too hard on the occasional excitement encountered on the job. Satisfaction in this area offers meaningful increases in volunteer-service commitment.

The other critical factor appears to be the innate value of understanding and skill development amongst this sample of SC volunteer firefighters. The results suggest that those members who place an emphasis on training and skill development have systematically *shorter* service commitments. In this instance, it is between a three and four years shorter commitment per interval on the response item. This relationship would suggest that volunteer departments are not

as effective at emphasizing skill development as they could be. As shown previously (see Figure 2) volunteer firefighters' emphasis on understanding and skill development shows substantive increases from the initial motive stage. This result associated with retention shows that at least some portions of their rosters are going to move on once they learn the basics of service and the education process stalls. Changes in the remaining control variables hint that this lack of skill development may be particularly important to nonlegacy recruits.

In sum, results suggest that fire-service leaders seeking to retain and expand rosters should emphasize aspects of personal enhancement as well as understanding amongst their volunteers. This result does not mean that other factors like values orientation are not important. The assessed level of import associated with values is meaningful, but it simply does not exhibit much variance. The lack of variance on commitment to helping others and civic responsibility suggests that they are somewhat like necessary conditions to join. Volunteer firefighters have this orientation, and departments must carefully cultivate it. In addition to that factor, however, they should be working toward improving aspects of volunteers' personal enhancement and skill development in order to keep them engaged and committed to the service.

Conclusions on SC Volunteers and Recommendations

Based on the analyses presented in this article, what do we now know about the state of SC volunteer fire departments? First and foremost, the findings show that the current estimates (SC State Firefighters Association, 2013; US Fire Administration, 2013) of volunteer rosters are inflated. If anything, the sampling frame utilized in this study indicates that the decline in volunteer firefighters may be worse than initially thought. These results also tend to emphasize the prominence of three of Clary et al.'s (1998) volunteerism categories: (1) values, (2) enhancement, and (3) understanding.

In terms of recruitment and retention, the results suggest a lack of a long-term connection between motives to join and projected service length. This result means that typical members are becoming volunteer firefighters with naïve motives that develop and mature during service. Neither initial motives nor mature expectations appear to be robust explanations of retention. For the fire service, this result means that there are not really any limitations on recruiting. Much like the military, recruiting appeals can vary widely from volunteer to volunteer. This factor is not a liability for fire-service leaders; it is an asset. It does not appear to matter by what means fire-service leaders pull potential volunteers into the queue. Volunteers can be recruited with wide-spread appeals to different motives (the exception may be a strong emphasis on social goals

and networking, which is negatively related to service period). Recruits' expectations will eventually sort out, mature, and align with the dominant expectations within the organization (i.e., values, enhancement, and understanding factors).

The emergence of understanding factors in the primary tier of importance among expectations to continue service was due mainly to the increase in the importance of *obtaining training*. Snowball respondents repeatedly stated that they did not fully appreciate and understand the importance of training until after serving for several years. Understanding factors also represents a means by which volunteer firefighters can promote values like *helping others*. In many combination (career and volunteer) departments, there are separate and unequal training standards for career versus volunteer personnel. While volunteers may be unable to complete the massive amount of training required by a full-service, all-hazards department, a basic level of training should be consistent between the career and volunteer groups. This type of equivalence contributes to the volunteer feeling like a valued part of the organization. This equivalence also reduces the friction between career and volunteer personnel and acts to increase the level of satisfaction that a volunteer receives from values and enhancement. Many fire-service leaders have responded with the opposite tack — lowering standards in an effort to bolster retention — and that appears detrimental according to these results. Such an approach may result in the volunteer wandering aimlessly about the organization without a sense of belonging or personal enhancement.

Finally, fire-service leaders must recognize the effects of family obligations, membership in other civic groups, and most importantly, gender and race on service length. These variables act to limit firefighters' service. Recruiting efforts must not only consider candidates outside of the social network of existing members, but also strive to make the work environment more diverse and accepting.

In summary, fire-service leaders should recognize the lack of limitations on recruiting. Candidates will enter the fire service with relatively naïve motives to join, these motives will eventually mature into fully informed expectations for continued service that generally revolve around the factors of values, enhancement, and understanding. The importance of these factors does not drive service length. Instead, it is simple satisfaction. Expressed satisfaction with enhancement factors provide statistically significant increases in service length, while understanding factors and a lack of skill development have negative effects on service length. Thus, the analysis suggests that a robust emphasis on training in concert with efforts to break down the levels of insularity associated with diverse recruits is critical to counteracting the observed decline in the numbers of SC volunteer firefighters.

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Endnotes

¹ Of these seven departments, four were wholly volunteer departments. Of the 25 respondents, three respondents were female and one respondent was African-American.

² The representative sample included 161 traditional (white male), 35 female (nonminority), 21 minority (18 male and 3 female) respondents.

³ We also tested whether departmental provision of a respondent's equipment would have an effect on retention, but the results were inconsequential and not statistically significant.

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Current Female Firefighters’ Perceptions, Attitudes, and Experiences with Injury¹

Abstract

Research presented here examines how the demands of fire fighting uniquely affect women. A national sample of 73 female firefighters and fire-service leaders participated in focus groups and key informant interviews. Participants were asked about perceived threats to safety and standard operating procedures (SOPs) that lead to injury regarding gender differences. A thematic qualitative analysis was conducted and the following six themes were identified: (1) impact of working in a male-dominated field, (2) harassment, (3) similar rates/types of injury, (4) inadequate training, (5) ill-fitting gear, and (6) functional techniques/endurance. Both chronic and acute injuries/causes were discussed. Future direction will require diversity education and new training methodologies for the fire service.

Keywords: *female firefighter, injury, training, occupational health, harassment*

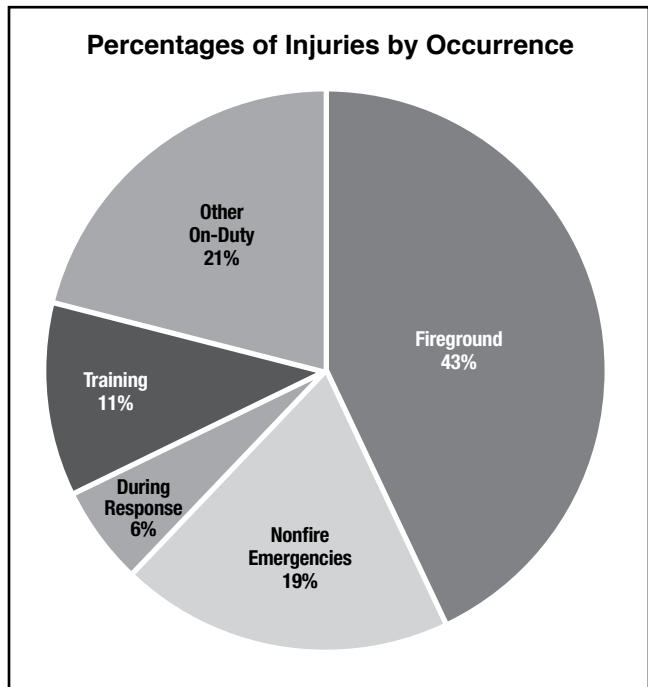
Introduction

Fire fighting is an inherently dangerous occupation with high rates of injuries and fatalities. Although women are substantially underrepresented in the fire service, their numbers are growing, and research must be directed toward female-specific injuries, fatalities, and training. Nearly a quarter of a century after women first entered fire fighting as a career, the National Fire Protection Association (NFPA) reports that more than 10,000 women hold career-level fire-suppression positions in nearly 1,000 fire departments in the United States (US). The national annual average percentage of female career firefighters from 2008–2012 was 3.8% (National Fire Protection Association [NFPA], 2015). Of the 1,134,400 career and volunteer firefighters in the US in 2014, 82,550 (7%) were women (Haynes & Stein, 2016).

Fire fighting has one of the highest rates for occupational injuries and fatalities (Poplin, Harris, Pollack, Peate, & Burgess, 2012). Each year, the NFPA conducts a Survey of Fire Departments for US Fire Experience to study firefighter injuries and fatalities in order to provide national statistics on their frequency, severity, and characteristics. **Figure 1** illustrates the distribution of firefighter injuries in 2015.

The NFPA estimated that 68,085 firefighter injuries occurred in the line of duty in 2015 (Haynes & Molis, 2016). Almost half (42.8% or n = 29,130) of these injuries occurred during fireground operations, which

Figure 1: Injury Occurrence (%) (Haynes & Molis, 2016).



included structure fires, vehicle fires, brush fires, etc., and referred to all activities from the moment of arrival at the scene to departure time, including setup, extinguishment, and overhaul (Haynes & Molis, 2016).

Approximately 13,275 injuries occurred at nonfire emergency incidents, 3,800 while responding/returning from an incident, 7,560 during training activities, and 14,320 occurred during other on-duty activities (Haynes & Molis, 2016). Strains, sprains, or muscular pain accounted for 52.7% of fireground injuries (Haynes & Molis, 2016). In fact, among emergency medical services (EMS), fire fighting, and police occupations, sprains and strains were the leading causes of injuries treated in US hospital emergency departments between 2000 and 2001 (Reichard & Jackson, 2010). While general rates are informative, data are not reported by gender due to the small numbers of female firefighters, so little is known about how the tasks and roles of fire fighting impact women in the fire service.

Most emergency-response activities require awkward positioning and significant exertion, increasing the likelihood of injury (Poplin et al., 2012). In order to perform fire-suppression and rescue duties safely and effectively, it is necessary that firefighters possess strength, stamina, and agility (Hulett, Bendick, Thomas, & Moccio, 2008). Women must be equally trained and equipped in a way to avoid injury and enable them to safely perform the job of a firefighter. However, according to iWomen, the largest organization of female firefighters in the US, more than half (58%) of women reported ill-fitting protective gear. In addition, 14% of women reported ill-fitting self-contained breathing apparatus (SCBA) face pieces, a vital piece of protective gear (Hulett et al., 2008). With females representing a small percentage of the fire service, the lack of properly fitting equipment and specific training for women may be overlooked by leadership and training officers (Hulett et al., 2008; US Department of Labor, 2009). However, since there are over 82,000 female members of the US fire service (which has explicit goals for increasing diversity), it is imperative that women are as well prepared, equipped, and trained as their male counterparts.

A qualitative study was completed in 2008 that examined recruitment and retention issues in the fire service. Several reasons for why the number of females in the fire service are still so low were noted including the following: (1) discrimination and harassment, (2) recruitment, and (3) physical testing and equipment issues, echoing issues noted by iWomen nearly 20 years prior (Federal Emergency Management Agency [FEMA], 1996; Hulett et al., 2008). Injury was not specifically explored in the 2008 report, but it has been suggested that the exclusion of women in the emerging scientific literature on firefighters may also contribute to low rates of women in the fire service (Jahnke et al., 2012).

The present study is novel because there are little systematic data on injuries among women firefighters. Although the fire service has a mission of increasing diversity, current studies demonstrate that women face similar challenges noted more than 20 years ago (FEMA, 1996; Hulett et al., 2008; Jahnke et al., 2012).

This study utilizes the Person-Environment Fit (PE-Fit) Model for the study of occupational stress and relates this model specifically to women in the fire service. The PE-Fit Model posits that when occupational demands and pressures exceed the capability of an employee to deal with them or when these demands do not align with one's morals, this "lack of fit" contributes to overburden, role ambiguity, and conflicting role demands (Quick & Tetrick, 2003, p. 187). The resulting physical and psychological stress can then lead to adverse behavioral consequences such as lower productivity, absenteeism, turnover, employee burnout, and health-related problems (Quick & Tetrick, 2003).

The research presented here uses qualitative methods to explore perceptions, beliefs, and attitudes regarding injury among current female firefighters and key leaders from the fire-service community. The aim of this research is to build upon the current literature and bridge the gap in knowledge, training, and education regarding female firefighters and their experiences in the fire service by examining key themes regarding current female injury rates, experiences with injury, perceptions, and training.

Methods

This section discusses the methods used in this study. The section is organized into three subsections: (1) study design and measures, (2) participants, and (3) data-analysis procedures.

Study Design and Measures

This qualitative study used grounded theory to develop themes based on feedback from participants. Seventy-three subjects participated in one of eight focus groups. Focus groups occurred at national conferences and in areas/departments where the research team had access to large groups of women firefighters. Interviews took place with women in leadership positions across the US based on recommendations from fire-service advisors.

After explaining the purpose and procedures of the study, participants were provided an opportunity to ask questions. Participants then signed informed consent documentation and completed a brief demographic questionnaire. The discussion began with the question, "What are the biggest health concerns facing the fire service?" The Results section provides an analysis of the responses to that question that were related to injury, as well as responses to specific questions regarding injury such as "What are the biggest threats to safety [in the fire service]?"

All focus groups were transcribed verbatim. After the initial question, domains covered in the sessions included task-related stress and safety, standard operating procedures (SOPs) relating to safety and gender differences, on-the-job injuries, and training differences between men and women. Responses from the resulting discussion are presented in the Results section.

Participants

A national sample of 73 current female firefighters and fire-service leaders, aged 25–66 years, participated in this study. Number of years in the fire service (experience) ranged from 3 to 30 years. Focus groups were convened by inviting past participants from previous research projects as well as by recruiting participants at national fire-service conferences (e.g., iWomen). There were 27 female fire-service leaders and 46 female firefighters who participated in this study.

Data-Analysis Procedures

A two-phase process was used to capture the meaning behind the transcribed text with the overall purpose of understanding major themes across and between transcripts. First, researchers reviewed the transcribed documents to develop a familiarity with the text and began a thematic analysis by searching for patterns and themes that occurred frequently in a single interview or were common across interviews. The data were then coded by identifying major patterns and themes. Use of multiple reviewers assisted in establishing the thematic framework.

Next, the transcripts were uploaded to NVivo 10, a qualitative data-analysis software that allows researchers to highlight and code data into “parent” nodes for overall themes and “child” nodes for subthemes. Summaries were then made within each major/parent theme. The two primary coders compared their analyses, and any discrepancies were discussed. A third researcher reviewed the findings of the two primary analyses to confirm that the summary of the findings was reflective of the data collected.

Results

The following major themes were identified, but are not listed in order of importance or occurrence:

1. Similar rates/types of injury regardless of gender
2. Impact of working in a male-dominated field
3. Focus on functional movement techniques/muscular endurance
4. Inadequate fire service training
5. Ill-fitting gear
6. Harassment affecting performance on the job.

Since responses were similar across the leader and firefighter groups, the results were combined.

In general, participants thought that males’ and females’ experiences with injury types and rates were similar across genders. Perceived common injuries for females included mostly upper-body injuries: back, neck, and shoulder, but they also noted knee and ankle injuries. Participants stated the following:

- “Fire doesn’t discriminate. It will kill you either way, whether you’re male or female.”

- “. . . So, I think the danger’s equal whether you’re male or female . . .”
- “I think the injuries are pretty much [the same] across the board.”

Others noted that females being in a male-dominated field contributed to an increased risk for injury. Being the minority group pushed women to try harder, get stronger, and often times not ask for the help they needed, even on tasks that, to be completed safely, required more than one person.

I think we put ourselves at risk sometimes for trying to do more than we’re capable of because of that risk of scrutiny that, you know hey, I’ll go that extra mile, I’ll pick up that extra piece of equipment. I’ll do something instead of asking for help.

Another participant stated the following:

. . . sometimes not wanting to ask for help, like, wanting to prove themselves so they’re going to try to lift something instead of asking for help . . . and it’s probably too heavy for them to be lifting . . . but they want to prove that they can do it. And . . . they’re not using proper technique . . . to do things.

A different participant added the following:

I think that we push ourselves so hard that we are operating outside of probably what’s safe for us . . . whether it’s having to reach further to vent or um, physically, where, you know — something hurts and you know in your brain, “Oh crap. That’s a hurt.” That’s just not a “I’m working too hard,” and working anyways.

Participants often noted a constant need to “prove” themselves. This idea led to injury by taking on too great a work load or by avoiding asking for help because male workers would have concluded females were not cut out for the job even though male counterparts asked for help in similar situations.

Some of the most difficult tasks for women included activities requiring upper-body strength. Participants noted that back injuries were common for both sexes, usually due to inadequate strength and poor lifting techniques; but participants also noted shoulder, neck, knee, and ankle injuries were common among women due to a smaller body size and ill-fitting gear. A gap was identified in traditional training methods. Often, only one method of a skill was taught when in reality there were multiple different ways to complete a task, depending on the situation and the strengths and weaknesses of the crew completing that task.

. . . there was a training exercise where you’re supposed to get someone out of a window, down a ladder, and carry them down. And there was one way where your arms are across and they’re lying on your arms and you’re walking

down the ladder, but he was, like, a wider person. He wasn't heavy, but it's just that my one arm couldn't reach . . . We just had to, tweak his bottle [air pack] a little this way — and, like, tilt him, and then I could reach on both sides. I'm not going to go down with my friend because we're playing training and I drop him.

Women have different musculature and often used different body mechanics when lifting, moving equipment, and doing work on the fireground. Females and males who have less upper-body strength experienced difficulty executing tasks in a traditional manner. It was suggested that alternative methods for accomplishing tasks be offered.

You know, it's certainly peer reviewed that they could pull from. And I guess bottom line it's OK to admit that women are not stronger, and we accept that. We know we're not stronger, but we're going to figure out how to do it. We're going to adapt.

So we're going to be smarter and use our body. Because if you're spent because you have to do a certain drill a certain way on the fireground and you're spent, then what good are you for your team for the rest of the work that needs to be done?

As mentioned previously, many participants identified inadequate training as a threat to safety and increased risk for injury. Education was identified as a limiting factor regarding training. "I think that there is a huge gap [in] fitness training. Even for the men, it's very traditional, like the CPAT [Candidate Physical Ability Test] and Cooper's test and pushups, sit ups, and military press. And women's bodies are different." Participants identified the need for training on different methods of accomplishing the same task to allow those with different body types to use a method that complimented their strengths as opposed to enhancing their weaknesses. Participants suggested that females use more leg strength to complete a task whereas males may use more upper-body strength.

I would say [we use] our waist and legs . . . our upper body is not, not as (inaudible) as theirs. I mean, we can work out all we want, but we're not going to be as strong as them up top. So, we just have to do things differently, so obviously technique. We can be just as strong; we just have to do it differently. I mean, we look funny, but we're going to do it.

Also, as firefighters aged, they needed different training and techniques to accommodate their changing bodies. ". . . and women's bodies are different, especially between 30 and 45. First of all, there are the hormonal changes . . ."

