Perspectives

Delivering public services safely

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Technological Advancements in the Fire Service Industry & Assimilating Fire Personnel to Improvements

By Stephen J. Spradlin

For Americans, technology is part of everyday life, from cell phones to microwave ovens, technology has made day-to-day tasks less complex and more efficient. In the fire service industry, technological advancements in PPE have made firefighters safer on the fire grounds. The introduction of drone technology has made fire planning and other fire operations more effective. Technology-based improvements to fire service equipment and operations is an integral part of improving the overall safety for fire service personnel. But with an aging fire service community, how difficult will it be to integrate technology-based improvements into the industry?

According to National Fire Protection Association (NFPA), in 2015 there were approximately 1,160,450 firefighters in the U.S. (Haynes & Jones, 2017, p. iv). More than half of firefighters are age 40 or older (Chart 1) and the age of volunteer firefighters has been increasing since 1987 (Charts 2 and 3).

Unfortunately, with an aging fire service industry,

CHART 1

Half the fire service is 40 or more years old.

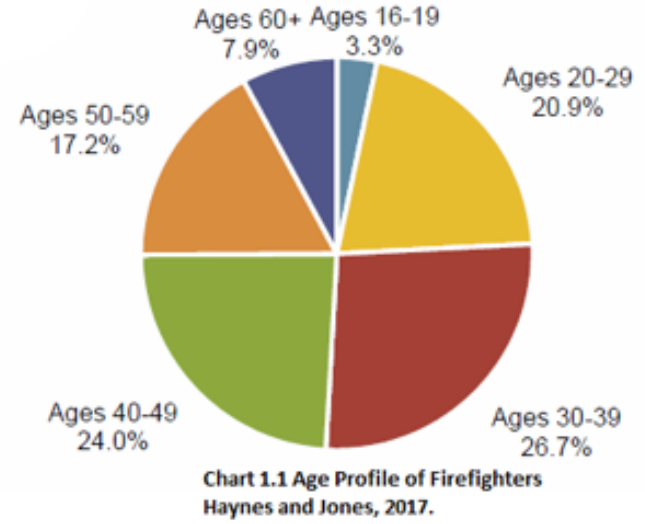


Chart 1.1 Age Profile of Firefighters
Haynes and Jones, 2017.

CHART 2

Age Profile of Firefighters by Community Size, 1987*
NFPA, 1987 **Mostly volunteer firefighters*

Size of Community	% Under Age 30	% Age 30-39	% Age 40-49	% Age 50 & Up
10,000-24,999	33.0%	33.8%	20.6%	12.6%
5,000-9,999	35.8%	32.4%	19.1%	12.7%
2,500-4,999	34.6%	32.5%	19.3%	13.6%
Under 2,500	29.7%	33.5%	20.9%	15.9%

CHART 3

Age Profile of Firefighters by Community Size, 2014*
NFPA, 2014 **Mostly volunteer firefighters*

Size of Community	% Under Age 30	% Age 30-39	% Age 40-49	% Age 50 & Up
10,000-24,999	28.4%	28.2%	24.4%	19.0%
5,000-9,999	29.9%	26.2%	21.5%	22.5%
2,500-4,999	29.1%	25.5%	22.1%	23.3%
Under 2,500	22.9%	25.1%	21.0%	31.0%

accepting the use of new techniques can be a difficult adjustment. Having success with their original training, veteran firefighters often are reluctant to change or adapt to new innovative methods. By educating firefighters on the benefits provided by new technologically advanced means and methods, fire service professionals can perform their duties more safely and efficiently.

Self-Contained Breathing Apparatus

Self-contained breathing apparatus (SCBA) were introduced in the fire service industry in 1945. SCBAs provide a firefighter with breathable air during various firefighting operations. Air is provided through a face piece, which is connected to a pressure regulator, and supplied by a high-pressure tank. Early SCBA packs were based on units developed for World War II pilots and consisted of heavy steel tanks that were cumbersome to wear. Currently, SCBAs must meet guidelines established by NFPA.

While there are several manufacturers of SCBAs, current models are designed to withstand flames and high heat, and the units are light weight (Figure 1). SCBAs are equipped with an audible alarm to notify the user of low air levels.

The personal alert safety system (PASS) is also incorporated into the unit. The PASS device can be activated by the user or can detect when the user is not moving. An audible alarm, different than the low air level alarm, will notify other emergency service members when a firefighter is in distress and needs immediate assistance.

SCOTT SAFETY, 2014.

