Initiative

8

Utilize available technology wherever it can produce higher levels of health and safety.

Executive Summary

The 16 Firefighter Life Safety Initiatives were developed by fire service leaders at the National Firefighter Life Safety Summit (2004) in response to the flat-line of firefighter fatalities over the past decade. With their high level of expertise and birds-eye view of everyday fire service reality, these men and women sought to identify safety deficiencies in training, response, and operations—deficiencies which have contributed to the same LODD scenarios year after year. A sub-group of participants was asked to focus on technology and how the identification of technological fixes might contribute to the bigger picture of reducing line-of-duty deaths. The 8th Initiative asks the fire service to utilize existing technology, borrow allied technology, and be aware of emerging technologies whose application can influence firefighter injuries and deaths.

Introduction

A major study conducted in 2006 by the United States Fire Administration and the National Fire Protection Association focused on the needs of U.S. fire departments. Where technology is concerned, the fire service is certainly gaining ground, but lags in important indicators. For instance, 24% of fire departments lack Internet access, which means they lack access to information about emerging technology and actual web-based technologies. An estimated 60% of fire departments do not have enough self-contained breathing apparatus to equip all firefighters on a shift. Three-fifths (60%) of fire departments have at least some SCBA units that are least 10 years old. An estimated half (48%) of fire departments do not have enough personal alert system (PASS) devices to equip all their firefighters. These are basics, second nature to many of us, and yet we forget that tens of thousands of firefighters are responding everyday dangerously lacking basic levels of safety (USFA, *Four Years Later—A Second Needs Assessment of the U.S. Fire Service*, 2006).

Regarding new and emerging technology, the USFA/NFPA study found the following:

• A majority (55%) of fire departments now own thermal imaging cameras, and another one-fourth have plans to acquire them. A previous survey (2001) reported that 24% of departments had such cameras, and the majority of those without them had no plans to acquire one.
• Only one department in 17 had mobile data terminals (6% of departments, up 4% from 2001), though the majority of fire departments protecting at least 100,000 population have them. Most departments with without mobile data terminals (69% overall) still have no plans to acquire them.
• Only one department in 31 has advanced personnel location equipment, though one-fourth of the fire departments protecting communities of at least 500,000 population have them.
• Only one department in 18 has equipment to collect chemical or biological samples for remote analysis, though most of the fire departments protecting communities of at least 100,000 population have such equipment.

Recommendation # 1: *Read reports by fire service organizations about the state of fire service technology to determine where your organization stands on the continuum of technology readiness.*

This White Paper will not attempt to classify and recommend all the latest technologies that could be available to the most affluent fire departments protecting huge populations. Rather, it is a discussion of readily accessible technologies that would benefit any department—be it volunteer, combination or full-paid. Instead of conducting a scientifically sound survey, we instead asked a group of Michigan fire chiefs and fire service leaders for their opinions, to both explore their level of knowledge and to get a “real world” take on what is really needed to conduct safe emergency operations.

Overview

Webster’s dictionary defines technology as “a capability given by the practical application of knowledge.” Firefighters are knowledgeable in many areas, and apply that knowledge in different ways each and every day in order to safely mitigate the challenges of firefighting. The problem is the fire service is comfortable with what works, and does not adjust well to new concepts when it comes to challenging what has been satisfactory in the past. This is the power of culture at work. Of course we will change from straight stream to fog or combination nozzles and then back to straight stream but, in the end, they all spray water.

There are certainly a lot of new ideas that can be identified and adapted into our profession. Global positioning systems, developed by our military and assisting people all across this country everyday, are being utilized by some fire departments to help dramatically improve response times. There are robots that can perform assembly, assist in bomb mitigation, and even small airplanes that

can deliver a bomb remotely without a pilot. Is there also a robot firefighter in our future—a machine we could send into the most treacherous environments without fear of loss of life? With this image in the back of our minds, what do we have available today that can save our firefighters?