Another participant added:

When I was 35 . . . what I could do at 35 and what I could do at 45 was — there was a decline from there. But then . . . (from 45 or 35) to what I am now, which is 48, there's an even more drastic decline. The decline is even more significant. And it could be because of injury, but I don't know.

One participant also noted that "policy and practice are two different things" when talking about what training and policies were in place to ensure safety and what was actually done on the fireground. This comment was an important note for higher ranking officers and the organization as a whole regarding aligning training with SOPs to ensure safety for all members of the organization.

Participants identified issues with ill-fitting gear as one of the biggest threats to safety and increased risk for injury among female firefighters. Ill-fitting boots, in particular, were identified as leading to ankle injuries. Women reported that the bunker gear in their respective departments was made for males. ". . . you know, gear and clothing, recognizing that women and small men have not been fit properly for decades." ". . . women are getting (inaudible) leftover gear and when they buy things, they buy them in bulk. . . ." One participant noted her department had to go through a lawsuit before they offered female-specific protective equipment or bunker gear. "Our gear is good now. We had to go through unfortunately a lawsuit to, uh, make it right. But now, it's no problem with the gear. They have female's; they have men's. It fits pretty good."

SCBA masks often were reported as being "unisex" but were made to fit a wider jaw, so many females with more narrow faces could hardly get a good seal. It was stated that, if their mask did not seal tightly around their face, they had an increased exposure to inhalation hazards during a fire, where the SCBA should be their first line of defense. ". . . it's not correctly sized. And it does pass the fit test initially, but . . . there's no smaller size available. Our faces are narrower, so that if they get stretched out in the least, they're not going to make a seal."

Harassment was an interesting factor identified that led to injuries. Women noted that they did not have the support of their male crew members and were even threatened by them. Some of the participants interviewed reported being threatened by or made uncomfortable by male coworkers on the job. One participant said she was told, "You're just here looking for a husband." This harassment was not only inappropriate, but females noted that comments like this made them less confident and impacted their performances on the job. Participants stated that adversity to females came from both older and younger members of the fire service. ". . . sometimes I think [it was] not the older guys but some of the younger guys

[who] got intimidated that a girl came in and could do the job.” One participant noted “male counterparts that don’t want them [females] there” as the biggest threat to safety for female firefighters.

. . . they’ll berate you and belittle you so much that you start doubting yourself. And when you doubt yourself, and you worry, that’s when you’re more apt . . . to have an accident or get hurt. I’ve had firefighters tell me to my face that if they were going to hurt me or kill me . . . they could get me alone in a house fire. It’s my word against theirs, so . . . you know, what are they going to do? Nothing.

One participant said, “. . . training officers or leadership in the department have said, ‘Let’s make this hard enough so the women won’t pass.’”

Discussion

The purpose of this study was to explore current themes reported by female firefighters related to their perceptions, attitudes, and experiences with injury to build upon what is currently known. This study exposes similar issues that have been experienced by females in the fire service for years. Many of the issues identified in this study echo and expand on problems identified as early as 1995 when iWomen conducted their initial survey of women in the fire service (FEMA, 1996). More than 20 years later, women still represent a similar percentage of the fire service and are experiencing similar issues, exposing possible problems with recruitment and retention of females in the fire service and identifying some issues with training and education. Our results reinforce the need for further research, as well as policy and guideline/SOP changes in the fire service to increase the possible recruitment pool of new firefighters, improve retention, and provide a healthier occupational environment. Diversity education for the entire fire service is also necessary to enhance a culture of change.

A National Report Card on Women in Firefighting examined the inclusion, acceptance, training, testing, and promotion of women in fire and emergency services (Hulett et al., 2008). The study identified the following key factors that may act as barriers to women entering or remaining in the fire service:

1. Discrimination and harassment;
2. Unfair recruiting methods;
3. Inadequate uniforms/equipment;
4. Inadequate firehouse living accommodations;
5. Sexual harassment; and
6. Unfair promotional processes.

All of these factors may be a part of an underlying workplace culture that does not fully accept female firefighters. Nine years later, our research found similar

themes regarding women in the fire service, and specifically it found how factors that have been identified for years still impact female injury rates on the fireground and gives insight into how we can improve these factors.

Sinden et al. (2013) conducted qualitative research about the occupational experiences of female firefighters and identified similar themes including the following:

1. Physical demands/difficulties;
2. Gender-related physiological differences;
3. Compensatory strategies;
4. Equipment maladaptation;
5. Earning respect;
6. Negative attitudes of male counterparts; and
7. Recognition of injury risk.

Studies have shown that female firefighters experience higher rates of injury than male firefighters, but these studies neglect to capture the reasons behind these findings (Liao, Arvey, Butler, & Nutting, 2001; Sinden et al., 2013). Neglecting to research this subset of the population can lead to negative outcomes as discussed in our findings. An unhealthy occupational environment — one in which the employee feels undervalued, constantly challenged, and/or undermined — leads to negative health outcomes, both physically and psychologically (Quick & Tetrick, 2003).

Women are an integral part of the workforce. Better understanding how they differ from their male counterparts in size, stature, and training requirements will allow for advances in training and equipment, increased female recruitment and retention, decreased time away from the job due to injury, and decreased injury costs for fire departments. The discrimination and harassment women in the fire service face may affect job performance physically as well as mentally. Work-related stress has been shown to lead to decreased health (Quick & Tetrick, 2003).

As discussed previously, the PE-Fit model suggests that when occupational demands and pressures exceed one’s ability to cope with them, the employee becomes overburdened, and the employee must deal with role ambiguity and conflicting role demands (Quick & Tetrick, 2003). The resulting physical and psychological stress can lead to adverse behavioral consequences such as lower productivity, absenteeism, turnover, employee burnout, and health-related issues (Quick & Tetrick, 2003). The harassment and adversity female firefighters face may be a reason there are still so few women in the fire service today. Correcting these issues can increase recruitment and retention within the fire service.

The current body of literature shows the need for change in the fire service with respect to female firefighters. By accessing women in the fire service at

various national conferences, we were able to obtain numerous responses; and as our results are similar to what current literature are available, it is likely representative of the female firefighter population as a whole. In general, the findings offer an interesting glimpse of the perceptions of the health of women in the fire service with some unique challenges. Findings also highlight some of the similarities and differences between male and female firefighters and bolster the argument for studying female firefighters as a unique occupational subpopulation.

Study Limitations

Similar to other qualitative studies, this study has some important limitations; although the findings do mirror results of other research. For example, the study supports previous findings that identified occupational risk factors for female firefighters and the interrelationship between gender and psychosocial work factors. The interview questions were developed to elicit personal insights into the experiences of females working in a physically demanding, male-dominated field. Questions surrounding experiences with gender issues may have influenced their responses; however, the questions were developed to understand the general experiences of female firefighters.

The identified themes represent synthesis and analysis of all interview questions. Also, although the focus groups and key-informant interviews were drawn from a national sample of female firefighters, with females representing such a small percentage of the fire service, it is possible that some “voices” of female firefighters may have been missed in this investigation. As such, future research should focus on further examining the experiences of females in the fire service.

Conclusion

Qualitative studies such as this one can be used to develop questions that guide future research. Further research should be directed at investigating female firefighters and their performances and risks for injuries on the fireground. It is important to examine how barriers faced at work affect the work climate as well as her ability to do her job effectively. Research must also examine the negative health outcomes of a hostile work environment. Studies should examine the impact that these issues have on the recruitment and retention of women firefighters. This factor is a major public-health issue as females are part of the responders that protect communities all across the US. In order to better protect our communities, we must make an effort to better recruit, protect, train, and educate these first responders and those that work with them. Educating fire-service trainers on diverse methods of training and accomplishing fireground tasks will ensure a more well-rounded fire service. In addition, education for the fire service as a whole regarding diversity, inclusion, and harassment in the work place is imperative.

Future research to mitigate injury should examine task components of fire fighting and consider the interaction between gender and performance demands in fire-fighting tasks. Training is a significant opportunity in the fire service. In a job in which one depends on his/her crew members for their lives, it is dangerous when there are crews who may not watch out for the entire team's safety solely because of gender differences. There is a need not only for changes in physical training but also in education and training regarding diversity in the workplace as well. Training programs for firefighters, both male and female, must be evaluated for effectiveness and to ensure that they reflect the most current training recommendations. Additional data must be gathered regarding women firefighters to assess female-specific injuries, injury rates, and ways to prevent injuries in this subset. Research also should be directed towards the fit of equipment and protective gear for females.

Addressing the issues identified in this study will require policy changes for injury prevention. The data suggest that the fire service must include female-specific training for drills and fitness training, including strength training, with a consideration for female anatomy and musculature. The National Fire Incident Reporting System (NFIRS) needs to be organized in such a way that data can be collected with regard to women firefighters. Also, the NFPA might consider collecting gender-specific data. SOPs must be reviewed by fire-service leadership for relevance to today's female fire-service personnel. Given the high rates of injury among firefighters and the physically demanding nature of the job, it is important to fully understand the risks. Very little data exist in the published literature that focus on injuries among female firefighters.

In order for changes in knowledge and training to be effective, a significant push to include representation from organizations such as the International Association of Firefighters (IAFF), the fire-service training leadership as represented by the International Fire Service Training Association (IFSTA) as well as overall fire-service leadership represented by the International Association of Fire Chiefs (IAFC) is critical. It is suggested that these associations are contacted with respect to this current information and to request input as to methods and information needs moving forward. By inclusion, the ability to reach many more female firefighters can become a reality; and, by extension, conclusions and recommended changes can be disseminated to those who can affect these changes.

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Endnote

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Discovering Underlying Themes in Fire-Related Research: An Analysis of 238 Peer-Reviewed Studies

Abstract

Even though the fire service has been the subject of a growing body of academic studies since the early 1970s, no attempt has been made to discover underlying themes or the contributions and limitations of this research. As such, this article presents a systematic literature review of a representative sample of 238 fire-related academic studies drawn from peer-reviewed journals published between 1970 and 2016. Findings suggest that three themes or meta-categories define fire-related academic research during the 46-year time span. In order of importance (based on the number of studies in a meta-category) the themes or meta-categories of research are health and safety, management, and organizational culture. Results presented in this article suggest that research bridging the intersections of the meta-categories will enhance the development of a more in-depth understanding of the links among health and safety issues, managerial work, and organizational culture in the fire service.

Introduction

In the wintery night of January 23, 2014, a major fire in a retirement home caused the death of 32 elders in the municipality of L'Isle-Verte, located in the Province of Quebec, Canada. A government inquiry into the matter correlated deficiencies in fireground operations in part to flaws in knowledge-management processes.¹ Similarly, a recent literature review on knowledge management in the public sector concluded that: "surprisingly, there were few articles [on knowledge management] investigating key public services such as police, fire, ambulance, and the armed forces" (Massaro, Dumay & Garlatti, 2015, p. 545).

This conclusion raises the question as to the state of research on the fire service. In fact, even though the fire service has been the object of a growing body of academic studies since 1970, to date no attempt has been made to discover underlying themes or the contributions and limitations of this research. As such, this article presents a systematic literature-review analysis of 238 fire-related academic studies drawn from peer-reviewed journals published between 1970 and 2016.

The article is organized into three sections. The first section presents the methodology used to select the sample of academic studies upon which the literature-review analysis is based. Based on the analysis of 238 academic studies, section two first identifies three themes or meta-categories underlying the academic fire-related literature published between 1970 and 2016; and second it discusses the contributions and limits of this body of literature. Finally, in section three, findings emerging from the literature review are used to offer suggestions for the future direction and development of fire-related academic research.

Methodology

The focus of this systematic literature review analysis is on 238 academic, peer-reviewed articles published in English or French² found in refereed journals, although a few books, chapters in academic books, and reports are also included to support the author's analysis of the articles and provide references to theories discussed in the research. The review is based on an iterative process and flexible design (Robson, 2002) characterized by a methodology that allows for replicability and transparency through an audit trail of the analyst's decisions, technique, and conclusions (Tanfield, Denyer, & Smart, 2003).

The data (e.g., academic studies) review started by searching databases (e.g.: ProQUEST, JSTOR, EBSCO, Cairn, Erudit, Taylor & Francis, Persée, Google Scholar, and Directory of Open Access Journal) using Boolean operators and the following keywords in study titles and/or abstracts: *fire*, *fire service*, *fire department*, and *firefighter* (in French: *service d'incendie*, *incendie*, and *pompier*). This initial search found 169 fire-related research studies. An analysis of the 169 article abstracts and/or keywords sections provided evidence of three themes or meta-categories in which to group the research papers. In order of importance, based on the number of studies, the three meta-categories were: health and safety, management, and organizational culture.³ Reading and analysis of the 169 studies allowed the creation of subcategories of topics in each meta-category (e.g., studies of firefighter stress in the health and safety meta-category or research on leadership in the management meta-category). Subcategories for each meta-category are presented, in alphabetical order, in **Table 1**.

Table 1: Three Meta-categories and Subtopics

Meta-categories	Health and Safety	Management	Organizational Culture
Subtopics	Alcohol consumption Cancer Cardiovascular problems Contamination/exposure Effects of equipment Fitness Line-of-duty death Managing health and safety Obesity Stress Tobacco use	Court rulings Emergency response Gender/minority issues Finance Human resources management Leadership Optimization Performance Provision of services Training Work organization Work relations	Commitment Culture Emotions Family (internal & external) Knowledge Motivation Role Serious leisure Trust

Another step in the search process involved scanning the “reference lists” of the 169 originally identified studies and “mining” other new academic-research articles. A total of 64 new studies were found. This second phase of the search-and-analysis process identified no new underlying themes (e.g., meta-categories) or subcategories were investigated by the authors of the 64 new studies. As such, each of these 64 articles were assigned to one of the three meta-categories.

Finally, a third and final database search was conducted using as keywords the 32 subcategories of fire-related research studies associated with the three mega-categories (see Table 1). In total, five new relevant fire-related research studies were found. In sum, as noted previously, the analysis that follows is based on a final set of 238 peer-reviewed articles.

Findings

This section outlines the findings emerging from the analysis of the 238 peer-reviewed articles. Findings are organized into four subsections: (1) general observations, (2) health and safety meta-category, (3) management meta-category; and (4) organizational culture meta-category.

General Observations About the 238 Literature-Review Studies

As a general observation, scholarly work in both the health and safety and the management meta-categories is largely based on quantitative methods (surveys, samples, calculations, etc.), while research in the organizational culture meta-category is in large part based on qualitative methods (interviews, observations, discourses, etc.). Both quantitative and qualitative methods are found in English research, while most French research stems from the social-science perspective and is based on qualitative methods.

Regardless of whether they are called career (e.g., United States [US]) or professionals (e.g., France), studies generally separate firefighters into two categories: (1) those who hold a permanent full-time position in a fire department or (2) volunteer, citizens who have a different primary occupation and volunteer in a fire

department. Research work in the health and safety meta-category has shown an interest in both career and volunteer firefighters, while the focus has been more on career firefighters in the management meta-category and on volunteer firefighters in the organizational culture meta-category.

There is a global interest in research on the fire service. **Table 2** shows the distribution (percentage) of the 238 articles included in the analysis across the three meta-categories (health and safety, management, and organizational culture) by nation. The data indicate that almost 57 percent (56.7%) of the 238 fire-related studies originated in the US. Moreover, studies from the US, United Kingdom (UK), Canada-English, and Australia represent 78.6 percent of all published material. As indicated in Table 2, only seven studies (3.7%) offer a comparative analysis between or among nations. Clearly, to date, an attempt to understand the differences or commonalities among fire services across nations has not been a priority of fire-service scholars.

Table 2 also shows that the meta-category of health and safety studies represents one-half ($n = 119$, 50%) of the literature on the fire service, with management studies equaling 33 percent ($n = 79$), and organizational culture constituting 17 percent ($n = 17$). Finally, spanning almost five decades, **Figure 1** shows the exponential growing interest of research on the fire service.

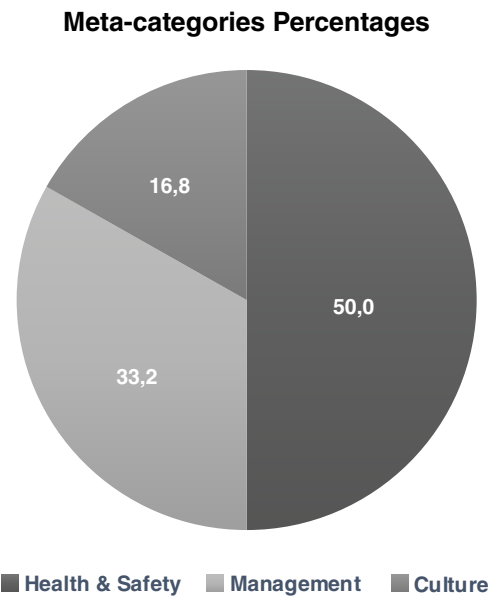
The following three sections detail findings for each of the three meta-categories based on the relative order of importance of each topic (as measured by the percentage of studies included in a category).

Health and Safety Meta-category

The health and safety meta-category refers to research on the impacts of fire fighting and lifestyle on the general health and safety of firefighters, both inside and outside of the fire house. Figure 1 shows the overall interest of research on this topic since 1970. As the figure shows, research in this genre began to grow exponentially beginning in the early 1990s and continues this pattern of growth today.

Table 2: Percentage of 238 Studies by Nation and in each of the Three Meta-categories

Country	Health & Safety	%	Management	%	Culture	%	Total	%
United States	75	63,0	41	52	19	48	135	56,7
United Kingdom	9	7,6	13	16	0	0	22	9,2
Canada - English	5	4,2	10	13	1	3	16	6,7
Australia	6	5,0	2	3	6	15	14	5,9
Canada - French	0	0,0	1	1	3	8	4	1,7
France	2	1,7	2	3	9	23	13	5,5
Comparative	3	2,5	4	5	0	0	7	2,9
Poland	3	2,5	1	1	0	0	4	1,7
Iran	4	3,4	0	0	0	0	4	1,7
Spain	0	0,0	1	1	0	0	1	0,4
Nigeria	1	0,8	0	0	0	0	1	0,4
Nordic	1	0,8	0	0	0	0	1	0,4
Ukraine	1	0,8	0	0	0	0	1	0,4
Germany	0	0,0	1	1	0	0	1	0,4
Lithuania	1	0,8	0	0	0	0	1	0,4
Philippines	0	0,0	0	0	1	3	1	0,4
Croatia	1	0,8	0	0	0	0	1	0,4
Portugal	1	0,8	0	0	0	0	1	0,4
Turkey	1	0,8	0	0	0	0	1	0,4
Taiwan	0	0,0	2	3	0	0	2	0,8
Saudi Arabia	2	1,7	0	0	0	0	2	0,8
Malaysia	1	0,8	0	0	0	0	1	0,4
Japan	1	0,8	0	0	0	0	1	0,4
Sweden	1	0,8	1	1	1	3	3	1,3
Total	119	50	79	33	40	17	238	100,0



Studies in this meta-category focus mostly on male subjects; research on female firefighters is sorely lacking (Jahnke et al., 2012). Firefighters routinely work in environments that are immediately dangerous to life and health (IDLH) (Austin, Dussault & Ecobichon, 2001; Graham, et al., 2008; Kales, et al., 2001; Lees, 1995; Luz, 2003; Moschella, 2009; Wyant, 2010); and this situation provides a rich context for research. On one hand, the prevalence of stress, cancer, cardiovascular events, and line-of-duty deaths (LODDs) are incentives for research work (e.g.: Bryant & Harvey,

1996; Poston et al, 2014; Golden, Markowitz, & Landrigan, 1995; Guidotti & Clough, 1992; Hansen, 1990; Lemon & Hermiston, 1977; Regher, Hill, & Glancy, 2000). On the other hand, the importance of this meta-category is not estranged from the impacts of traumatic events such as the terrorist attacks on September 11, 2001, which put at the forefront the dangers associated with fire fighting and rescue work.