FIGURE 1
Scott Air-Pak X3 SCBA

Recently, Barry Lavoie of BAE Systems introduced thermal imaging technology into the face pieces of SCBAs. Similarly, in 2016 Scott Safety introduced an in-mask thermal imager. "The concept behind Scott Sight came from ongoing discussions with firefighters and a need for every firefighter to have increased visibility in dark environments" (Scott Safety, 2016). Thermal imaging allows the firefighter to "see the outlines of obstacles in pitch black settings" (Feathers, 2015). Firefighters currently use thermal imaging devices that are handheld. The use of thermal imaging can aid firefighters in locating victims, which can be nearly impossible under fire conditions as visibility is nonexistent. Having a hands-free device would allow firefighters to perform tasks that would be impossible without both hands.

The SCBA unit is an essential piece of fire service personnel equipment. Continued improvements to the SCBA unit have aided fire service personnel significantly in firefighting activities. Ultimately, the development of increased hands-free visibility under fire conditions, benefits the fire service personnel as well as the community, allowing firefighters to locate victims quicker as well as perform their duties more efficiently.

Drones in the Fire Service

The use of drones has become common in recent years. Drones are small, unmanned aerial vehicles that are operated from a remote location. Drones are being employed in various ways and are a fast-growing technology that can be utilized within the fire service community.

For exmple, drones can be employed during the search for a missing person. By using a drone, ground command can get an overall layout of the area to be searched as well as potentially locating the victim. The drone can also be programmed to fly a specific pattern which is monitored from the ground and can aid in the search operations.

ZULLYC3P, 2015.

FIGURE 2
Drone Fox-C8 XT equipped with a camera

Utilizing drones on the fire grounds can be a vital tool for scene command. Having a bird's eye view of the scene can aid in monitoring fire behavior as well as expose any other hazards that fire personnel may encounter while working, such as power lines or natural gas feeds (Figure 3). Using drones during wildland fires can also benefit fire operations. "With wildland fires, this technology allows individuals to see how the fire is progressing and helps crews work upstream of the fire to find any potential objects or individuals that would need protecting or saving" (Larson, 2016).

BILL O'NEILL/ELGINET MEDIA, 2015.

FIGURE 3
Drone over structure fire

Currently the use of drones in the U.S. is regulated by the Federal Aviation Administration (FAA), and "requires permission (certificate of authority) from the FAA prior to use" (Werner, 2015). The fire department's locality may apply for permission to operate a drone but must adhere to guidelines for the implementation and operation of a drone use program. Further training of drone pilots may be recommended.

While the use of drones in the fire service industry is still in the developmental stages, there is no doubt the benefits that drones could provide. Allowing the operator to be in a safe location while providing real-time information to scene command would allow fire operations another tool to operate more efficiently and add another layer of safety to fire personnel.

GPS & Tracking Technology in the Fire Service

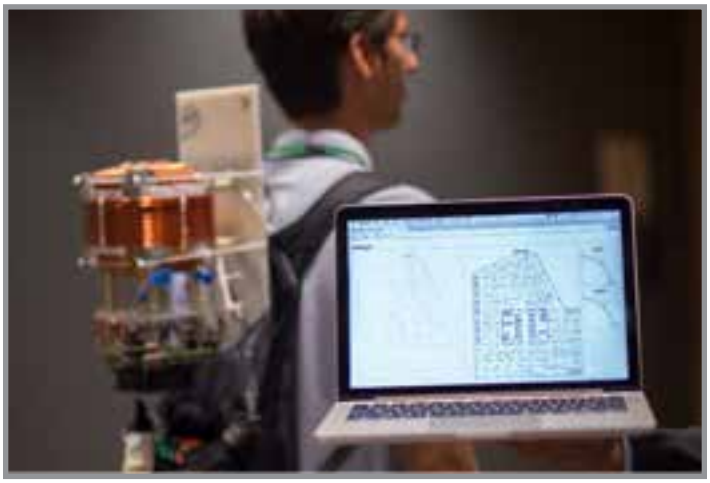
Global Positioning System or GPS technology allows a user to accurately pinpoint their position using orbiting satellites and a GPS receiver. GPS has been utilized by the military, airlines, shipping companies, and can even be found on our cell phones. The use of GPS in the fire service community has revolutionized the way departments responds to calls. While GPS is also being developed as a locating tool for downed emergency personnel, other tracking technologies are also in development to assist with tracking firefighters.