Technology Survey

In evaluating new technology, we should probably state at the beginning that we have great old technologies that are sometimes willfully ignored. By some estimates, over half the firefighters in this country still resist wearing a seatbelt from time to time or always. Many firefighters have worn seatbelts all their lives in their personal vehicles, yet do not buckle up when they are in a multi-ton piece of fire apparatus. As firefighters, they have *learned* to regard seatbelts as obstacles, making claims that they do not fit, they interfere with SCBA, and on and on. Seatbelts were invented to prevent people from being ejected from their vehicles almost one hundred years ago, and we are still battling this issue in the fire service. This simple and basic reason that seatbelts were first installed in vehicles should not be a cause of death to our firefighters today, but it is. With the development of three and four point belt systems, fit should not be an issue, but it is. Again, we see that this relationship between safety and technology is often an issue of culture as much as anything else. Many dollars are spent on seat and seatbelt studies, when in the vast majority of cases enforcing existing policies would accomplish the mission.

Recommendation #2: *Don't look for big technology fixes when existing technology is in-place.*

In the United States, vehicle accidents accounted for approximately 5% of the firefighter deaths in 2005, including crashes, roll-overs, ejections and variations on these scenarios. Certainly, excessive speed and driver error play a huge role in the majority of these accidents. There are, however, some emerging technologies (which, if used along with seat belts) could make a significant impact on reducing vehicle-related LODDs.

If fire apparatus were designed, for example, not to move without all occupants seated and belted, inevitably we will have a vehicle that had personnel available and in their seats ready to respond. However, there has been resistance to the use of this interventional technology due to the possible potential failure of the system, resulting in a fire apparatus vehicle that would not move even if the protocols were met—everyone was seated and belted. Is this an excellent example of where the application of technology might let us down, or is it an excellent example of mounting an excuse to stifle a good solution?

Recommendation #3: *When considering a new technology, anticipate resistance and think about ways to counter arguments with data.*

For this paper, 15 fire service leaders in Michigan (who have held or currently hold office in a state or regional Chiefs association, including the current President of the International Association of Fire Chiefs and the President of the Michigan Association of Fire Chiefs) were asked for their input regarding technology issues or technological improvements that would reduce firefighter injuries and fatalities. The following is a list of technologies or issues they felt should be immediately addressed:

• **Thermal Imaging Cameras**—Thermal Imaging Cameras have reduced the effort needed to overhaul fires by allowing fire crews to eliminate the need to aggressively remove walls and ceilings to verify fire extension. It is no longer necessary to climb ladders in commercial building to find a bad light ballast as it can now be done from the ground utilizing a thermal imaging camera. We still make mistakes and have rekindles, but we did so even with the old methods before the technology was available. However, due to their cost, such cameras are not available to most fire departments—where one camera can exceed a small department's annual equipment budget! The survey group felt strongly that chief officers need to seek ways to add thermal imaging cameras to their available tools, as they are a proven and invaluable technology. The good news is that a majority (55%) of fire departments now own thermal imaging cameras, and another onefourth have plans to purchase one (USFA, 2006).

Recommendation #4: *Thermal imaging cameras are no longer "bells and whistles," but important technology with multiple applications. If your department does not have this equipment and cannot budget for it, consider writing a Fire Act Grant in order to obtain one.*

• **Gas and vapor monitoring systems/CO Monitors**—Gas and vapor monitoring systems at fire scenes and general incidents need to be implemented in the fire service. This is a policy and attitude change that must occur sooner rather then later. We have been responding to known carbon monoxide incidents since home detectors became available in 1993. Virtually all first responders are exposed to dangerous gases, vapor-by products and CO at every fire scene. They have a need, and a right, to know what levels are in the environment, and when these levels are reaching the danger zone. Without a doubt, we should be monitoring air toxicity during active firefighting and during overhaul operations.

There are indications that the by products of materials commonly found at fire scenes are related to chronic illness and early death in first responder populations. According to one life insurance industry analyst "the average firefighter reduces their life expectancy by five years. The reasons for the decrease in life span is due to stress, long and short term, bad diet and eating times, disrupted sleep patterns, the physical conditions the firefighters have to work in, the environmental and chemical hazards they are exposed to. The physical demands of firefighters are different than other professions because firefighters have to perform immediately, there is no warm up time. They may have to rescue

victims or one self and have to do lifting, pulling, or dragging. Hose handling, lifting ladders, and forcing entry into a buildings, are different than other professions in that these have to be performed in conditions of high heat, smoke and very adverse conditions. The firefighter is exposed to constant hazards on a daily bases that is an assault on their body and immune systems." (for more, see http://www.bfdlocal920.com/firefighter.htmv)
The World Trade Center Health Registry has 13,000 cases they are tracking from the 2001 attacks, and there has already been one documented death related to the rescue and recovery work done at Ground Zero (see http://wtceo.org/ and http://www.cdc.gov/niosh/updates/upd-09-9-04.html).