Fire fighting: A stressful job. For the public, fire fighting is synonymous to courage and heroism (Jean-tet & Gernet, 2011; St-Denis, 2013). Although this idea

Figure 1: Growth of Fire-related Studies Between 1970 and 2016



may be true, researchers from around the globe (e.g., US, Canada, Iran, Ireland, and France) have correlated firefighters' involvement in traumatic events to stress (Brown, J., Mulhern, & Joseph, 2002; Mauro, 2009; Sepidarkish, Hosseini, Pakzad, & Safiri, 2014; Yazdi & Shafirani, 2001), because many of these first responders develop symptoms of posttraumatic stress disorder (Beaton, R., Johnson, Infield, Ollis, & Bond, 2001; Beaton, R. D., Murphy, Pike, & Corneil, 1997; Carter, H., 2007; Corneil, Beaton, Murphy, Johnson, & Pike, 1999; Fullerton, McCarroll, Ursano, & Wright, 1992; Gasaway, 2007; Jeannette & Scoboria, 2008; O'Neill & Wagner, 2012; Palmer & Spaid, 1996; Pillai & Williams, 2004; Wagner & Waters, 2014).

Stress has been correlated with sleep-related problems and anxiety experienced by Canadian, US, and Iranian firefighters during normal shift work and at home (Beaton, R. D., & Murphy, 1993; Beaton, R., Murphy, Johnson, Pike, & Corneil, 1998; Beaton, R., Murphy, Johnson, Corneil, & Pike, 1999; Mehrdad, Haghighi & Naseri Esfahani, 2013). In addition, research on Canadian firefighters has shown that, for some individuals, regular exposure to emergency situations can lead to hostility, which is a predictor of obsessive-compulsive behavior, depression, and anxiety (Wagner, Pasca, & Crosina, 2016). In fact, research on US firefighters shows that male firefighters tend to present a higher percentage of clinical symptoms of depression (16%) than the general population of men (7%) (Pyle et al., 2009). As a result, research findings draw attention to the consequences of this stressful environment on the individual, such as the concerning problem of alcohol consumption by both male and female firefighters (Bacharach, Bamberger, & Doveh, 2008; Boxer & Wild, 1993; Haddock, Day, Poston, Jahnke, & Jitnarin, 2015; Jahnke et al., 2012; Murphy, S. A., Beaton, Pike, & Johnson, 1999; Piazza-Gardner et al., 2014) and the risk of cardiovascular incidents.

At the heart of the matter. A significant number of firefighter deaths are attributable to cardiac arrest, caused by factors such as strenuous work, stress, fatigue, and sedentary lifestyle (Aronson, Tomlinson, & Smith, 1994; Davis & Dotson, 1978; Guidotti, 1993; Kales, Soteriades, Christophi, & Christiani, 2007; Kunadharaju, Smith, & Dejoy, 2011; Patterson, Suyama, Reis, Weaver, & Hostler, 2013; Roy, Kirschbaum, & Steptoe, 1998; Staley, 2009; Vastag, 2007; Wolkow et al, 2014). Heat stress is of concern for firefighters (Olafiranye, Hostler, Winger, Wang, & Reis, 2015; McLellan & Selkirk, 2006; Stevenson, 1985). Tests conducted on US firefighters in training conditions show that after an intense effort in a hot environment, blood composition is altered that, in turn, places firefighters at risk of cardiovascular incidents (Smith, D. L., 2002; Smith, D. L., & Petruzzello, 1998; Smith, D. L., Dyer, & Petruzzello, 2004; Smith, D. L., Manning, & Petruzzello, 2001; Smith, D. L., Petruzzello, Chludzinski, Reed, & Woods, 2005; Smith, D. L., Petruzzello, Chludzinski, Reed, & Woods, 2001; Smith,

D. L., et al, 1995; Smith, D. L., Petruzzello, Kramer, & Misner, 1997; Smith, D. L., Petruzzello, Kramer, & Misner, 1996).

During these tests, many firefighters have also shown clinical signs of hypoglycemia that were mitigated only after 90 minutes of rest and intense rehydration (Smith, K., Rich, Pinol, Hankin, & McNeil, 2001), which is rarely available on the fireground. In addition, research work has shown that fire-smoke exposure can cause elevated blood carboxyhemoglobin (Al-Malki, 2009). Minimum carboxyhemoglobin thresholds previously considered safe have recently been associated with triggering angina or myocardial ischemia in persons with cardiac preconditions (Dickinson, Mechem, Thom, Shofer, & Band., 2008).

Although this line of research points to the importance of preventive measures such as physical fitness and quality of lifestyle based on healthy habits, authors from the US have documented a series of indicators of firefighters' sedentary lifestyles such as poor physical conditions, poor cardiovascular conditions, as well as aerobic capacities inferior to occupational standards (Saupe, Sothmann, & Jasenof, 1991). Similar research was carried out in the Ukraine. Stetsenko and Arhipenko (2015) suggest optimizing control over professional physical education to sustain physical self-improvement motivation. On the same topic, researchers from countries such as the US and Croatia also documented the negative impact of obesity (Brown, A. L., et al., 2014; Brown, A. L., et al., 2015) and of firefighters' high body-mass index on cardiovascular capacity and working ability (Lalić, Bukmir, & Ferhatović, 2007).

For fire-service leaders, addressing the impacts of firefighters' life habits such as smoking, malnutrition, lack of exercise, and/or obesity on cardiovascular health (Jahnke, Poston, Haddock, & Jitnarin, 2013; Jitnarin, Haddock, Poston, & Jahnke, 2013; Onieal, 2010) then becomes a priority to reduce the risk of cardiovascular incidents. While researchers from Poland and the US point to the necessity of supporting fire-service leaders in their attempts to promote the wellness of firefighters, they also note that these leaders must do so using the relative accuracy of devices and calculation formulae to measure physical demands on firefighters, which at times can lead to poor or inexact evaluations (Clapa, Cisek, Tofilo, & Dziubinski, 2015; Klaren, Horn, Fernhall, & Motl, 2014; Lindberg, Oksa, Antti, & Malm, 2015; Mehta et al., 2015; Mier & Gibson, 2004).

Firefighters and cancer: A public policy issue.

Exposure to toxic substances on the fireground or in training (Alkali, Bandele, & Ballah, 2013; June-Soo et al, 2015; Kirk & Logan, 2015; Rotander, Toms, Aylward, Kay, & Mueller, 2015) is an aggravating factor that places firefighters at a greater risk of developing different types of cancers (e.g., brain, lung, and prostate) and leukemia (Demers, Heyer, & Rosenstock, 1992; Edelman et al., 2003, Ide, 2014).

The correlation between cancer and fire fighting has been established, and research is still ongoing globally (e.g., Canada, US, Nordic Countries, and Scotland) to determine with greater certainty those aggravating factors that contribute to the development of different types of cancer (Daniels et al., 2014; Daniels et al., 2015; Fritschi & Glass, 2014; LeMasters et al., 2006; Pukkala et al., 2014). Research reviewed in this article provides public administrators at all levels of government the information they need to confidently recognize cancer as an occupational disease among firefighters. As such, preventive cancer measures are now an important challenge for fire-service leaders. Even though firefighters wear personal protective equipment (PPE) and breathing apparatus, they are still at risk of cross-contamination from carcinogens. In essence, this factor may mean rethinking tradition-based procedures and implementing innovative decontamination measures and other preventive actions.

Line-of-duty deaths (LODDs). Since 1977, an average of 100 firefighters have died each year in the line of duty in the US (Malo & Delorio, 2008). This statistic is six times higher than other industrialized nations (Pessemier, W. L., & England, 2012) pointing to a serious organizational problem for US fire-service leaders (Ruan & Groves, 2010; Smith, T. D., & DeJoy, 2014).

In a recent study, researchers identified a cluster of three factors that represent 97.5 percent of LODDs: (1) poor health and physical condition, (2) PPE issues, and (3) human errors (Moore-Merrell, Zhou, McDonald, Fisher, & Moore, 2008). Slightly more than a majority of deaths occurred in volunteer departments (52%), whereas 39 percent occurred in full-time departments and 9 percent in combination departments (Moore-Merrell et al., 2008). Subsequent work by Moore-Merrell and her colleagues showed that a cluster of three factors was significant in explaining LODDs, thus supporting some of their previous conclusions: lack of situational awareness (37.35%), poor health and physical condition (28.57%), and human error (10.65%) (Moore-Merrell, Zhou, McDonald-Valentine, Goldstein, & Slocum, 2009). Again, firefighters' poor health and physical condition stand out in the complex equation between the actual risks of fire fighting and preventive measures. In the context of volunteer fire departments, these findings pose a real challenge to fire-service leaders who must contend with the difficulties associated with recruitment of volunteer personnel while at the same time meeting the health and fitness requirements set forth by occupational standards.

Equipment and tools. This systematic review of 238 fire-related studies found a global interest on equipment and tools used by firefighters. Researchers are interested in a wide range of subjects ranging from the properties and maintenance of protective clothing (Atalay, Bahadir, & Kalaoglu, 2015; Grineviciute, Valaseviciute, Narviliene, Dubinskaite, & Abelkiene, 2014)

to the risks of hearing loss on the fireground due to the use of fire-service equipment (Negar Assadin, Esmaily, & Mostaan, 2013; Root et al., 2013).

Other studies have illustrated the importance of injuries sustained during road accidents and the risks associated with the operation of tanker trucks oftentimes by inexperienced drivers (Wieder & Roche, 2008). The review also found a series of papers investigating the effects of protective equipment on the postural balance and gait of firefighters. Results suggest that heavy boots, suboptimal air-bottle design, and the lack of flexibility of turnout gear are correlated with problems associated with posture, fatigue, and injuries (Hur, Park, Rosengren, Horn, & Hsiao-Wecksler, 2015; Park et al., 2015; Rosengren, Hsiao-Wecksler, & Horn, 2014; Sobeih, Davis, Succop, Jetter, & Bhattacharya, 2006).

The review found two studies on the etiology of injury in the fire service, one from the US (Poplin, Harris, Pollack, Peate, & Burgess, 2012) and one from Poland (Pawlak, Gotlib, & Galazkowski, 2016). This research shows that in-station activities such as physical and sporting exercises, training exercises, and maneuvers are important sources of injury.

Health and safety as a leadership challenge: Summary of research in meta-category. Research in this meta-category brings attention to a plethora of risks that firefighters face every day from stress to cancer to injuries. Proactive health and safety management in the fire service is of concern both to scholars and fire-service leaders, especially given the high number and relatively stable yearly LODDs (Karter & Stein, 2013; National Fire Protection Association [NFPA], 2015) and an organizational culture that leans towards low levels of fitness and sedentary life habits (Jahnke, Haddock, & Poston, 2014).

A lack of focus on the health and physical-fitness knowledge of firefighters is putting them at risk (Grace, 2013). Scholars have documented the fact that some organizations may not assign sufficient importance to creating a safety climate (Smith, T. D., & DeJoy, 2014), maybe because of a limited understanding of what constitutes a proactive organizational safety culture (Pessemier, W. L., & England, 2012).

As discussed earlier, research on cancer in the fire service has grown significantly in the last decade. Incorporating strategies to influence behavioral changes in the way firefighters think about their own protection would assist fire leaders with implementing ongoing prevention measures. To this end, research results suggest that implementing a comprehensive health and safety program tends to have beneficial outcomes on the general health of firefighters (Easterling & Prince, 2007; Elliot et al., 2004; Pessemier, W., 2008; Poplin et al., 2015; Strawson, 2008; Welbourne & Booth-Butterfield, 2005), on suicide prevention (Finney, Buser, Schwartz, Archibald, & Swanson, 2015), and even on the health of firefighters' spouses (Zimmerman, Gerace, Smith, & Benerza, 1988). However,

many of the papers reviewed failed to give a full or clear definition of what a comprehensive program should encompass to bring about long-lasting changes in firefighters' health and safety behaviors.

As research shows, addressing health and safety issues involves upending institutionalized and entrenched behaviors and norms. For fire-service leaders, this change requires an adaptive leadership approach (Heifetz & Linsky, 2002) that commands a change in thinking towards higher standards of prevention and protection and mandates a revision of the "structuring activities managers undertake in order to deliberately shape the behavior of organization members" (Andrews, 2010, p. 89).

Management Meta-category

For this meta-category, management is understood as "organizational process and practices that focus on weighing up and balancing opportunities and constraints from the environment with the internal capabilities, with the aim of enhancing public value and to achieve higher levels or organizational performance" (Walker, 2010, p. 227). Figure 1 illustrates the fact that research on the fire service began with an interest on management topics in the early 1970s. The figure also shows a surge of research on management during the first decade of the 2000s, after a decline in research during the 1990s. Departing from the theoretical models characterizing this meta-category in the 1970s and 1980s, studies now focus on a variety of managerial challenges.

Optimization of service delivery. The management meta-category focuses mainly on career fire departments and finds its roots in the RAND Corporation⁴ studies about the New York Fire Service in the early 1970s (Green & Kolesar, 2004). Researchers were mostly interested in optimization of service from an operations research perspective (e.g., Carter, G., Chaiken, & Ignall, 1972; Carter, G., & Rolph, 1973; Wallace, R. J., 1977. See also Hogg, 1968, for a first attempt at a mathematical model.)

For example, studies focused on location modeling and assignment problems through complex calculations of squad deployment and firehouse siting optimization (Green & Kolesar, 2004; Ignall, E. J., et al., 1975; Kolesar & Blum, 1973; Kolesar & Walker, 1974). Scholars also discussed problems related to efficiency of first-due unit dispatch (Chaiken, 1978; Ignall, E., Carter, & Rider, 1982; Swersey, 1982) and staffing policies (Halpern, J. S., Sarisamlis, & Wand, 1982). Even though the calculations provided data to optimize squad deployment, findings were criticized for not considering the socioeconomic environment in which the fire stations were located (Seley, 1979; Wallace, R., 1978; Wallace, R., 1993).

This genre of research is still carried out globally providing new models to optimize the number of responding firefighters in Canada (Sadeghi-Naini &

Asgary, 2013); reconfigure fire and rescue services in the UK (Murphy, P., Greenhalgh, & Parkin, 2012); identify the influence of organizational features in perceived emergency-management performance in Australia and New Zealand (Bhandari, Owen, & Brooks, 2014); take into account environmental conditions on technical efficiency in Spain (Garcia Sanchez, 2006); and establish new collaborations in daily response in Sweden (Weinholt & Granberg, 2015).

Other research correlated the efficiency of service delivery to the wealth of neighborhoods showing that property value can be an indicator of fire protection (Coulter, 1979) or that a correlation exists between high levels of social capital and fire-service outcomes (Andrews & Brewer, 2010). Some authors showed an interest in rating systems for fire departments (Coe, 1983) and in calculations to improve fire protection through the installation of detection devices in dwellings rather than adding fire stations (Halpern, J., 1979).

In the evidence reviewed, researchers tested different operational and economic models to measure the cost of fire protection (Seward, Plane, & Hendrick, 1978) and to determine the optimum level of performance in employee staffing with regards to the type of department (career, volunteer, or combination) (Brudney & Duncombe, 1992; Brunet, Deboer, & McNamara, 2001; McDavid, 1986). While these studies were instructive, the results and the generalization of findings were often limited by the use of case studies (Band et al., 2010; Craig, Verbeek, & Schwartz, 2010; Deng, Hsieh, Yang, & Sheu, 2001; McDavid, 1986; Woska, 1988).

Leadership: between authority and sensemaking.

A number of studies in this literature review focused on the topic of leadership in the fire service (Carter, H., 2007; Kupietz, 2010). Leadership is often depicted as the cornerstone of career development for fire officers (Jones & Feller, 2009) and as a channel to give orders.

Early research on leadership in the fire service showed that willingness to expose oneself to danger was associated with effective leadership as seen in military combat (Frost, Fielder, & Anderson, 1983). Departing from this view of leadership, authors suggested that the ability to mobilize emotional communication skills is a crucial asset of leadership (Riggio, R. B., Salinas, Riggio, H. R., & Cole, 2003) and that transformational leadership in routine situations may support subordinates in learning opportunities (Pillai & Williams, 2004). Researchers also suggested that fire-service managers should attempt to create a better understanding of fire-service operations as business management and dispel the myth that surrounds incident commanders as inflexible, autocratic, and paramilitary (Williams, 2010). Research also underscored the concept that firefighters under the command of a charismatic officer who expresses positivity are happier than those under the command of a noncharismatic superior (Erez, Johnson, Misangyi, Lepine, & Halverson, 2008).

Systems applied to manage emergencies vary between countries, and scholars have shown an interest in understanding decision-making processes of fire-service leaders in the stressful environment of the fireground (Young, St Clair Wilson, & Wetherell, 2013). Research from Australia, for example, shows that different decision-making patterns have been associated with the officer's rank, because the available information can be different for the first-arriving officer or the officer assuming command in a multialarm emergency (Lauder & Perry, 2014). Scholars have demonstrated that, in some instances, firefighters rarely base their decision on the first information at hand, instead taking some time to analyze the situation (Bayouth, Keren, Franke, & Godby, 2013).

For some researchers, intuition is key for situational awareness because fireground incidents are too fast-paced to facilitate time-consuming rational decision-making processes (Gasaway, 2007). As such, sensemaking, the process by which "people make retrospective sense of the situation in which they find themselves" (Weick, 1995, p. 15), then becomes an important asset amidst a confusing environment (Moschella, 2009).