A GPS System For Fire Department & EMS Dispatch (Hamit, 1997) outlines the benefits provided by GPS mapping which allow dispatch to provide vital information to responding emergency personnel. Dispatch can include real-time traffic information, as well as status of other emergency vehicles and fire hydrant location information. This information can allow the emergency responders to operate more efficiently and provide better service.

While GPS technology has aided the fire service in providing vital information to first responders, it has its limitations. Portable radios used by firefighters have incorporated GPS tracking that can assist in tracking or locating firefighters in distress. Unfortunately, GPS is unreliable when utilized indoors. Being underroof obstructs the receiver unit from the satellites used to triangulate the firefighter's position. Fortunately new technologies are being developed to aid in tracking firefighters.

Holy Grail of Firefighter Tracking on the Horizon, Sensor Technologies are Poised to Trump GPS for Tracking Interior Firefighters (Chauhan, 2014) discusses sensor technology that is being developed and is more reliable than GPS. Sensor modules worn by the firefighter use accelerometer and barometer readings and relay their position through the radio to scene command.

Engineers with the NASA Jet Propulsion Laboratory are also working on technology that can help track fire service personnel on the fire scene (Figure 4). According to Good (2016), "The team has been demonstrating the system, called POINTER (Precision Outdoor and Indoor Navigation and Tracking for Emergency Responders), for national and regional leaders in the first-responder community." The technology is based on electromagnetic fields that can penetrate walls and are not limited like satellite-based GPS technology.



PAUL WEDIG/DHS-SCIENCE AND TECHNOLOGY DIRECTORATE, 2016

FIGURE 4
POINTER technology in use

While GPS also provides a tool to track firefighter personnel on the fire scene, the continued development of sensor and other tracking equipment is vital research that will add to the safety of first responders.

Firefighting Foam

Firefighters have various tools and techniques when battling fire. Most commonly, fires are extinguished using water applied in a straight stream or fog pattern. However, there are limitations when using water. Fire trucks are limited in the amount of water they can carry. Rural communities may not be equipped with hydrants and fire tankers would need to shuttle water to the fire scene from

the closest source. This could lead to running out of water during suppression efforts, and put firefighters in a vulnerable position. The introduction of firefighting foams has aided in lessening the short falls of water.

Firefighting foams provide a tool to firefighters that maximizes the water usage by adding a surfactant to the water that helps suppress fire. A blanket of foam is created that aids in the removal of oxygen from the fire, while the water removes the heat, thereby attacking two portions of the combustion triangle, oxygen and heat.

Currently, firefighting foams are based on synthetic substances and are not biodegradable. However, according to the article *New Ceramic Firefighting Foam Becomes Stronger When Temperature Increases,* "a team of chemists from ITMO University, in collaboration with research company SOPOT, has developed a novel type of firefighting foam based on inorganic silica nanoparticles (ITMO University, 2015). This new fast hardening foam (FHF) is biodegradable and has a higher fire extinguishing capacity than other foams. When the foam comes into contact with a burning object, it clings to it, quickly cooling it, and extinguishing the fire.

FHF (Figure 5) has many possibilities on the fire grounds. "Rapid suppression of structure fires, protection of adjacent structures, property protection during wildfires, containment of a wildfire, or protection of evacuation routes during wildfires" (Avsec, 2017). With the advanced fire suppression characteristics of FHF, as well as its biodegradability, there is no doubt FHF would benefit both firefighters and the community.

FIGURE 5
Firefighters deploying foam

FIRECHIEF.COM, 2017

Conclusion

A firefighter's duty is to protect property and life. In the early years of the fire service industry, the risk of danger was greater to firefighters and the community. Often times it has been said, change in the fire service industry is brought on by blood, meaning a catastrophe has to happen before change is implemented. This is no different in the fire service community, often firefighters perform tasks the way they were trained many years before.

Educating firefighters on the benefits of safer and more advanced equipment and procedures, helps in diminishing the risk to firefighters on the fire grounds. The implementation and acceptance of technological advancements by fire service personnel can be credited with safer fire protection services. Ultimately providing the community with a quick and efficient response during fire emergency should be the goal of every fire department. ■

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Stephen (Josh) Spradlin is the fire safety inspector at Virginia Tech University. He conducts inspections, leads fire drills and is a liaison for fire marshall inspections. He also serves on the Blacksburg, VA, volunteer fire department

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Officers

Administrator
Lori Schroth
lori.schroth@yahoo.com

Assistant Administrator
Brandon Cody
hody08@yahoo.com

Content Coordinator
Elliot Laratonda
epl@vt.edu

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ASSE Staff

Manager, Practice Specialties
Charlyn Haguewood
chaguewood@asse.org