• **Radio interoperability** – In this post 9-11 era we need the ability to use our department radios to talk to a multitude of responders from federal agencies to small local jurisdictions. When emergency responders are challenged with simple house fires, standard radio communication is usually sufficient; when they are challenged with incidents involving hazardous material spills, bomb threats or any multi- jurisdictional event, interoperable radios for scene management are essential life safety tools. However, interoperability is extraordinarily expensive. A consortium of 16 communities in southeast Michigan spent 16 million dollars on radios and repeater towers for radio system. As a result, communication between those communities improved, but they still could not talk directly with the communities that bordered them who had not participated in the funding. Estimates provided to Wayne County (MI) Emergency Management for a complete interoperability system within the county was over 100 million dollars. This cost was for one county in one state. Where will the money come from to provide true radio interoperability throughout the United States?

• **Integrated PASS devices and Bar Coding Accountability Systems**—Integrated pass alarm devices are part of the new air packs that will in time become a standard. These devices "alarm "with a bell, buzzer or other alert whenever a firefighter is down. Disturbingly, however, there have been some observations where the alarms are ignored. This is due to the fact that as a whole, we do not yet take accountability as a serious enough fire ground issue. Accountability systems in the fire service need to be improved and a nonnegotiable tactic for firefighter safety at every emergency scene. Incident commanders need to practice identifying the duties being performed by their staff at all times. They should routinely request Personnel Accountability Reports (PAR) at expected intervals during the events they are managing. It is the most important aspect of the job to know what your people are doing, where they are performing their tasks, and when they should be done and ready to be assigned additional tasks at the scene. There is also a moral and ethical dimension to fireground accountability that begs the issue of how it can ever be ignored.

There are all many models of accountability systems available to the fire service today. We must keep the system that we chose simple to allow all fire departments to benefit from the technology and use. Accountability systems with

simple tags and a small board will work at almost all fire scenes involving structures. Wildland conflagrations that occur over huge areas can be well served with the advanced electronic computer supported systems available today. Barcoded accountability systems can be used in their simple form as a tag placed on a board at the emergency scene, or barcodes can be scanned and loaded into a computer as a more advance feature. However, fire service leaders have not yet embraced a good way to use accountability systems at all fire scenes—and this is one area where routinization will help reinforce a new normative behavior. Fire service leaders need to develop methods that work in their organization and adjust their operations to include accountability at all emergency scenes. This needs to become as essential as personal protective gear is to all emergency responders. We must improve our attitude about accountability as well as the technology which supports it.

Recommendation # 5: *Fire ground accountability, as mandated with the Incident Command System, must be a priority at every fire. If your department does not have a policy regarding fire ground accountability, write one and train to it. If you do have an accountability system and it is not being used, find out why and remember it is everyone's duty to stop unsafe practices.*

The chiefs surveyed for this paper also identified a sub-group of technology for vehicles.

• **Opticom systems**-- Opticom emitters are a priority control system which allows emergency responders to change a traffic light signal in their favor as they approach busy intersections. While earlier versions of this technology had some lens clearing issues, they are now fairly reliable technology. However, there have been reports where systems have been purchased by the general public and this has created a safety nightmare, so much so that jurisdictions are now prohibiting them in privately owned vehicles. Opticom emitters, are the interview group admitted, a response to the fact that, as a service, we have had a hard time enforcing safe intersection anticipation. They worried that the systems would be abused and that they tacitly encourage speeding. Far better, they said, to enforce existing policies regarding stopping at intersections, with the realization that a minute or two would not significantly impact the vast, vast majority of responses.