Research from Canada shows that decision-making processes underline ethical responsibilities because the individual must assume the responsibilities of his/her decision (St-Denis, 2016), and research from the UK found that personal biases affect the selection of information used in decision making (Catherwood, Edgar, Sallis, Medley, & Brookes, 2012).

Complex managerial issues. Research on management in the fire service is based on multiple paradigms (Hassard, 1991) and focuses on a number of complex managerial issues. For example, researchers have analyzed labor relations and confirmed the effects of impasse procedures (Kochan & Baderschneider, 1978) and arbitration measures (Ashenfelter, 1971; Devinatz, 2015; Dinan, Ford, McDonnell, & Pyper, 2006; Wasylenko, 1977; Wheeler, 1977; Wheeler & Kochan, 1977) on the constant increase of firefighters' wages (Smith, R. L., & Lyons, 1980). There is also research interested in understanding legal grounds for mandatory retirement due to age (Klassen & Gillin, 1999).

Delivery of contemporary fire-related services (including suppression, emergency medical services, education, and training) occurs in a stressful environment (Brunsdon, Woodward, & Wilson, 2007) characterized by financial austerity and "cutback management" worldwide (Murphy, P. et al., 2012; Perrot & Blenkarn, 2015; Weinholt & Granberg, 2015). This fiscal stress has made it difficult for fire leaders to maintain adequate levels of service to citizens and in some cities had led to station closures or brownouts (England & Brown, 2014), personnel reductions (Fry, Magazine, & Rao, 2006), and impacts on the training required by fire departments to successfully execute confined-space emergency response (Wilson, Madison, & Healy, 2012; see also Halbesleben & Clark, 2010).

Studies analyzed in this literature review also assess the impact of fire-service initiatives on public services. For instance, research by Moschella & Chou (2013) suggest that few fire departments in their study fully maximized the use of electronic government (e-government) in rendering efficient public services. On the other hand, there are examples of successful initiatives. A study from the UK avers that a new education-based program based on the desire to listen to and learn from individuals who have actually experienced a fire can result in improved fire services (Wales & Thompson, 2013). In Sweden, a study on new collaborative patterns between security officers who could respond to emergencies and the fire service has documented possible cost benefits (Weinholt & Granberg, 2015). In Canada, a study of the impact of door-to-door fire prevention by on-duty firefighters confirmed a reduced frequency and severity of fires (Clare, Garis, Plecas, & Jennongs, 2012).

Finally, issues related to difficulties in the recruitment of volunteer firefighters have drawn global attention. Simpson (1996) documented the impact of modernization in rural New York State because the new middle class is less inclined at volunteering in the fire service. In Taiwan, austerity measures have impacted recruitment processes where there is now a need to refine core-competency indicators for employee selection (Lin, 2016). In France, where 80 percent of firefighters are volunteers, managing volunteerism now entails new organizational structures between localities and regions (Chevreuil, 2010; Derboulles, 2001).

In a rare comparative study between male and female motivations to join the fire service in Canada, Perrot & Blenkarn (2015) have shown that female volunteers showed a distinct pattern of motivations that could prove beneficial for the fire service. Still, this study underlined that the highly masculinist culture of the fire service places female workers in an environment where they must cope with hostility, "problems with equipment and protective apparel, challenges in childcare, and the perception that they are not up to the task" (Perrot & Blenkarn, 2015, p. 244). This portrait is in line with the findings of many scholars who studied diversity issues in the fire service as women and minorities still represent a small percentage of firefighters trying to find a place as outsiders (Maleta, 2009; Yoder & Aniakudo, 1997) within a mostly white male-oriented profession (Clarke & Kaleem, 2010; Hashen & Lilly, 2007; O'Brien, 2003; Pfefferkorn, 2006; Pudal, 2011b; Scaife & Lilly, 2007).

Management as a leadership challenge:

Summary of research in meta-category. In summary, research on management in the fire service has addressed a variety of interesting and relevant topics, but there remains a critical need to address these issues in the contemporary context of both career and volunteer fire departments. For instance, applying models of firefighters and apparatus deployment in the volunteer context would shed light

on topics largely unexplored in the peer-reviewed literature. As difficult choices challenge fire-service leaders, updating economic models and providing comparative results between fire departments would provide necessary data on which to base strategic decisions. Moreover, these data would enrich the discussion on management in difficult financial times, on quality of service delivered to citizens, and on e-government capacities. For example, few research studies address fire-service management in the context of networks of other actors sharing an environment of constraints (Meier & O'Toole, 2010). Furthermore, the fire service would gain from research on diversity (Pitts, 2010) documenting, for instance, the influence of women in leadership positions on both managerial and cultural aspects of the fire service. These studies could address questions such as how does gender influence managerial strategies, human-resources management, and recruitment? This line of research would surely further our understanding of the relationship between public-service motivation and organizational performance (Brewer, 2010).

Organizational Culture Meta-category

Organizational culture consists of collective basic assumptions that people share: values, such as priorities and philosophies and visual artifacts that act as representations of culture (Hofstede, Neuijen, Ohayv, & Sanders, 1990; Schein, 1984). Research on the culture meta-category has been in constant evolution since the 1970s, and it has centered mostly on understanding the act of volunteering. There is a strong emphasis on the life, work, and play of volunteer firefighters, while research on career firefighters is not as documented on these topics.

Fire fighting as serious leisure. The fire service has its roots in rural communities and is characterized by a social, club-like structure based on a localized vision centered on protecting the community and its common goods and values (Carp, 2001; Thompson, 1995). Stebbins' seminal work on serious leisure theory (Elkington & Stebbins, 2014; Stebbins, 1996; Stebbins, 2008) has been used extensively to explain the folklore associated with the firehouse, which revolves simultaneously around work and leisure (Perkins, 1989; Perkins & Benoit, 1997) and differentiates the fire service from other municipal services (McCarl, 1984; Perkins, 1989; Perkins, 1990; Perkins & Benoit, 1997; Perkins & Metz, 1988; Thompson, 1993; Thompson & Bono, 1993). A serious leisure is defined as:

the systematic pursuit of an amateur, hobbyist, or volunteer activity sufficiently substantial, interesting and fulfilling for the participant to find a (leisure) career there acquiring and expressing a combination of its special skills, knowledge and experience (Elkington & Stebbins, 2014, p. 4).

Volunteer firefighters represent a strong illustration of the intersection between volunteering and serious leisure (Stebbins, 1996; Stebbins, 2008) as individuals enter a specific world-view characterized by groups, events, routines, practices, organizational structures, and a unique knowledge stock (Stebbins, 1996).

Commitment: Firefighters and the sense of belonging. Personal as well as functional reasons explain what it means to be a volunteer firefighter (Liao-Troth, 2005). In many countries, a volunteering family history, often with the same fire department (Retière, 1994), being part of a social network linked to a fire department, and/or a sheer sense of commitment to the community (Chevrier & Dartiguenave, 2011; McLennan & Birch, 2009) are vectors of volunteering in the fire service. The sense of belonging to a closely knit group, where confidence in each other acts as an organizational cement (Auger & Reynaud, 2007), is also a strong incentive that promotes self-esteem (Pudal, 2011b). For instance, in Canada, France, and the US, the fire station is often seen as the higher locus of men's sociability as they become actors of the community's social life (Chevrier & Dartiguenave, 2011; St-Denis, 2015; Tracey & Scott, 2006),⁵ which in turn allows firefighters to engage in a privileged relationship with citizens who often idealize the occupation (Jeantet & Gernet, 2011; Tracey & Scott, 2006). In fact, in many communities, it is through the volunteer fire department that men and women express strong values of democracy, patriotism, and autonomy (Lozier, 1976; Perkins, 1989; Pudal, 2012; Scott & Kroman Myers, 2005).

Firefighters usually commit themselves for the long term when they join the fire service, where they find old and new friends and a sense of community (Thompson, 1993; Thompson, 1995; Thompson & Bono, 1993). US firefighters who are members of church organizations have even indicated that being a firefighter is as important, if not even more so, than their affiliations with their religious communities (Perkins & Metz, 1988). Moreover, many volunteer firefighters experience a higher degree of satisfaction doing their work in the fire service than in their primary occupation. They are happier and tend to work harder in the fire service. The volunteers show a greater interest in what they do, feel more useful, and sense that their efforts are better recognized. In turn, they feel a greater sense of belonging as they gain new responsibilities (Thompson & Bono, 1993).

Data support the strong commitment of volunteer firefighters with a significant correlation between age and years of service (Perkins, 1989; Perkins, 1990). For example, research on Pilipino firefighters showed that they tend to score high on scales measuring predisposition to help (Magno, 2010); and Lee & Olshfski (2002) have shown that US firefighters are committed to their jobs, which they view as honorable and dedicated to community service. Very few firefighters wish

to leave their roles because they justify their desires to join the fire service as a way to serve their communities. Equally important, being a firefighter also allows one to engage in devotee work (Perkins & Metz, 1988), be part of an action-oriented primary group, and provide meaningful service to the local community (Perkins, 1989). These activities help fight alienation by taking part in work characterized by commitment and self-realization (Thompson & Bono, 1993).

Knowledge as a gateway into the fire service. As part of the group, firefighters learn a valued knowledge stock (Retière, 1994) about fire fighting through experiential learning and on-the-job training (Bromé, Lyman, & Told, 2014; Hagemann, Kluge, & Greve, 2012; Moran & Starling, 2005; Sommer & Njâ, 2011; Taber, 2008). Through legitimate peripheral participation in the community of firefighters (Brown, J. S., & Duguid, 1991; Fuller, 2007; Lave & Wenger, 1991), the newcomer slowly becomes an insider (Lloyd, 2007; Huysman, 2004). Knowledge transfer from experienced firefighters to newcomers is often the way by which some of the best practices are taught and shared. In this context, discipline (Dietrich, Riberot, & Weppe, 2016), storytelling (Dietrich, Riberot, & Weppe, 2016), and critical reflection (Childs, 2005; Douesnard & Saint-Arnaud, 2011) play important parts in the dissemination of knowledge as the novice firefighter “engages with institutionally sanctioned information” (Lloyd & Somerville, 2006, p. 190).

Learning from the old-timers is also an occasion to develop a singular understanding of rules of sociability in the fire service as well as the institutionalized culture (Myers, 2005; Perkins, 1989; Yarnal & Dowler, 2002): “When discussing initial firefighter training, it is not simply technical skill training, but an introduction into the ‘culture of firefighting’” (Taber, Plumb, & Jolemore, 2008, p. 274). Exercises and drills then become occasions for firefighters to learn in groups and engage in learning by doing (Bourgeois & Chapelle, 2011; Roloff, Wooley, & Edmondson, 2011).

Becoming a firefighter: A total role. Firefighters usually enjoy widespread gratitude, status, and prestige in their communities and are recognized through symbols (jackets, clothing, patches, blue lights, etc.) (Thompson & Bono, 1993). In turn, this social recognition can also trigger tensions since the role of firefighter is understood as a “total” role, because being a firefighter has an impact on many other important roles around which an individual organizes his or her self-concept (Perkins, 1989; Pudal, 2011b; Smith et al., 2001). Research has shown a strong presence of rituals, traditions, and codes that regulate the entire life of a firefighter in a culture that well exceeds the workplace (Perkins, 1989; Pudal, 2011a). Thus, firefighters are caught managing emotions between social recognition and personal coherence (St-Denis, 2013). As a consequence, investing oneself in the fire service can lead to tensions and conflicts in family relations or with

other social obligations, in particular when there is a need to be available 24 hours a day.

Being a firefighter has a substantial impact on personal identification, accomplishment, fun, and camaraderie — all the while imposing constant negotiation and compromise between personal obligations, serving the community, and enjoying being part of the fire service (Yarnal & Dowler, 2002). In theory, a leisure participant can quit whenever he/she wants to in order to pursue another interest. On the contrary, volunteer firefighters feel that social pressures preclude them from leaving their roles: the pressure to stay is, at the same time, influenced by the norms and cultural pressure of the group and by the sense of duty towards the community. In the end, the sense of commitment and obligation becomes more important than anticipated when first joining the ranks — in part because volunteer firefighters think that citizens are overly absorbed with the heroic image of fireground operations (Lavilunière & Bialès, 2012). In turn, citizens do not envision the interrupted work time, conflicting family schedules, sick children, or missed family events (Yarnal & Dowler, 2002).

Evidence from research underlines the fact that volunteer firefighters voice concern over community expectations because citizens most often do not make any distinction between volunteer and career firefighters. All types of firefighters face the challenge of professional evaluations when discussing quality and provision of services (Yarnal & Dowler, 2002). To this end, a relatively small number of articles address the issue associated with balancing fire fighting with family life. Data point to the negative effects of shift work on family life, the transfer of stress from traumatic events to family siblings (Pfefferbaum et al, 2002), and the pressures of the social atmosphere of the firefighters’ group on families (Cowlshaw, Evans, & McLennan, 2008; Regher, Dimitropoulos, Bright, George, & Henderson, 2005).

Cultural traits of volunteer firefighters identified by research are somewhat notable in their career counterparts. Results from research on assimilation in a US career fire department suggest that in high-reliability organizations, newcomers quickly adopt organizationally prescribed roles, and integrate into their new environments as socialization efforts seek member reliability and mutual trust (Myers, 2005). Newcomers in dangerous or emergency/rescue organizations must quickly learn to communicate and behave in ways that instill trust (Colquitt, Lepine, Zapata, & Wild, 2011) and confidence with their coworkers (Myers, 2005). Research results have also shown that fire stations can become environments showing signs of the *group-think* phenomena (Laughlin, 2008) where variance is not tolerated, and shared similar perspectives fail to challenge shared views (Rashman, Withers & Hartley, 2009). Groupthink creates pressure on newcomers to adopt behaviors that are in accordance with institutionalized practices in the group of firefighters.

Leveraging organizational culture to support leadership: Summary of research in meta-category

Research findings in the organizational culture meta-category help one understand what it means to be a firefighter and the almost sacred aspects of the fire-service culture. Being a firefighter appears to be more than a profession: it is an encompassing role that defines the individual in all aspects of social and private life.

Based on the studies reviewed in this article, additional research on serious leisure in the fire service, in the contemporary social, familial, and cultural context, would allow a better understanding of the tensions associated with a firefighter's many, and at times conflicting, roles. Since fire-fighting activities are mostly conducted in immediately dangerous conditions to life and health, this serious leisure has the potential to cause important tensions in the lives of volunteers because it creates ambiguity between pride, heroism, courage, self-abnegation, idealism, and social pressure.

Additional research is also needed to understand the ambiguity of citizens' expectations of firefighters. For example, research discussed previously shows that the populace view firefighters as courageous and heroic. Does this perspective mean that firefighters should be risk averse in order to save lives that may already be lost in a fire or to save property? Understanding how the public's expectations fare with the realities of fire fighting could shed light on a firefighter's agency, recruitment, and provisions of services (US Fire Administration [USFA], 2007).

Analyses of studies reviewed in this article also found that firefighters feel pressured by the citizens of their communities to perform to high standards regardless of whether they are volunteers or career personnel. As such, these men and women dedicate themselves to mastering a complex knowledge stock. In turn, this knowledge stock is being challenged both by the necessity to develop new competencies to respond to evermore complex emergencies and by scientific and applied research that force firefighters to reconsider agreed-upon practices (e.g., Holmgren, 2014; Madrzykowski, 2013).

Finally, most of the work on culture, role, and commitment has focused on volunteer firefighters. Research on culture in the context of career fire departments could prove helpful to sustain a holistic research agenda providing data to support studies in the health and safety and management meta-categories.

Discussion

In general, the body of research on the fire service does not show the *superstar effect*, where a very small group of scholars published the overwhelming majority of articles (Massaro, et al., 2015). In fact, authors generally contributed one or only a few articles to the body of knowledge about fire fighting and firefighters. This

plurality of research perspectives added richness and diversity to the study of fire fighting across the world. The paucity of peer-reviewed, fire-related articles produced over the past 46 years suggests that the field of research on the fire service is still in its infancy; much work remains to be done.

This review tells a story about firefighters. In many communities, the firehouse becomes a focal point for the individual's engagement in public service. Joining the fire service allows these men and women to gain a special status that defines the boundaries of a respected role in the community. In fact, through their commitments in this public service, firefighters gain a sense of belonging and, as underlined by the studies reviewed in this article, this special status comes with serious trade-offs. Fire fighting is a stressful profession that requires fitness and self-discipline to be able to function in a working environment characterized by significant danger, loud noises, and multiple aggressors that have important and long-lasting health consequences such as hearing impairment, lung diseases, and cancer — and unfortunately all too often death.

Assuming a leadership position within the fire service comes with numerous challenges. First, citizens recognize firefighters as pillars of community life through their involvement in protecting others as well as the symbolic representation of courage. Juggling with these expectations and the optimization of service in an austere financial environment becomes a complex public-administration challenge. Second, fire-service leaders must also face the challenge posed by the risk of LODDs and promote a cultural change in basic assumptions related to health and safety. On one hand, the organizational culture is a strong asset to leaders with such values as commitment, engagement, and service. On the other hand, as this same culture leans towards low levels of fitness and life habits, it becomes a barrier to necessary changes. Finally, as documented in this review, there is an important knowledge stock to be mastered in the fire service. With a growing body of academic research on the fire service, leaders need to engage in strategic knowledge management and leverage available data from research into best practices on the fireground. In doing so, fire leaders could bring valuable changes in the training programs by raising future firefighters' awareness on issues such as health and safety, lifestyle, and factors related to LODDs.

Results presented here suggest that research work bridging the intersections of the meta-categories would sustain the development of an in-depth understanding of the links between managerial work, health and safety issues, and organizational culture. Examples include research on diversity and women's leadership in the fire service, the interface between the fire service and other public agencies, mergers of fire departments, and change management in a conservative organizational culture often characterized by group-think.

Future comprehensive literature reviews of research on the fire service should encompass peer-reviewed articles published in different languages. This approach would allow for a more comprehensive, comparative, and global understanding of the fire service.

Conclusion

The purpose of this article was to present a systematic literature review of 238 fire-related academic studies drawn from peer-reviewed journals published between 1970 and 2016. No claim is made that these 238 studies represent the *population* of fire-related academic studies published during this 46-year time span. Undoubtedly, some peer-reviewed articles were missed because they were not indexed in major searchable databases such as EBSCO or JSTOR and/or the title or abstract of an article did not contain the keywords *fire*, *fire service*, *fire department*, and *firefighter* (in French: *service d'incendie*, *incendie*, and *pompier*). In order to overcome these search limitations, the *reference lists* of articles found in the initial search were mined, and 64 additional articles were added to the literature review. Finally, five new studies were identified using the meta-categories subtopics-shown in Table 1. Nevertheless, the studies included in this literature review are offered as a *representative sample* of peer-reviewed articles appearing between 1970 and 2016.

The literature review offered here makes three important contributions to the body of knowledge on the fire service: First, as the first systematic, global, and inclusive literature review of research on the fire service, it provides empirical evidence of three meta-categories that characterize the state of research on the fire service. In order of importance (based on the number of studies in a category) the three meta-categories are (1) health and safety, (2) management, and (3) organizational culture. Second, the review offers the first longitudinal view (1970–2016) of research work on the fire service written in both English and French. Third, based on analysis of the 238 studies, the review offers multiple recommendations where additional research could prove beneficial to fire-service leaders.

Based on the publication dates of studies, the last decade underscores a clear surge of interest of research on the fire service. An encouraging sign of the growing maturity of this field of research is now the possibility, and one could argue the necessity, for meta-analyses allowing for a better understanding of a multiplicity of studies in the same meta-category — e.g., health and safety.

Firefighters are viewed by their fellow citizens as modern heroes. The peer-reviewed, academic research studied here and summarized into three meta-categories holds the potential to support fire-service leaders in their efforts to bringing everyone home safely.

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Endnotes

¹ The final report is available at <http://www.coroner.gouv.qc.ca>. The document was accessed on February 1, 2016.

² This choice allowed the author to cover Canada (both English and French), France, English-speaking countries, and research published in either language in other countries. Books have been published on the fire service, but they were omitted in this review because most are not written for the academic, research community.

³ For validity purposes, a search was conducted using the same keywords in a small random selection of 90 theses (45 in English and 45 in French) through the following three databanks: ProQuest Dissertation & Theses Global, Thèses Canada, and Theses.fr. All theses could be classified into one of the three proposed meta-categories.

⁴ See www.rand.org

⁵ The theory is based on an analysis of the importance of the fire station to men, not women firefighters.

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Getting Engaged: Facebook and the Fire Service

Abstract

Crisis situations around the world are repeatedly proving the critical impact of contemporary social-media usage. Leaders in the American fire service are recognizing the strengths of these tools and having their agencies rapidly increase usage of social media during both emergency and nonemergency periods. While research on social-media usage during disasters is expanding, much less is known about how the fire service uses these applications on a day-to-day basis. This study conducted analyses on fire departments' official Facebook pages to determine what they are posting and what factors influenced the amount of engagement in the forms of likes, comments, and shares that these posts received. Five major findings emerged from the research effort. First, posts disclosing information about a fire-department's history, its people, and its actions got the most likes and comments overall. Second, content that provided general community information, public-service announcements, or situational awareness got the fewest number of likes and comments. However, among these types of posts, general community information got more likes than public-service announcements or situational awareness. Third, posts that contained content shared from other Facebook pages received fewer likes and comments than posts that did not contain shared content. Fourth, posts made between 10 p.m. and 2 a.m. received more shares than content posted at other times of the day. Fifth, posts containing images received more likes and comments than posts that did not contain images. These findings can offer guidance to fire departments on how to better engage their followers and foster relationships via Facebook on a day-to-day basis.

Keywords: *Facebook and fire-department usage, social media and the fire service, US fire departments' Facebook pages*

Introduction

Research on public-safety agency usage of social media is expanding rapidly (Latonero & Shklovski, 2010). Social-media applications such as Facebook and Twitter are repeatedly proving their usefulness as collaboration and coordination tools during disasters (e.g., Dufty, 2012; Bonson, Royo, & Ratkai, 2015). These uses include managing stakeholder needs and expectations (Wardell & Su, 2011; Alexander, 2014), increasing situational awareness, and informing both emergency responders and residents about local conditions (Houston et al., 2014).

Stakeholders are increasingly *expecting* their local emergency-service agencies to use these applications. A 2010 American Red Cross survey reveals 69% of respondents believed that emergency-response agencies should regularly monitor their social-media sites so that they can respond quickly to posted requests (Wardell & Su, 2011). Although slow to initially accept and adopt social media, fire-service leaders are finding that social media offers tremendous opportunities for communicating with their communities during both emergency and nonemergency situations (Murphy, 2013; Sheil, Violanti, & Slusarski, 2011). Guidance on

fire-service Facebook usage, however, remains limited (Sheil et al., 2011).

Large variances in staffing resources and stakeholder needs among different communities leads to few *right-way* methods for social-media adoption and use (Wardell & Su, 2011; Hughes, St Denis, Palen, & Anderson, 2014). Simply creating an agency Facebook profile is not an effective way to create an online relationship with the community (Waters, Burnett, Lamm, & Lucas, 2009; Waters, Canfield, Foster, & Hardy, 2011; Bonson et al., 2015).

While emergency situations encourage stakeholders to seek out information from official emergency-services agencies, nonemergency situations can prove challenging for attracting audiences. This challenge is a critical weakness in that the *principle of continuity* suggests that behavior prior to a crisis, including that of organizations, will likely carry over during and after one (Quarantelli & Dynes, 1977). It is critical, therefore, to develop relationships that seek to change people's behavior during nonevent times. Fire-service leaders must recognize the potential that Facebook has to foster these relationships.

Literature Review

Facebook is considered the most popular social-networking application in the world. By early 2016, nearly 67% of American adults had Facebook accounts (Gottfried & Shearer, 2016). Facebook has the highest levels of engagement among social-media users (Bonson et al., 2015). More than 60% of account holders visit the site at least once a day, with nearly 40% visiting multiple times a day (Bonson et al., 2015). The average user spends 55 minutes a day on the site (Waters et al., 2011).

In addition to individual accounts, Facebook also features pages. These pages allow nonindividuals, such as companies, organizations, or government agencies, to secure a place on the site. Organizations use pages for establishing online communities, branding, and marketing (Murphy, 2013). Shared content is carefully curated and selected in order to present an *ideal* representation, allowing agencies to maintain a high level of control over their online images (Farquhar, 2013; Kaplan & Haenlein, 2009). Pages can provide a social presence, reduce ambiguity and uncertainty in communications, and allow for self-presentation and disclosure (Kaplan & Haenlein, 2009).

Sheil, Violanti, & Slusarski (2011) found that the majority (66.7%) of US fire departments that they surveyed used social media. In their study of social-media use during Hurricane Sandy, Hughes, St Denis, Palen, & Anderson (2014) found Facebook to be the most common type of fire-service social-media account. Among the 568 fire departments located within 100 miles of where the storm made landfall in southern New Jersey, nearly 70% had Facebook pages (Hughes et al., 2014).

A majority of American adults receive news from social media, with two-thirds of Facebook users getting news on the site (Gottfried & Shearer, 2016). More critically, some subsets of stakeholders, such as younger populations, use social-media tools as their primary sources of information and communication (Anatomy Media, 2017; Waters et al., 2011). Social-networking sites may be the only form of media that reach some parts of the population (Mergel, 2013; Bonson & Ratkai, 2013). Therefore, it is critical that fire-service leaders know how to reach a multitude of audiences on a day-to-day basis.

Little research exists as to the influence different types of content have on stakeholder interaction with government-agency Facebook pages (Bonson et al., 2015). Mergel (2014) found three missions that government agencies have when utilizing social-media tools: *transparency*, *participation*, and *collaboration*. *Transparency* involves having a social-media presence that simply eliminates one-way information and represents the agency online (Mergel, 2013; Mergel, 2014; Ellison & Hardey, 2014). *Participation* involves both pushing information out and listening to or pulling information in (Mergel, 2013; Mergel, 2014; Schultz & Peltier,

2013; Shen & Bissell, 2013). Two-way communication helps build and maintain trust and makes citizens feel empowered (e.g., Olsen & Shindler, 2010; Kweit & Kweit, 2004; Schultz & Peltier, 2013; Latonero & Shklovski, 2010). Advanced social-media relationships also allow for what Mergel (2014) describes as *collaboration*, the third common government agency social-media mission. Collaboration requires not only two-way communications, but also interactive exchange that involves discussions, networking, and mutual content sharing between agencies and stakeholders (Mergel, 2013; Mergel, 2014).

To help ensure that content appears in followers' newsfeeds, posted material must generate user interactivity. Page administrators can gauge the effectiveness of posts by the responses they get from other users via typed comments, likes, reactions, or shares (Farquhar, 2013; Swani, Milne, & Brown, 2013). These *one-click* buttons allow users to easily express their feelings toward viewed content, and their speed and ease encourage frequent interaction (De Vries, Gensler, & Leeelan, 2012; Swani et al., 2013; Parsons, 2013). Because they require more effort from the user, comments likely hold more weight when determining what is chosen as interesting content (Bucher, 2012). These interactions are seen not just by the two parties involved, but also in the newsfeeds of friends connected to the users who are doing the engaging (Swani et al., 2013; Shen & Bissell, 2013). This visibility, essentially, allows engaged followers to act as endorsers and promoters of the content shared on a page (Swani et al., 2013). This *viral* process helps interesting content to spread very quickly (Shen & Bissell, 2013).

Facebook users are more likely to like or engage with posted material when they see one or more of their friends also engaging with that same content (Swani et al., 2013). This *amplification* is important for emergency messages. Research has shown that people tend to respond to warning messages more when they see others in their social circles also responding to them (McLean & Power, 2013; Lindell & Perry, 2012). Effective posted content must actively attract and keep a stakeholder's attention, as well as promote interactivity (Waters & Lo, 2012; Wardell & Su, 2011). Entertaining and current content leads to increased engagement (De Vries, et al., 2012); this type of content increases follower satisfaction and loyalty (Gummerus, Liljander, Weman, & Pihlstrom, 2012).

Although overall social-media usage continues to expand, many long-time users have moved away from these tools due to information overload, privacy concerns, and boredom (Bright, Kleiser, & Grau, 2014). This *social-media fatigue* is leading to declines in active engagement on Facebook among some demographics (Bright et al., 2014). Original content sharing on Facebook by nonprofessional sources is down as much as 21% (Griffith, 2016). In their study of Western European citizens' engagement with local governments' Facebook pages, Bonson et al. (2015) found

that the most common type of post contained links to other content. These posts, however, received the lowest levels of engagement from followers.

Even with challenges, the upside of fire-service leaders utilizing Facebook for interaction with stakeholders remains high. It is important to find out what content local stakeholders are interested in and find valuable (Kaplan & Haenlein, 2009). Page managers should develop online personalities that make them seem authentic and responsive with interactions that are consistent, clear, and personal (Wardell & Su, 2011; Schultz & Peltier, 2013). Questions or comments left on pages should get replies; even just a *thanks* works. These replies reinforce the idea of interactivity and lead to repeat views of the page by people going back to read responses (Waters et al., 2011).

To date, most research has focused on the use of social media during and after disasters (Sheil, et al., 2011). Little research exists on how response agencies can effectively utilize social media on a day-to-day basis. The purpose of this research is to examine what content fire departments typically post to Facebook, the world's biggest social-media site. The study also looks at what content generates the most engagement with followers.

Research Objectives

Facebook has become a significant, mainstream tool for people and organizations to share and consume content. Less understood is how these agencies, and in particular local fire departments, can best utilize Facebook on a day-to-day basis. Although research on fire-service use of social media and Facebook is growing, no study has looked at what variables affect the amount of online interaction different posted content gets. Understanding this engagement, measured by the number of *likes*, *comments*, or *shares* that posted content receives, is critical for fire-service leaders to understand in order to most effectively reach their stakeholders.

Waters et al. (2009) found that nonprofit organizations use Facebook in three ways in order to cultivate relationships with their followers. The first of these strategies is *disclosure*. In response to demands for more transparency, these efforts tell the story about what the organization does, its history, and its people. The next strategy is *usefulness*. Usefulness focuses on information dissemination to followers. The final strategy is *interactivity*, which seeks to develop both online and offline interactive relationships with followers.

For this study, these three strategy categories are slightly modified to reflect the content commonly posted by fire departments and Mergel's (2013; 2014) third function of social media, *collaboration*. Thus, the three categories used in this study are *disclosure*, *information*, and *involvement*. Within these main categories, more specific subcategories of content are also identified.

Disclosure posts talk about the fire department, its people, and its activities. Within *disclosure* content are posts that discuss *history*, *fire-department life*, and *activity recaps*. *History* posts talk about the activities, people, and resources from a fire department's distant past. *Fire-department life* posts talk about a department's everyday moments and its current personnel and assets. *Activity recaps* highlight things that the department has recently participated in, including organized events, emergency responses, and training sessions.

Information posts share general content and tell stakeholders about news or hazards that could affect them or the community. Information posts include *general information*, *public-service announcements*, and *situational awareness*. *General-information* posts share nonemergency-related local news and information. This post can include non-fire department-related community news or posts about the fire service in general. *Public-service announcements* include general safety-awareness content. *Situational-awareness* posts include locally specific *happening-now*-type safety information, including weather alerts and road closures.

Involvement posts seek direct interaction between the fire department and stakeholders. Subcategories contain *physical-involvement*, *virtual-involvement*, or *general-engagement* content. *Physical-involvement* content discusses initiatives that the fire department is planning or engaged in that seek in-person public participation. These initiatives can be meetings, educational classes, or other events. *Virtual-involvement* posts seek online interaction such as surveys or trivia questions. *General-engagement posts* include light-hearted entertainment content such as the sharing of jokes or cute pictures, as well as community *thank-you's* or holiday greetings.

The research hypotheses (RHs) of the study explore what types of content among these main strategies and subcategories generate the most online interaction on official fire-department Facebook pages. The number of *likes*, *comments*, and *shares* that each post receives measures this interaction. Other variables examined included posts containing content *shared from another Facebook page*, posts having *links to other web pages*, posts giving the *day of the week* and *time of the day* that the posts were initially made, and whether the posts contain *videos* or *images*. RHs included the following:

- **RH1** — There is a statistically significant difference among Facebook users' online interaction (mean numbers of likes, comments, and shares) with fire-departments' *disclosure*, *information*, and *involvement* posts.
- **RH2.1** — There is a statistically significant difference among Facebook users' online interaction (mean numbers of likes, comments, and shares)

with fire-departments' *disclosure*-post subcategories (*history*, *fire-department life*, and *activity recaps*).

- **RH2.2** — There is a statistically significant difference among Facebook users' online interaction (mean numbers of likes, comments, and shares) with fire-departments' *information*-post subcategories (*general information*, *public service announcements*, and *situational awareness*).
- **RH2.3** — There is a statistically significant difference among Facebook users' online interaction (mean numbers of likes, comments, and shares) with fire-departments' *involvement*-post subcategories (*physical involvement*, *virtual involvement*, and *general engagement*).
- **RH3.1** — There is a statistically significant difference among Facebook users' online interaction (mean numbers of likes, comments, and shares) with fire-departments' posts based on whether they include *shares from other Facebook pages*.
- **RH3.2** — There is a statistically significant difference among Facebook users' online interaction (mean numbers of likes, comments, and shares) with fire-departments' posts based on whether they include *links to other web pages*.
- **RH4.1** — There is a statistically significant difference among Facebook users' online interaction (mean numbers of likes, comments, and shares) with fire-departments' posts based on the *day* of the week they are made.
- **RH4.2** — There is a statistically significant difference among Facebook users' online interaction (mean numbers of likes, comments, and shares) with fire-departments' posts based on the *time* of the day they are made.
- **RH5.1** — There is a statistically significant difference among Facebook users' online interaction (mean numbers of likes, comments, and shares) with fire-departments' posts that include *videos*.
- **RH5.2** — There is a statistically significant difference among Facebook users' online interaction (mean numbers of likes, comments, and shares) with fire-departments' posts that contain *images*.

Methodology

The methodology used in the study is divided into three main topics: sampling, coding, and analytical methods. These methodology topics are used to test RHs.

Sampling

The study examines the postings of 50 fire departments located across the US during a one-month period, December of 2014. December is a busy time

for local community events. As such, many fire departments are active during this time of the year with events such as food and toy drives, holiday parades, and Santa-Claus runs. This diversity in activities and expected types of social-media content made this time of year attractive for this study. Homogeneous purposive sampling was used to choose the included agencies. This sampling method seeks out settings where specific processes are likely to occur (Denzin & Lincoln, 1994). It also seeks a homogeneous population that contains units sharing the same characteristics.

To be included in the study, the researchers first identified fire departments having official and active Facebook pages (see **Figure 1**). The departments chosen for study have Facebook pages managed by employees or volunteers from within their organizations. It is not uncommon for departments to have official pages established, but populated with little or no content. Any department found with a page that was active but not populated with content was eliminated from inclusion in the study.