Recommendation # 6: *Be cautious when purchasing technology, even if it is within your organization's financial reach. Some technologies, such as Opticom systems, may solve one problem, but precipitate other concerns.*

The chiefs who participated in this survey also said they were looking forward to improvements in the following areas (**see appendix A**):
• Anti-lock Breaking systems
• Engine Break Systems
• Compressed Air (Class A) Foam Systems
• GPS Systems

- Haz-Mat Pre-Plans
- Radio Intercom Systems
- Black Boxes
- LED Lights

Although outside the scope of this investigation, this group of Michigan chiefs also noted that technologies regarding residential, commercial, and industrial fire suppression systems are also saving firefighter lives. Computer Aided Dispatch (CAD) systems were also listed on their inventory of areas needing technology support.

Simulators

Simulators, both for driver training and structural fire training are invaluable tools in today's safety arsenal. Both allow firefighters to *virtually* experience environments we hope they will never face in real life—yet, which they must be prepared to encounter. Driver simulators and training aids teach driver/operators how to recognize and anticipate hazards. These tools can allow your personnel to train and become acclimated to driving in emergency and non-emergency environments, and without ever endangering themselves or members of the community. They can be as real as the streets in your town, complete with your stoplights and speed limits, and local weather conditions. The units that bring the most value are the more expensive ones costing over $100,000, but portable units are coming to the market at more realistic prices.

Recently, the Kentucky Fire Commission, which provides training and education services for firefighters throughout the Commonwealth of Kentucky, purchased mobile driver training simulators. "Getting to or from the fire is one of the most dangerous aspects to being a firefighter," said Ronnie Day, Executive Director for the Kentucky Fire Commission. "More people are injured or killed in driving accidents involving fire trucks than fighting fires. It only makes sense that we do everything we can to reduce those driving accidents" (FAAC Incorporated, September 26, 2006, http://www.faac.com/20060926.htm).

Live fire training in acquired structures is one of the most contentious issues in the fire service today. Every year there are injuries and fatalities associated with live fire training. Where once this training was accepted as the only way to give firefighters the feel of a real fire, it has subsequently come under much criticism. Acquired structures, unlike burn buildings, are not designed to be burned or to be used for firefighter training. They are either donated by or purchased from property owners who have no further use for the property and, in almost every case, are destined for demolition. They can range from residences to vacant schools, factories or shopping centers. In some cases high-rise buildings or other large structures have been made available for firefighter training. While these structures provide excellent training opportunities for firefighters, they come with a variety of inherent risks factors including asbestos contamination or other contaminated

residues, unprotected vertical shafts, openings in floors, missing stairways, wall or ceilings finish materials with rapid flame spread or high smoke production characteristics, and insulation that produce toxic products of combustion. These are just a few of the problems associated with live fire training (Firefighter Life Safety Resource Kit, Volume 1, 2006).

The Michigan chiefs who gave background for this paper were most vocal on the topic of training-related LODDs, as five of them had attended the funerals in 1987

In Memoriam
Marsha L Baczynski
Milford Township FD
Robert A Gregory, Sr.
Highland Township FD
Thomas B Phelps
Lynne Township FD
October 25, 1987

for three firefighters who had lost their lives in a Milford, Michigan training incident. Simulator technology works well, especially in training for high-risk environments.

The Michigan chiefs were adamant that we must find ways to fund the purchase and use of these great tools. Several departments have purchased flashover simulators which offer remarkable opportunities for firefighters to learn how to recognize the early signs of flashover so they can take appropriate action. Clearly, simulators offer a “realistic” teaching tool to educate firefighters on flashovers and other imminent dangers, while risks are controlled and minimized. Many will argue that live fire training buildings and simulators do not provide the same quality of realism as live fire training in acquired structures—but the increased margin of safety they provide more than makes up for a loss of realism.

Recommendation # 7: *Try to ensure that the firefighters in your department or region have the opportunity to train on driving and structural fire simulators. Simulator technology is expensive, but the expense can be shared among fire service departments or other training organizations, such as state training facilities, community colleges or other places where multiple agencies could use them.*

In 2005, the National Fallen Firefighters Foundation sponsored a Fire Service Research Agenda Symposium where many of the issues brought up by the Michigan chiefs were discussed. The symposium, however, did mention other technologies which may impact on LODDs; several of them included:

• **Community Risk Assessment Tools**—Which will allow fire department planners to systematically and scientifically identify and assess specific risks.