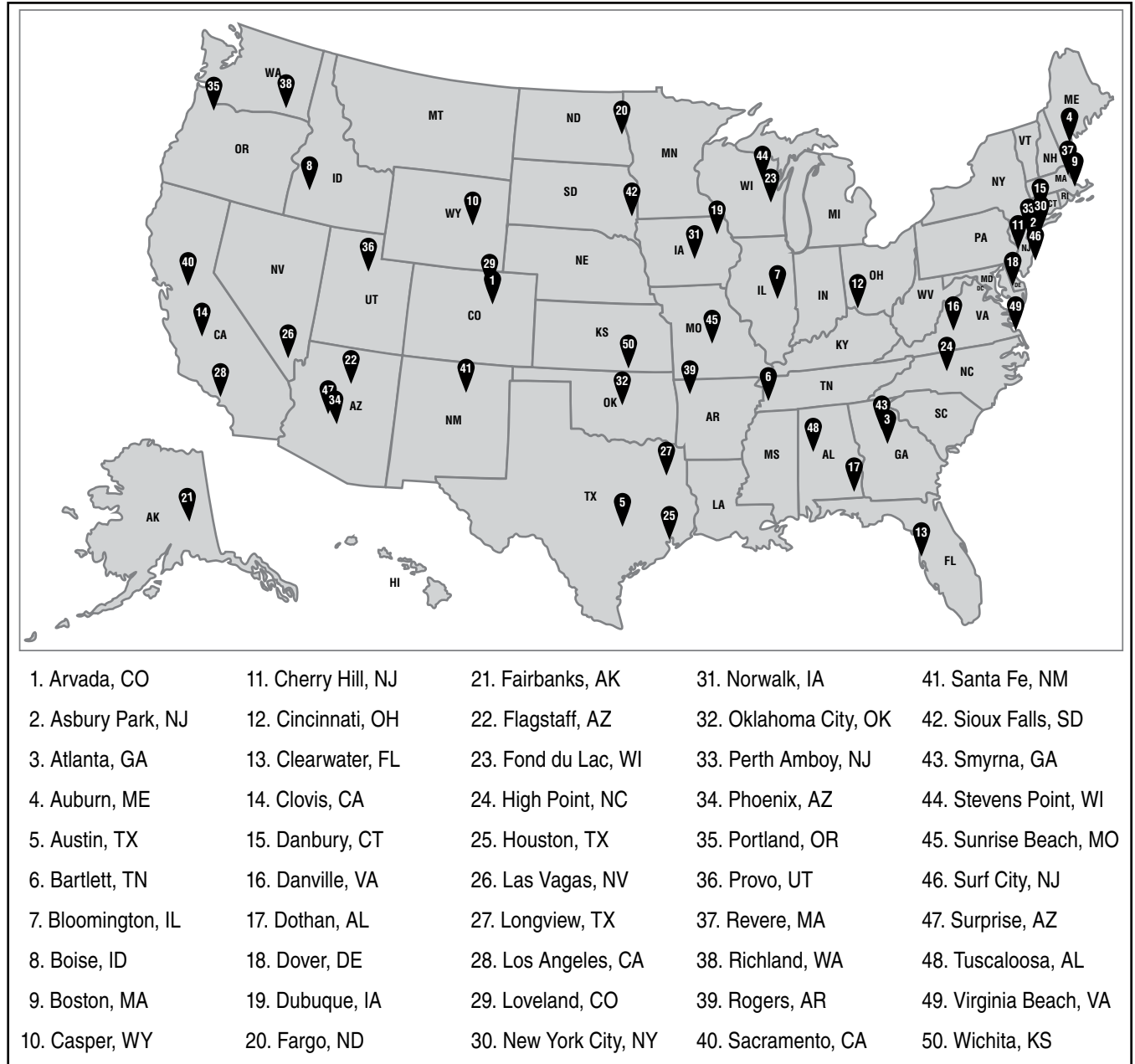
Coding

Each post made during the month examined was recorded and manually coded for content. The numbers of *likes*, *comments*, and *shares* for each post were the dependent variables. The independent variables included the main content strategies of *disclosure*, *information*, and *involvement*. Other independent variables examined included *shares from other Facebook pages*, *links to other web pages*, *day* and *time* of the original post, and whether the post contains *video* or *images*.

Content analysis required researchers to recognize, interpret, and quantitatively categorize messages (Ramanadhan, Mendez, Rao, & Viswanath, 2013). The method is defined by Berelson (1952) as "a research technique for the objective, systematic, and quantitative description of the manifest content of communication" (p. 18). These processes must be duplicable and accessible to others (Krippendorff, 2013). Facebook pages are especially suited for this type of analysis because their metrics, including the numbers of likes, comments, and shares, are publically viewable and constantly current (Lai & To, 2015). Anyone with Facebook access can access these pages and see what is posted and how much engagement these posts receive (Bonson & Ratkai, 2013).

Initial coding was conducted on the reviewed content. To test for inter-coder reliability or agreement, three additional reviewers also coded a sample of the content population (i.e., total posts). Lombard, Snyder-Dutch, & Bracken (2002) defined inter-coder reliability as "the extent to which independent coders evaluate a characteristic of a message or artifact and reach the same conclusion" (p. 589). Training on the coding categories occurred over two sessions using a provided coding guide.

Figure 1: Geographical Dispersal of Sample (plus Fairbanks, AK) and List of Fire Departments Included in the Study.



Twenty percent of the total number of posts (227 of 1,142) was randomly selected for review using an online list randomizer. This sample size is consistent with Emmert and Barker’s (1989) suggestion of a 10–25% sample reviewed by trained and independent coders (Lacy & Riffe, 1996). Among the 20% random sample, the average pair-wise percent agreement was 93.54%, resulting in a Krippendorff Alpha (nominal) score of 0.899. This high rate of reliability confirms the clarity and meaning of the post categories used in this study.

Analytical Methods

Analysis of variance (ANOVA) and t-tests are used to test the RHs. ANOVA is appropriate to test differences

between the means of an interval-ratio-level dependent variable across independent variables that have three or more categories (Healy, 2012). ANOVA requires roughly equal numbers of cases in each category of the independent variable and the homogeneity of variance (Healy, 2012). For this study, this requirement was not possible due to the number of Facebook posts for each content-category type being unequal. For tests that showed significance within ANOVA, additional tests were conducted using the Levenes’ homogeneity test and Welch and Brown-Forsythe robust tests of equality of means. While ANOVA can tolerate some deviance, these tests are more suitable when working with unequal variances and sample sizes.

Also, if the null hypothesis is rejected, ANOVA is not specific in indicating what is significant in causing

this rejection. It merely indicates that one category's mean is statistically significantly different from the others (Healy, 2012). T-tests were used to test variables containing only two groups. These tests compared whether two independent variables have statistically significant different means that are unlikely to have occurred randomly. T-tests are limited, however, to looking only at means and individual scores (Healy, 2012).

Results

Nearly all posts in the sample, 97.37% ($n = 1,112$) received at least one *like*, *comment*, or *share*. Descriptive statistics showed that *likes* were the most common types of engagement with 97.19% ($n = 1,110$) of posts receiving at least one. *Shares* were the second most common type of interaction, with at least one found in 48.51% ($n = 554$) of posts. *Comments* were the least common engagement type, with at least one found in 46.32% ($n = 529$) of content. Statistical analyses for each research question are in the paragraphs that follow.

To test RH1, three separate ANOVA analyses were conducted on the mean differences between the numbers of *likes*, *comments*, and *shares* for each of the main content categories of *disclosure*, *information*, and *involvement*. Test results showed the following:

- **Likes** — The ANOVA analysis showed a significant difference in the mean amounts of *likes* ($F_{2, 1139} = 9.45, p < 0.01$)¹ between the three main Facebook post-content categories. *Disclosure* posts ($n = 483$) saw the most *likes* with a mean of 252.67. *Involvement* posts ($n = 253$) were next, with an average of 99.13 *likes*. *Information* posts ($n = 406$) received the fewest *likes*, averaging 21.84.
- **Comments** — Based on one-way ANOVA, the mean number of *comments* between the three main content categories was found to be statistically significant ($F_{2, 1139} = 11.34, p < 0.01$).² Each post saw an average of 4.23 ($n = 1,142$) *comments* per post. *Disclosure* content ($n = 483$) saw the most *comments* with a mean of 6.70. *Involvement* posts ($n = 253$) were next, averaging 5.21. *Information* ($n = 406$) received the fewest with a mean of 0.69.
- **Shares** — One-way ANOVA showed no significant statistical difference in the mean number of *shares* among the three main content categories ($F_{2, 1139} = 0.15, ns$). As such, differences were considered random.

RH2.1 was not supported. The statistical analyses results, using one-way ANOVA, did not show a significant difference in the mean numbers of *likes* ($F_{2, 480} = 0.070, p = ns$), *comments* ($F_{2, 480} = 0.308, p = ns$), or

shares ($F_{2, 480} = 0.156, p = ns$) among the disclosure content subcategories of *history*, *fire department life*, or *activity recaps*.

The analyses of RH2.2 showed that there are significant differences among the *likes* for fire departments' *information* post subcategories ($F_{2, 403} = 4.11, p < 0.05$).³ In the descriptive statistics across the three subcategories of this content, the overall mean number of *likes* was 21.84. *General-information* posts received the most *likes* with 31.37. *Public-service announcements* followed with 19.89. *Situational-awareness* content saw the fewest number of *likes* with a mean of 13.60. The differences, based on one-way ANOVA, between the mean number of *comments* ($F_{2, 403} = 2.975, p = ns$) and *shares* ($F_{2, 403} = 0.521, p = ns$) of the information subcategories were not statistically significant.

RH2.3 was not supported. The statistical differences between the mean number of *likes* ($F_{2, 250} = 0.657, p = ns$) and *shares* ($F_{2, 250} = 0.657, p = ns$) were not significant using one-way ANOVA. The mean number of *comments* was not statistically significant based on the findings of the more robust Welch ($F_{2, 51} = 1.099, p = ns$) and Brown-Forsyth ($F_{2, 22} = 1.940, p = ns$) tests of equality of means.⁴

RH 3.1 was partially supported using the t-test. The descriptive statistics showed an average of 33.94 *likes* for posts containing content *shared from other Facebook pages* and 153.56 *likes* for posts that did not. The t-test showed a significant difference between the means of these posts ($t_{(1140)} = 4.26, p < 0.01$). The descriptive statistics showed a mean of 0.81 *comments* for posts containing content *shared from other Facebook pages* and a mean of 4.80 for pages that were not shared. The t-test showed these statistics to have a significant difference ($t_{(1140)} = 5.90, p < 0.01$). The differences, based on the t-test, between the mean *shares* for content *shared from other Facebook pages* and those not containing *shares from other pages* were not significant ($t_{(1140)} = 1.06, p = ns$).

RH3.2 was not supported. The t-test showed that there is no significant difference between the mean *likes* ($t_{(1140)} = -0.33, p = ns$), *comments* ($t_{(1140)} = 0.60, p = ns$), or *shares* ($t_{(1140)} = 0.42, p = ns$) for posts *including links* to other web pages versus posts not including links.

RH4.1 was not supported. The statistical-analysis results, based on one-way ANOVA, do not show significant differences in the mean amounts of *likes* ($F_{6, 1135} = 0.457, p = ns$), *comments* ($F_{6, 1135} = 0.779, p = ns$), or *shares* ($F_{6, 1135} = 0.834, p = ns$) among the main-content categories based on the *day* of the week that they were posted.

ANOVA was used to test RH4.2. The results showed that there are significant differences in the mean number of *shares* of main category posts based on the *time* they were posted ($F_{5, 1136} = 2.572, p < 0.05$).⁵ Posts made between *10 p.m. and 2 a.m.* ($n = 67$) showed the highest mean number of *shares* with 106.87. The

statistical differences, using one-way ANOVA, in the mean amounts of *likes* ($F_{5, 1136} = 0.707, p = ns$) or *comments* ($F_{5, 1136} = 0.345, p = ns$) based on the time of posting were not significant.

RH5.1 was not supported. The differences, using the t-test, between the mean *likes* ($t_{(1140)} = 1.16, p = ns$), *comments* ($t_{(1140)} = 1.08, p = ns$), and *shares* ($t_{(1140)} = -1.03, p = ns$) among the main categories of content based on whether they *included videos* or did not were not significant.

A t-test was used to test RH5.2. The results showed a significant difference between the *likes* for posts *containing images* and the *likes* for posts not containing images ($t_{(1140)} = -4.09, p < 0.01$). The mean number of *likes* for posts containing images was 184.53 and 37.76 for posts not containing images. The descriptive statistics showed an average of 5.43 *comments* per post *containing an image* against 1.77 for those not having an image. These results showed significance ($t_{(1140)} = -4.16, p < 0.01$). The difference between the mean *shares* of posts *containing an image* and those not containing an image was not statistically significant ($t_{(1140)} = 0.78, p = ns$).

Table 1 provides a summary of significant results found in the study and discussed in this Results section. The table describes variable types and gives the number of likes, comments, and shares.

Discussion and Conclusions

Although people spend a lot of time on Facebook, it is a platform, more often than not, used by people to have quick, frequent entertainment experiences (Bonsen et al., 2015; Murphy, 2013). The descriptive statistics found in this study support this concept, show-

ing *likes* to be the most common type of Facebook engagement, followed by *shares*. The ease of simply *one-clicking* the *like* or *share* button is much easier than having to type a *comment* (De Vries et al., 2012; Swani et al., 2013). However, this study was not able to identify any statistically significant difference between the numbers of *shares* based on the content of posts.

The fire service is largely a local-government resource. Fire-department activities typically happen in or near the communities they serve. As such, firefighters are a part of that community, both while they are on-duty and off-duty. Their histories connect locally. Therefore, as the results of RH1 indicate, it is not surprising that *disclosure* content gets the most engagement. It is consistent with Mergel's (2013 and 2014) findings that increasing transparency is the most common tactic for a government agency's social-media use.

As discussed by Murphy (2013), Facebook is increasingly a "*communication channel*" (p. 175). Much like a traditional broadcasting network, attracting followers and getting them to interact requires interesting and entertaining content (Waters et al., 2011). These requirements are consistent with *involvement* posts being the next most-popular category as found in RH1. The goals of many posts described as *general engagement* or *virtual involvement* are to amuse followers and solicit online interaction. These goals are consistent with Mergel's (2013; 2014) findings of participation being another common government-agency social-media tactic.

This entertainment element makes the fact that *information* posts, largely consisting of safety *public service announcements*, were generally the least

Table 1. Summary of Significant Results

Variable	Likes	Comments	Shares
Main-Content Categories			
• Disclosure	252.67	6.70	-
• Information	21.84	0.69	-
• Involvement	99.13	5.21	-
Information Subcategories			
• General Information	31.37	-	-
• Public Service Announcements	19.89	-	-
• Situational Awareness	13.60	-	-
Includes Share from Other Page	33.94	0.81	-
No share from Other Page	153.56	4.80	-
Time of Post			
• 6 a.m. – 10 a.m.	-	-	13.86
• 10 a.m. – 2 p.m.	-	-	6.55
• 2 p.m. – 6 p.m.	-	-	11.35
• 6 p.m. – 10 p.m.	-	-	18.81
• 10 p.m. – 2 a.m.	-	-	106.87
• 2 a.m. – 6 a.m.	-	-	1.06
Includes Image	184.53	5.43	-
No Image	37.76	1.77	-

engaged type of content as found by RH1. If Facebook was like a television *channel*, as suggested by Murphy (2013), then *information* content would be the commercial breaks. Again, followers are looking to be entertained. These posts largely seek to educate. While obviously important, these types of posts are inconsistent with what people are generally looking for when going to Facebook on a day-to-day basis.

Facebook is also growing as a place for people to get local news (Gottfried & Shearer, 2016). The results of RH2.2 support this statement, showing a significant number of *likes* for posts containing *general information*. This information was about general items of interest going on in the community. Fire departments posting information, including photos and videos, serve as local news broadcast sources. As Bonson et al. (2015) noted, information about local issues resonated most with stakeholders. Lin et al. (2014) found that information from local news sources were relied on more for evacuation information than that from national media. The dissemination of this type of content, as noted by Bonson et al. (2015), helps agencies increase their social legitimacy.

Results of the study brought about a significant challenge for fire-service leaders. While the emergence of social media and the near universal usage of Facebook offer unprecedented opportunities to engage stakeholders, the type of content that is most popular with followers is not the type that traditional command and control systems are used to sharing. For example, Ramanadhan et al. (2013) confirmed that participatory approaches are uncommon among community-based organizations. This situation, as noted by Wallace (2006), contributes to a disconnect where the public does not know what their fire departments typically do, and fire departments do not know what their stakeholders want and expect. Also challenging, as found by RH2.2, is that posts containing *public-service announcements* and *situational-awareness* content are the least likely types to engage followers. As Lindell and Perry (2012) noted, unfortunately these posts contained the type of content that needed to be delivered and understood the most when trying to positively influence stakeholders' risk-management behaviors.

Posts *shared from* other Facebook pages or containing *links to* other web pages generally did not attract much engagement. This situation was consistent with the findings of Bonson et al. (2015). Schultz and Peltier (2013) noted the importance of organizations developing their own authentic online personalities. Followers may perceive posts involving this type of content as being boring or lazy. Also, because they are not original, these posts are also likely to have been seen elsewhere in followers' Facebook feeds, and thus they decrease the likelihood of interaction.

As discussed in RH4.2, posts made at different *times* did not show significance except for *shares*. The results indicated that Facebook users are more likely

to share fire-departments' posts in the *10 p.m. to 2 a.m.* periods than other times of day. Internal Facebook mechanisms often determine the time and day when followers see content. These mechanisms remain proprietary and appear to be tweaked often. Although some followers see content immediately after it is posted, others may not see it for several hours or even the following day.

The results of RH5.2 showed that posts containing images generally generated significantly more engagement than posts not having them. This result is consistent with the Bonson et al. (2015) findings showing that posts with pictures lead to the highest level of social-media engagement. These findings are also similar to the results of the Wu, Lindell, and Prater (2015) study that concluded that experiment participants preferred graphic information to text and numeric content during hurricane threats. These findings may have to do with the speed and simplicity of seeing a picture, as opposed to reading a text or watching a video. Pictures attract attention and can provide quick entertainment or informational value.

On the other hand, the results of RH5.1 showed that *video* did not have a significant impact on engagement. This result is also consistent with the Bonson et al. (2015) findings that text-only posts received more engagement than those with videos. People tend to rapidly scroll through their newsfeeds, and videos require users to stop and watch. This situation is likely to change, however, as Facebook continues to increase the use of auto-play for *videos*. At the time of this study, not all *videos* posted were auto-play; they required a user to stop and press *play*. As of early 2015 (Blattberg, 2015), this action is no longer the case.

This study had several limitations. First, it contained a relatively small sample size. Of the more than 27,000 fire departments in the US, only 50 were examined. Although these departments are scattered across the nation, different local stakeholders may have different needs. A small, volunteer fire department is able to communicate about a much more local area than a large-city fire department covering neighborhoods many miles (kilometers) apart. Also, only one month's worth of postings for each fire department is included in this study.

The ever-changing nature of Facebook also makes studying its usage very challenging. The internal rules and mechanisms of Facebook are largely secretive and often change with little notice. As Ellison and Hardey (2014) confirmed, Facebook's primary corporate interest is a commercial one and not a social or community one. Furthermore, although creating unprecedented opportunities to directly reach their stakeholders, the customizability of social-media content is leading to the minimization of people's exposure to new or counter-belief content (Dylko et al., 2017). This situation also increases the potential for audiences to be exposed to *fake news* or disinformation that is meant to be

misleading (Benkler, Faris, Roberts, & Zuckerman, 2017). This change is important and critical because these technologies have become mainstream forms of communication for nearly all population demographics that fire agencies serve (Van Dijck & Poel, 2013). It is critical that fire-service leaders know how to reach a multitude of audiences on a day-to-day basis.

The study is useful, however, to provide a basic understanding of how fire-service leaders are using Facebook and what posted content leads to the most engagement with followers. Facebook has essentially become a mainstream, broadcasting tool to promote engagement within the fire station and local community. For the first time, fire departments and other emergency-services organizations have direct access to and a significant amount of influence over what content is delivered to their stakeholders. Furthermore, based on the findings of this study, fire-service leaders can utilize this tool to find a better approach to communicate with stakeholders and promote leadership and management. It is likely that these findings can be applied to other social-media tools as well. Different social-media applications are likely to reach different audiences. It is essential for fire departments to understand these additional social-media tools and use them, along with other traditional outreach efforts, to engage the widest range of stakeholders. Risk prevention, mitigation, and preparedness are among the fire service's most important goals. Improved engagement with the public on a day-to-day basis can improve the success of these endeavors and lead to increased safety for both stakeholders and emergency responders alike.

Future recommended research would include increasing (1) the number of fire departments included for study, (2) the length of time that posts are analyzed (i.e., from a one-month time period to several months), and (3) the impact of Facebook posts on leadership and management of fire departments. Video is also likely to increase as an element of content. Different variables related to these videos could be studied. As discussed, various stakeholder demographics use different social-media applications. Additional research could be used to see how engagement can be maximized on platforms such as Twitter, Instagram, Snapchat, or whatever other future applications are introduced. Finally, the type, size, and region of fire departments might also have impacts on how the general public interacts with their local fire departments. The data used in the present study did not have enough statistical power to control for these other explanatory (independent) variables. In short, a larger sample size is needed to more fully understand the dynamics of variables independently impacting the use of social media on American fire departments.

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Endnotes

¹ Since the ANOVA results showed that the standard deviation (SD) of the *disclosure* category was much larger than others, a Levene's Test of Homogeneity was performed. The result was significant ($F_{2, 1139} = 22.28, p < 0.01$). This result indicated that the ANOVA assumption of equal variance was not met. In order to overcome this violation, the Welch and Brown-Forsyth test was used. The adjusted F-ratio indicated that the results were significant (Welch test: $F_{2, 449} = 15.49, p < 0.01$ and Brown-Forsyth test: $F_{2, 575} = 13.09, p < 0.01$). The same statistical testing process will be performed for the rest of the research questions (RQs) if the ANOVA results show much larger SDs in one group but not the other groups.

² Homogeneity Test: $F_{2, 1139} = 23.54, p < 0.01$; Welch test: $F_{2, 449} = 19.75, p < 0.01$; Brown-Forsyth test: $F_{2, 604} = 10.87, p < 0.01$.

³ Homogeneity Test: $F_{2, 403} = 7.31, p < 0.05$; Welch test: $F_{2, 209} = 4.05, p < 0.05$; Brown-Forsyth test: $F_{2, 180} = 3.83, p < 0.05$.

⁴ Homogeneity Test: $F_{2, 250} = 32.465, p < 0.05$; Welch test: $F_{2, 51} = 1.099, p = ns$; Brown-Forsyth test: $F_{2, 22} = 1.940, p = ns$.

⁵ Homogeneity Test: $F_{5, 1136} = 10.143, p < 0.01$; Welch test: $F_{5, 368} = 34.814, p < 0.01$.

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About the Authors

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The Academic Workshop features articles written by **master's and doctoral students** from domestic or international universities that highlight the use of a quantitative or qualitative methodology, a research design, and/or a conceptual framework applied to fire-service leadership and management issues and problems. With the continued growth of graduate programs in fire leadership and management, more and more students will write papers that can guide research focusing on fire and rescue services. In some cases, students may not have taken their projects to the field and gathered data or directly tested their research questions. Nevertheless, these papers represent solid research designs that can help other students conceptualize and formulate how to study fire-service leadership and management topics. In other cases, an article appearing in the *Academic Workshop* may have been taken from a much longer thesis or dissertation and thus represents a significantly truncated version of the original research. For those who have ever tried to *carve* an article-length version of a manuscript from a much longer thesis or dissertation, you know exactly how hard it is to complete this task.

Articles in the *Academic Workshop* are peer reviewed. As editor of the *IFSJLM*, I first screen an article for possible inclusion in this section of the *Journal*. Next, two peer reviewers analyze the article. If the reviewers and I agree that the article represents a solid learning tool, I invite the author to submit the manuscript to be published in the *IFSJLM*.

The following article was written by Randall W. Hanifen, a Shift Captain in the West Chester, Ohio (OH), Fire and Rescue Department and Associate Professor in the American Public University's Emergency and Disaster Management Program. The article is taken from his Ph.D. dissertation in Business Management with a specialization in Homeland Security. The version of his dissertation presented here is *significantly* modified from his original research in order to prepare an academic, journal-length article. Peer reviewers believed, and I agreed, that the article made excellent use of his qualitative data to develop *common themes* based on his interviews with fire-department and emergency-management agency (EMA) leaders. Findings of the research hold promise to enhance collaboration among fire-department and EMA personnel in disaster management.

Dr. Randall W. Hanifen, West Chester Fire-Rescue, Ohio/American Public University System

Enhancing Collaboration between Fire Departments and Emergency-Management Agencies (EMAs) in Disaster Management: Incident Command System (ICS) Versus Collaboration Theory

Abstract

Based on interview data collected from 17 fire department and emergency-management agency (EMA) executives found in four Urban Area Security Initiative (UASI) Regions in the State of Ohio (OH), the purpose of this study is to examine the following two research questions: (1) what are the advantages and disadvantages associated with the command and control/ Incident Command System (ICS) and the collaboration model to enhance teamwork among fire departments and local EMAs in disaster management and (2) what knowledge, skills, and traits do fire department and EMA personnel need to enhance collaboration when responding to disasters? Based on analyses of the interview data and the present ICS and collaboration literatures, ten common themes emerged from the study. However, analysis of ICS teaching manuals reveals that the common themes most needed to enhance collaboration between fire departments and EMAs in disaster management are not emphasized in the manuals. Two recommendations are offered to ameliorate this situation: (1) updating/revising of current ICS curricula to include a much greater focus on two-way communication within existing communication and leadership sections of ICS manuals and (2) creating a stand-alone course on collaboration theory as an addition to current ICS training materials.

Keywords: *fire departments, emergency management agencies (EMAs), command and control/Incident Command System (ICS), collaboration theory, collaboration in responding to disasters*

Introduction

Collaboration is essential to the future success of homeland security (Bowman and Parsons, 2013; Schafer, Carrol, Haynes & Abrams, 2008), and prior

research related to planning and delivering homeland security and emergency-management services indicates the need for collaboration among first

responders (Hanfling, 2013; Janssen, Lee, Bharosa, & Creswell, 2010). Homeland-security operations coalesce through numerous governmental and nongovernmental agencies collaborating to prevent, respond to, and recover from natural and human-made disasters such as terrorist and technological events (Abbasi & Kapucu, 2012; Kiltz & Ramsey, 2012; Yeager, 2009). Urban and metropolitan emergency-management agencies (EMAs) found that collaborating with multiple emergency-service organizations is a necessity and that sharing goals at the governance level is essential for interorganizational relationships (Kapucu, 2012; Okada, Tao, Yoshio, Peijun, & Hirokazu, 2011).

Despite the current literature specifying the use of collaboration theories and practices, Ash and Smallman (2010) and Sylves (2008) note fundamental differences between fire-department management practices and management practices utilized in emergency-management organizations. The significant difference in the management style within fire departments to manage incidents, as opposed to EMAs, involves the reliance on a command-and-control philosophy (Anderson, Compton, & Mason, 2004; Decker, 2011; Nja & Rake, 2008). Fire departments employ the Incident Command System (ICS), which focuses on unity of command and lines of authority more than collaboration with other agencies (Baker, F., 2008; Baker, F. J., 2009; Powell, Wright, Newland, Creed, & Logan, 2008; Scopetta, 2008). Recent events, such as the Atlanta snow storm, Gulf oil spill, Japan tsunami, and portions of the response to Hurricane Sandy (Charens, 2013; Cook & Willoughby, 2014; Tabuchi, 2011), demonstrate strained response capabilities due to the lack of collaboration between fire departments and EMAs.

The events of September 11, 2001, proved that large-scale disasters must involve collaboration among multiple agencies (Hanfling, 2013; Janssen et al., 2010) and particularly between fire departments and local EMAs. At the local level, fire departments serve as primary responding agencies for incidents involving disaster, fire, and emergency-medical response (Becker, Dark, Mason & Goodwin, 2012; Pryor, 2009). Federal mandates, such as Homeland Security Presidential Directive 5, Management of Domestic Incidents, require the use of the National Incident Management System (NIMS), which includes the ICS ("Homeland Security," 2003).

Prior to September 11, 2001, fire department command-and-control practices occurred in resemblance to military command-and-control principles (Arbuthnot, 2008), focusing on an authoritarian model rather than on collaboration theory (Rake & Nja, 2009). The Urban Area Security Initiative (UASI) grant program exists as a part of the federal government's Department of Homeland Security (DHS) and is designed to increase regional preparedness for metropolitan areas. The UASI grant program uses regions around metropolitan

areas to accomplish the preparedness efforts. Within Ohio (OH), the Metropolitan areas are Cincinnati, Dayton, Columbus, Cleveland/Akron, and Toledo.

The purpose of this qualitative, embedded multiple-case study is to examine the following two research questions: (1) what are the advantages and disadvantages associated with the command and control/ICS and the collaboration model to enhance teamwork among fire departments and local EMAs in disaster management and (2) what knowledge, skills, and traits do fire department and EMA personnel need to enhance collaboration when responding to disasters? The current literature posits a *disconnect* between ICS and collaboration theories (Darabi & Clark, 2012; Sommers & Svara, 2009). ICS focuses on autocratic, one-way communication rather than the two-way communication espoused by collaboration theory for emergency management (Darabi & Clark, 2012; Sommers & Svara, 2009).

Based on interview data collected from 17 fire-department and EMA executives in four of the five UASI Regions in OH, the study identified knowledge, skills, and traits that fire-department and EMA personnel need to enhance collaboration when responding to disasters. The identification of these needed common themes related to collaboration among fire departments and EMAs while operating at disasters will allow for the update/revision of current homeland-security, emergency-management, and fire-administration theories, as well as incident-management curricula.

Literature Review

Literature supporting the research question of the appropriateness of command and control theory as opposed to collaboration theories for fire-department personnel when interacting with EMAs includes six topics: (1) history of the interdependency of agencies, (2) local emergency management and homeland security issues, (3) the need for local homeland security, (4) areas of responsibility for fire departments; (5) fire-department command and control principles, and (6) collaboration theory (see, for example, Chenoweth & Clarke, 2010; Yeager, 2009; Bennett, 2011; Moynihan, 2008; Carter, H. R. & Fleming, 2009).

History of Interdependency

Fire departments and local homeland security and/or EMAs have worked together in varying capacities in many communities, including cities in the UASI metropolitan areas within OH, for many years. The terrorist attacks of September 11, 2001, substantiated that fire-department personnel respond to disasters of all types (Pryor, 2009) and that the interdependency and frequency of collaboration on planning and response projects increased in number and scope after the events of September 11, 2001 (Goffman, 2011; Tollefson, 2010). The planning and response projects concentrated

on topics ranging from nuclear detonation to natural disasters caused by climate change (Goffman, 2011; Tollefson, 2010). This interdependency occurs because of the immense amount of issues and responsibilities related to homeland security and emergency management for which the local fire department provides an integral role.

Local Emergency-Management and Homeland-Security Issues

Homeland-security and emergency-management activities concern numerous issues in the four disaster phases of (1) preparedness, (2) response, (3) recovery, and (4) mitigation. Efficient response requires detailed and advanced planning, which must consider a broad spectrum of potential disasters through all phases of emergency management (Murrain-Hill et al., 2011).

In addition to the four phases of emergency management, EMAs must provide a level of expertise related to potential hazards and disasters. This expertise becomes imperative because of the focused attention that the community will place on the local EMA during a large-scale disaster event (Hosseini & IZADKHAH, 2010). Planning for human-made disasters, such as chemical spills and terrorist attacks, involves activities beyond training and includes research and development, regulation compliance, and security enhancements (Ha, 2013; Plodinec & Smith, 2014; Wang & Bier, 2011). DHS suggests that local EMAs, as well as state and federal agencies, apply the National Planning Scenarios for planning purposes (Tyszkiewicz, McCleskey, & Miller, 2012).

The Need for Local Homeland Security

Local governments play an important role in all phases of a disaster because of familiarity with their communities. Nevertheless, little prior research and validation of practices related to the local response to disasters is available (Kusumasari, Alam, & Siddiqui, 2010). Due to the lack of actual disasters in most localities, a true measurement of effectiveness rarely occurs (Henstra, 2010; Thomas, 2012). Nirupama and Etkin (2012) established through interviews with 43 emergency managers in Ontario, Canada, that emergency managers understand their policy needs, but political nuances and a lack of understanding by government leaders hindered the adoption of needed policies and procedures.

Local emergency-management organizations are often required to bring the collective knowledge and actions of multiple governmental and nongovernmental organizations as well as the public together to produce the needed resources and support required at a large-scale disaster (Tano & Paki, 2011). Collaboration among the many medical resources within a community will enhance emergency response, public-health issues, and medical logistical needs (Gamboa-Maldonado, Marshak, Sinclair, Montgomery, & Dyjack, 2012; Quinlisk et al., 2011; VanVactor, 2012).

Local governments provide all of the nation's first responders, thus the local government's role in homeland security remains crucial because of the time-sensitive nature of many homeland security-related events (Becker et al., 2012). Management of the initial response to a disaster is crucial for a smooth transition to state- and federal-level agencies' interventions (Renaud, 2012).

Areas of Responsibility for Fire Departments

A modern fire department has expectations from the public to provide risk reduction, fire and disaster prevention, emergency medical services (EMS), and general emergency-response capabilities (Carter, H. R., & Fleming, 2009). Many of the disasters worldwide involve structural collapses, fires, and explosions, which demand the services of both the local fire department and EMS (Aini & Fakhru'l-Razi, 2013). Declining fire frequency and demographic shifts in communities have forced many fire-service organizations to shift paradigms to include community risk-reduction activities that meet the demands of aging baby boomers (Fleming & Zhu, 2013).

Fire departments deliver responses to hazardous materials at facilities and transportation routes, but in the post-9/11 environment, hazardous-materials responses also include weapons of mass destruction (WMD) and the casualty management that would accompany this type of catastrophic event (Dare, Oke, & Olanrewaju, 2009; Dowe, 2011). WMD incidents provide a new type of hazardous-materials incident that focuses on utilization of chemical and explosive events to inflict harm to people (Carter, H., Drury, Rubin, Williams, and Amlot, 2013; Dowe, 2011; Okumura, Seto, & Fuse, 2013).

Firefighters also perform the search-and-rescue operations at most disasters, including structural-collapse rescue, often providing the workforce for independent urban search and rescue teams (King, 2014). Firefighters also deal with small-scale, violent-scene issues through activist groups at various functions and events (Fernandez & Olson, 2011).

Fire Department Command and Control

Fire department command-and-control practices follow military command-and-control principles (Arbuthnot, 2008), focusing on an authoritarian model rather than on collaboration theory (Rake & Nja, 2009). Although fire departments adopted the NIMS, incident commanders continued to focus primarily on the command and control philosophies of ICS (Decker, 2011). Large-scale disaster inefficiencies and problems often relate to a lack of an effective ICS (Kirsch, Sauer & Sapir, 2012; Knox, 2013; Thompson, K. S., 2013). Knox (2013) reviewed after-action reports, congressional hearings, and Governors' review-panel findings for Hurricanes Andrew and Katrina and

found that a lack of an effective command structure contributed to inefficiencies in response-and-recovery activities. Failure to apply the ICS system properly can also lead to injuries and deaths of responders during incidents (Baker, F. J., 2009; Dooley, 2012).

ICS is rooted in military operations and focuses on accountability and communication (Bingham, 2014; Roberts, 2011). ICS allows common organizational structures, which increase efficiency and familiarity to incidents that are quick-paced and complex (Gasaway, 2014; Kastros, 2012; McLain, 2012). ICS adoption and education external to the fire service (Baker, F., 2008; Lam, Lin, Tsai, & Chiu, 2010) showed that personnel found the ICS system very functional.

Lutz and Lindell (2008) described the use of the ICS system in the Emergency Operations Centers (EOCs) functioning at Hurricane Rita, noting that fire and police personnel found the system familiar and useful; however, nonemergency response agencies, such as public works and social services, were uncomfortable in its use. Use of a collaborative model and relying on basic management principles while utilizing the ICS proved useful in past all-hazards incident-management team deployments (Miller, 1999; Whitney, 2013). Incident command provides direction and organization to incidents of various size and complexity (Bigley & Roberts, 2001; Williams, 2010). However, differences occurred in the level of authoritarian centric bases of the ICS system, with Bigley and Roberts (2001) finding a heavily authoritarian model and Williams (2010) finding a nonauthoritarian model.

Collaboration Theory

The increasing scope and severity of issues surrounding homeland security and emergency management mandate the use of collaborative strategies to understand and solve social, political, and economic concerns associated with disasters (Abbasi & Kapucu, 2012; Kiltz & Ramsay, 2012; McGuire & Silvia, 2010). Shared purpose, ownership, and relationships among agencies drive the development and sustainment of collaboration (Nayer, 2014; Stone, 2012; Zikmanis, 2012).

Managing collaboration requires skills and knowledge beyond the traditional autocratic leadership style possessed by many leaders in fire departments. One of the skills that Jordan (2010) found in his study of collaboration enhancement based on UASIs involved the balance of power within the collaborative groups. One of the largest issues to overcome when collaborating outside of an organization, such as the collaboration needed to plan and manage large-scale disasters, involves politics and uncertainty (Perz et al., 2010).

Disaster management and response often focus on a command-and-control style of management, which emphasizes gaining information and providing direction based on the information obtained (Bharosa, Lee, & Janssen, 2010; Chen, Pena-Mora, Plans,

Mehta, & Aziz, 2012). Natural and human-made disaster responses require an immense amount of information and knowledge transfer among numerous individuals, including the public (Bull, 2013; Egnoto, Svetieva, Vishwanath, & Ortega, 2013; Heil, Petzold, Romang & Hess, 2014; Su, 2011). The public expects quick and decisive actions from firefighters (Basinska & Wiciak, 2012; Subramaniam, Hassan, & Faridahwati, 2012), which forces their focus to command and control, not information sharing and collaboration. Utilization of integrated- and unified-command structures during planning and preparation efforts help ensure the use of unified command as defined in NIMS during the response and recovery phases (Banuls, Turoff & Hiltz, 2013; Thompson, D. L., 2011).

Research Methods

As noted previously, this research study employs the use of a qualitative, embedded multiple-case study methodology to determine the knowledge, skills, and traits that fire-department and EMA personnel need to enhance collaboration when responding to disasters. In order to determine these skills, traits, and abilities, the research protocol required the completion of a survey and the use of 17 face-to-face interviews.

The 17 interviewees were personnel who performed command functions for local EMAs and fire departments. This person was the chief executive officer of the organization in the majority of the interviews. The researcher asked the same questions to both fire and EMA executives. In order to maintain the confidentiality of the interviewee's identity, codes were used to identify each participant (for example, Interviewee 1-17).

The focus of the study is limited to four of the five UASI regions within OH to help minimize potential confounding impacts resulting from different state-level requirements related to fire departments and EMAs. Utilization of only one state's UASI metro areas limits the scope of the study and generalizability of the findings. Other researchers may find differences in themes generated due to statute and standard operating procedures (SOPs) across the 50 states. Nevertheless, this exploratory study offers a template that can be used in future research to explore for similarities and differences in findings among the states.

The interview protocol consisted of an interview survey and an interview questionnaire. The questionnaire allowed for face-to-face interviews. The design of the interview protocol followed the process argued for by Kvale and Brinkmann (2009), which covered the designing, piloting, validating, conducting, and reporting of the findings. Face-to-face interviews were transcribed, and the data were entered into a qualitative research software program to derive *common themes*. The common themes emerging from this analysis were similar to themes found in peer-reviewed studies outlined in the Literature Review section of this article. Additionally, the themes found in the study were

consistent with current NIMS-compliant ICS training programs offered in OH.

Findings

Research findings are organized into two parts. First, survey data from the 17 interviewees are examined. Second, interview data are analyzed.

Survey Findings

The survey provided to the interviewees prior to commencement of the interview phase of the research solicited demographic information, educational attainment, and work-related experience. The surveys did not contain any uniquely identifiable information. All 17 interviewees submitted their surveys. **Table 1** contains the results of the surveys.

Table 1: Survey Characteristics of the 17 Study Interviewees

Characteristics	n	%
Gender		
Male	16	94
Female	1	6
Total	17	100
Education		
High School	1	6
Some College	1	6
Associate's Degree	1	6
Bachelor's Degree	8	47
Master's Degree	5	29
Doctoral Degree	1	6
Total	17	100
Ethnicity		
African American	0	0
Asian	0	0
Caucasian	17	100
Hispanic	0	0
Other	0	0
Total	17	100
Results	Mean	Standard Deviation (SD)
Age	51.9	7.8
Years in Profession	27.9	9.8
Years in Current Position	6.3	4.2

Survey characteristics indicated that 94% of the interviewees were male. The median age of the applicants was 52 (SD = 7.8). Nearly a majority of the respondents held a bachelor's degree (47%) with 29% of the interviewees possessing a master's degree. The remaining interviewees possessed a high-school diploma, some college, an associate's degree, or a doctoral degree, all equivocally representing 6% of the interviewees. The interviewees had a mean of 27.9 years in the profession (SD = 9.8) and a mean of 6.3 years in their current positions (SD = 4.2).

Interview Findings

The interview questionnaire contained baseline questions, such as establishing the use of the NIMS ICS system by fire departments and EMAs and collaboration among fire departments and EMAs. The responses to these baseline questions are presented in **Table 2**.

All of the fire department and EMA respondents (n = 17) replied *yes* to the question that they interacted with each other. Affirmative answers ranged from statements such as *minimally* to *on a very regular basis*. All of the respondents (n = 17) answered *yes* when they were asked if they adopted and utilized NIMS ICS on a daily basis. Some respondents did note, however, that their incident volume did not allow the use of NIMS ICS on a daily basis but would use NIMS ICS when the incidents they responded to allowed them to do so.

All 17 respondents acknowledged the utilization of or at least the capability to use an EOC. Respondent's responses ranged from knowing an EOC existed at the county level to staffing and operating within the EOC on a regular basis. The formatting of the EOC found a wide range of responses, with *Hybrid* [the simultaneous use of emergency support functions (ESFs) and ICS sections (Planning, Operations, Logistics, or Finance)] as the most common format at 29%, followed by ICS and ESF, both at 24%. Lastly, *other* and *not sure* responses provided the least-common response at 24%.

The next phase of the analysis required *triangulation analysis*. Yin (2009) describes triangulation analysis as one of the advantages of the case-study methodology. The *themes* found in the *cases* were compared to *common themes* found in the peer-reviewed literature. The triangulation findings are presented in **Table 3**, which depicts the themes by region and the themes present in the peer-reviewed ICS and collaboration literature.

Table 3 shows the ten specific interview questions analyzed in the study (numbered at the top of the table), the four OH regions and the peer-reviewed ICS or collaboration literature (left-hand column), themes emerging from the 17 interviews in the four regions and previous literature (column and row information in the body of the table), and the ten common themes (one for each specific interview question shown and numbered at the bottom of the table).

Table 2: Baseline Interview Question Responses of the 17 Interviewees

Question	Response	n	%
Interaction with EMA/FD	Yes	17	100
	No	0	0
	Other	0	0
	Total	17	100
Adopted NIMS ICS	Yes	17	100
	No	0	0
	Other	0	0
	Total	17	100
Utilization of NIMS ICS on Daily Basis	Yes	17	100
	No	0	0
	Other	0	0
	Total	17	100
Utilization of an EOC	Yes	17	100
	No	0	0
	Other	0	0
	Total	17	100
Format of EOC	ESF	4	24
	ICS	4	24
	Hybrid	5	29
	Other/Not Sure	4	24
	Total	17	100

Notes: EMA: Emergency Management Agency, FD: Fire Department, NIMS: National Incident Management System, ICS: Incident Command System EOC: Emergency Operations Center, ESF: Emergency Support Functions

The ten interview questions included for analysis were as follows: (1) *Command and Control (ICS) Use Advantages*; (2) *Command and Control (ICS) Use Disadvantages*; (3) *Collaboration Advantages*; (4) *Collaboration Disadvantages*; (5) *Technical Knowledge to Increase Collaboration*; (6) *Technical Knowledge Deficiencies*; (7) *Leadership Traits to Enhance Collaboration*; (8) *Managerial Skills to*

Enhance Collaboration; (9) *Personal Traits to Enhance Collaboration*; and (10) *Knowledge, Skills, or Traits* that lend most to the collaboration. Based on data collected from the 17 interviews across the four OH regions and the peer-reviewed literature, 10 *Common Themes* emerged. (See bottom row of Table 3.)

For Question 1 related to the advantages of utilizing ICS, the common themes were *defining roles and responsibilities* and *ensuring a span of control*. The common themes related to Question 2, command and control use disadvantages, were *determining who is in charge* and *understanding the ICS system or terminology*.

The most common theme related to the *advantage of collaboration*, Question 3, was the *attainment of resources*. Respondents recognized these resources as beyond those typically available in their organizations or through traditional mutual aid. The common *disadvantage related to collaboration*, Question 4, was *power and coordination* of the process. Respondents noted that collaboration did not have the traditional hierarchy present within their own organizations.

The common themes associated with Question 5 (*technical knowledge needed to increase collaboration*) and Question 6 (*technical knowledge deficiencies*), were very similar. For Question 5, the common theme was *understanding responsibilities* and for Question 6, the common theme was *understanding responsibilities and needs of other entities*. Interviewees indicated collaboration would increase if they more completely understood the fire department's and EMA's responsibilities. The EMA directors who were interviewed appeared to hold an advantage in this area because some of the interviewees either served as a volunteer or a career firefighter at some point in their careers. Fire executives provided answers that demonstrated a lack of true understanding of the functions and responsibilities of their EMA counterparts.

With respect to Question 7, *leadership traits to enhance collaboration*, the common theme emerging from the analysis was *communications to include both one-way and two-way communication*. In fact, findings indicated that the *form of communication* is paramount. Often the problem is that the current use of the ICS in fire departments does not align with current collaboration theories (Somers & Svara, 2009; West-erlund & Rajala, 2010). While ICS often focuses on one-way communication, collaboration theory places a high emphasis on two-way communication. While not always the case, this communication disconnect can prevent needed collaboration between fire departments and EMAs.

Questions 8 through 10 asked interviewees to identify *managerial skills* (Question 8), *personal traits* (Question 9), and *knowledge, skills, or traits* (Question 10) needed to enhance collaboration between local fire departments and EMAs. Common themes for Questions 8 through 10 emerging from the analysis were *organizing and managing processes and personnel*

Table 3: Common Themes Emerging from the Analysis of Interviewees and Peer-Reviewed Literature for 10 Interview Questions

OH Region/ Literature	10 Interview Questions									
	(1) Command-and-Control (ICS) Use Advantages	(2) Command-and- Control (ICS) Use Disadvantages	(3) Collaboration Advantages	(4) Collaboration Disadvantages	(5) Technical Knowledge to Increase Collaboration	(6) Technical Knowledge Deficiencies	(7) Leadership Traits to Enhance Collaboration	(8) Managerial Skills to Enhance Collaboration	(9) Personal Traits to Enhance Collaboration	(10) K, S, or T that Lend most to Collaboration
Region 1	Gain Control; Designation of positions	Transitioning to full command; Little use of training to fully build out NIMS	Knowing each other; Additional resources; Local control	Control/ collaboration questions; Not all agencies are familiar or able to collaborate	Knowledge of resources and capabilities of the EMA; Knowledge of EOC operations and the relationship of EMA to operations	Understanding how planning and operations work together; Lack of prior relationships	Listening; knowledge of your expertise, methodical decision-making based on inputs received	Organization; ability to receive input; knowledge of the existing plans and ICS principles	Ability to talk to others; care and compassion; good listener; willingness to collaborate	Education; Knowledge of your discipline (SME)
Region 2	Span of control, common operating picture; Accountability	Terminology	Uncommon resource attainment	Coordination/ communication disconnect	EMA resources beyond traditional response	Understanding each other's job function	Cooperation and coordination	Coordination between entities	inclusiveness; Calmness	Engagement; Networking and relationships; Knowledge
Region 3	Understanding ICS/EOC; Working together	Communication; Ego and who is in charge	Coordination; Job function (Fire-Response and EMA-Support)	Time involved	Understanding responsibilities	Understanding the other discipline's job responsibilities	Inclusion of the right people and ideas; Communication	Utilization of Subject matter experts (SMEs); Treating everyone as equal	Outgoing; Good communication	Knowledge; Understanding limitations of knowledge
Region 4	Roles and responsibilities; Safety	Terminology; Who is in Charge	Regionalization; Resource Attainment	Inability to work with others	Practical knowledge of needs	What the EMA does and is responsible for	No ego and humble; Interpersonal Skills	Delegation; Good Listener; Able to fully utilize technology	Listening and communicating; Empathy; Integrity	Job Knowledge; Communication; Networking
Peer-Reviewed Literature	Unified Command	Who is in charge	Solving larger issues; Increased regionalization; Ability for multiple agencies to work in coordination	Power and control imbalances/ issues; Resource rich entities do not have interest/ need to collaborate	Understanding the roles/ responsibilities of the collaborating organizations; Understanding the information needed by other agencies within the collaborative network	Lack of knowledge of the needs of other collaborating organizations; Time needed to collaborate	Ability to gain and incorporate other's input; Good networker/ communicator; Goal setter/ inspirer	Managing the Group Process; Relationship builder; Coordinator; Decision-maker; Goal setting	Trust; Sociable; Relationship builder; Interpersonal skills	Knowledge; Knowledge sharing; Networking; Creating a climate of trust
Common Themes										
	(1) Roles and Responsibilities; Span of control	(2) Who is in charge; Terminology/ Understanding System	(3) Resource Attainment	(4) Power and Coordination	(5) Understanding Responsibilities	(6) Understanding Responsibilities and Needs of Other Entities	(7) Communication to include both One-way and Two-way Communication	(8) Organizing and Managing Processes and Personnel	(9) Trust and Communication	(10) Job Knowledge and Education

Notes: ICS: Incident Command System, EOC: Emergency Operations Center, NIMS: National Incident Management System, EMA: Emergency Management Agency, K, S, or T: Knowledge, Skills, or Traits, SME: Subject-Matter Expert

(Common Theme 8), *trust and communication* (Common Theme 9), and *job knowledge and education* (Common Theme 10).

With respect to managerial skills needed to enhance collaboration (Question 8), interviewees discussed the importance of coordination of activities across agencies and effective organizational use of personnel and groups. With respect to personal traits that enhance collaboration (Question 9), trust in the collaboration process and especially the listening portion of the communication process were mentioned as vital to

successful collaboration among fire departments and EMAs. Finally, when interviewees responded to the question of what knowledge, skills, or traits contributed most to collaboration between fire departments and EMAs (Question 10), the overwhelming responses focused on the attainment and possession of job knowledge and education. Respondents referred to job knowledge as training courses and education, with an emphasis on higher education.

Finally, a comparative analysis was conducted between the *common themes* shown at the bottom of

Table 3 and the current ICS curriculum that personnel in fire departments and EMAs must complete to comply with NIMS. The ICS 100, 200, 300, and 400 Instructor Guides provided the basis for the comparison. Analysis required the recording of the number of “segments” or parts in the manuals that matched each common theme.¹ **Table 4** depicts the number of times a common theme appeared in the given ICS course.

The common themes (1) *roles and responsibilities and span of control* and (2) *who is in charge and terminology/understanding system*, common themes for the advantages and disadvantages of the utilization of ICS (see Tables 3 and 4, respectively), found high amounts of segments in the ICS manuals at 53 and 30, respectively. Both of these scores are higher than the mean for the 10 common-theme categories combined, which is 23 (with a standard deviation of 18; data not shown in the table).²

The common themes (3) *resource attainment* and (4) *power and coordination*, which corresponded to collaboration advantages and disadvantages in Table 3, showed 26 segments for resource attainment and 46 segments for power and coordination (See Table 4). These findings suggest that despite being a disadvantage of collaboration efforts between fire departments and EMAs, ICS courses address the topics of power and coordination numerous times throughout the executive-level course requirements. In fact, the common theme (4) *power and coordination* is found in the ICS manuals twice as often as the mean for all 10 common themes combined, which as noted previously is 23.

The common theme *communication—all (7a)* finds a high number of segment occurrences in the ICS manuals (n = 40; see Table 4). However, when communication segments are examined more closely to include the subset of *two-way communication* (Theme 7b) that includes listening, the segments reduce to nearly 28% of the total communication segments (n = 11): A drop of almost 72 percent in the number of segments (11/40). This finding primarily occurs because an ICS organization usually contains a communication process that centers on the technology aspect of communication (one-way communication) rather than the human interaction of communicating (two-way communication).

The common themes (8) *organizing and managing processes and personnel*, (9) *trust and communication*, and (10) *job knowledge and education*, were among the lowest segment counts in the ICS manuals at 10, 1, and 9, respectively. Collectively, these three common themes totaled a paltry 20 segments of the total 233 segments found for all 10 common themes in the study. Unfortunately, those common themes that are largely absent and/or under emphasized in the ICS manuals are the very themes identified by interviewees that emphasize the knowledge, skills, and traits

Table 4: Common Theme Segments Found in Incident Command System (ICS) Manuals

Common Themes	ICS Course	n	%
(1) Roles and Responsibilities; Span of Control			
	ICS 100	6	11
	ICS 200	19	35
	ICS 300	14	27
	ICS 400	14	27
	Total	53	100
(2) Who is in charge; Terminology/ Understanding System			
	ICS 100	10	33
	ICS 200	8	27
	ICS 300	5	17
	ICS 400	7	23
	Total	30	100
(3) Resource Attainment			
	ICS 100	2	8
	ICS 200	6	23
	ICS 300	15	58
	ICS 400	3	11
	Total	26	100
(4) Power and Coordination			
	ICS 100	9	20
	ICS 200	6	13
	ICS 300	6	13
	ICS 400	25	54
	Total	46	100
(5) Understanding Responsibilities Within Organization			
	ICS 100	1	17
	ICS 200	1	17
	ICS 300	3	50
	ICS 400	1	16
	Total	6	100
(6) Understanding Responsibilities and Needs of Other Entities			
	ICS 100	1	8
	ICS 200	3	25
	ICS 300	5	42
	ICS 400	3	25
	Total	12	100

(Continued)

Table 4: (Concluded)

Common Themes	ICS Course	n	%
(7a) Communication—All			
	ICS 100	4	10
	ICS 200	9	23
	ICS 300	19	47
	ICS 400	8	20
	Total	40	100
(7b) Communication—Two Way (which is a subset of Common Theme 7a – Communication—All)			
	ICS 100	2	18
	ICS 200	4	36
	ICS 300	5	46
	ICS 400	0	0
	Total	11	100
(8) Organizing and Managing Processes and Personnel			
	ICS 100	0	0
	ICS 200	4	40
	ICS 300	3	30
	ICS 400	3	30
	Total	10	100
(9) Trust and Communication			
	ICS 100	0	0
	ICS 200	1	100
	ICS 300	0	0
	ICS 400	0	0
	Total	1	100
(10) Job Knowledge and Education			
	ICS 100	0	0
	ICS 200	3	33
	ICS 300	4	45
	ICS 400	2	22
	Total	9	100

needed most to enhance collaboration between fire departments and EMAs when responding to disasters.

Conclusion and Recommendations

This study provided evidence that the current ICS curriculum used to train fire-department and EMA personnel does not contain the information most needed to enhance collaboration during the response phase of a disaster. Recommendations for the practical applica-

tion of findings emerging from this research include the following:

1. Updating/revising all extant ICS curricula to include a much greater focus on *two-way communication* within existing communication and leadership sections of ICS manuals, and
2. Creating a *stand-alone course on collaboration*, which is theoretically grounded in the literature reviewed in this study, as an addition to current ICS training and educational material.

Since *all* fire-department and emergency-management leaders *must* receive training and education on NIMS ICS, ample opportunity exists for the development of a stand-alone course on collaboration that is theoretically specified. Collaboration among first-responder command executives is essential to the success of homeland security and disaster management (Donahue, Robbins, & Simonsen, 2010; Sommers & Svava, 2009; Bowman & Parsons, 2013; and Schafer et al., 2008).

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Endnotes

¹ Space does not allow for a detailed explanation of the coding process. The author will be happy to provide this information upon request. Please send your request to Randall@hanifen.org

² The mean for the 10 common themes as they appeared in ICS manuals was calculated by adding the total ICS manual segments for each common theme shown in Table 4 and then dividing by ten (the number of common themes). The numbers added were as follows: 53 (Common Theme 1) + 30 (Common Theme 2) + 26 (Common Theme 3) + 46 (Common Theme 4) + 6 (Common Theme 5) + 12 (Common Theme 6) + 40 (Common Theme 7a) + 10 (Common Theme 8) + 1 (Common Theme 9) + 9 (Common Theme 10). The sum of the 10 numbers was 233. The number 233 was then divided by the number of themes (10) producing a mean of 23 (rounded to the closest whole number). The total number of ICS manual segments associated with Common Theme 7b (Communication—Two Way), which was 11, was *not* included in determining the mean since this common theme is a subset taken from the larger Common Theme 7a (Communication—All).

About the Author (L1)

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