• **The National Integrated Management System**, it is hoped, will encourage

and technological support and improvements in the following areas: communication, interoperability, information management, and resource tracking/management.
• **Data Access Systems—**which will allow real-time monitoring to the incident commander from multiple sources.

Conclusion

Each new piece of technology has the potential to help lower and reduce the dangers we live with in the fire service. The key to getting the best benefits from any new tool is proper training, and putting the tools in perspective as an addition to common sense. The transition from horse drawn wagons to gasoline powered vehicles to the modern fire truck did not just happen. There were doubters along the way as there are with each new tool and idea that becomes available. You must evaluate your operation and purchase the technology that will help provide the safest work environment in all aspects of the job. You must train on the use of developing technology including its benefits, contradictions, ramifications and, most importantly, how it applies to your operation and how the new technology can improve your organization's effectiveness and the safety of your employees. That is what true fire service leadership is about.

Recommendations

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Recommendation #2: Don't look for big technology fixes when existing technology is in-place.

Recommendation #3: When considering a new technology, anticipate resistance and think about ways to counter arguments with data.

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References

National Fallen Firefighters Foundation, *Fire Service Research Agenda Symposium*, June 1-3, 2005. Available at www.everyonegoeshome.com
National Fallen Firefighters Foundation, Firefighter Life Safety Resource Kit, Volume 1, 2006. Available at www.everyonegoeshome.com
United States Fire Administration, *Four Years Later—A Second Needs Assessment of the U.S. Fire Service*, FA 303/Oct 2006. Available at www.usfa.dhs.gov/downloads/pdf/publications/fa-303-508.pdf.
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Appendix A: The chiefs who participated in the survey also were looking for improvements in the following areas:

• **Anti-lock Breaking systems --** Modern antilock brakes are far more reliable and less likely to need repair than the older style brake systems. Anti Lock Brakes require training to teach driver/operators to allow the computer to pulse rather than pump the brake pedal.

• **Engine Break Systems --** These systems require additional brake training to drivers to allow them to understand how their vehicles will react with engine brakes. These systems can cause a vehicle to go out of control during icy conditions if they are not fully understood.

• **Compressed Air (Class A) Foam Systems --** The use of foam products in fire suppressions operations require proper training to understand the use and limitations of the product. Compressed air foam systems require a greater amount of training to get the proper mixture and benefits from the foam. Lighter hose lines and faster fire knock down times should be good incentives to consider purchasing these systems.

• **Global Positioning Systems** (**GPS) --** There are good systems available for under $500 dollars today; although the requirement to manually load street addresses in the cheaper systems is a time consideration. If funds are available to install computers in fire service vehicles, GPS can show the most direct route to the emergency and allow for adjacent streets to be displayed with hydrants and exposures identified. These systems are pricey and require some data input by the department to gain the most value. GPS units can also help with helicopter responses for medical incidents by providing longitude and latitude

coordinates to the pilot.

• **Haz-Mat Pre-Plans --** As with global positioning systems, pre-plans are extremely helpful when they are available at the scene. Installed computers with loaded preplans would be helpful in hazardous material incidents. Downwind and downstream exposures could be clearly identified early in the incident. The material safety data sheets could be available on the computer at the scene saving time and potentially saving lives. Hazardous material responses are timewww. consuming and labor- intensive operations; anything that can be front loaded in terms of planning will help with operational efficiency. The preparation and development of pre-plans also helps fire department staff understand the dangers of some of facilities within their response area.

• **Radio Intercom Systems --** Communication of responding fire crews can be greatly enhanced with vehicle intercom systems. With them, crews on different vehicles can communicate to discuss their plans of action while they are in-route to the emergency. These systems can provide a clear understanding and exchange of information to all responders including real time information on scene conditions.

• **Black Boxes --** Starting in the late 1990's to the present, some vehicle manufactures were equipping vehicles with electronic data recorders (EDR), which are sometimes referred to as "Black Boxes." These boxes are intended to be used to collect data on vehicle-related problems, and could also be used in accident investigation. The information contained in the recorder shows vehicle speed, acceleration and deceleration information.

• **LED Lights --** These lights provide brighter warning signals with less power. They have fewer maintenance concerns which may provide an added degree of safety since the lights should have fewer failures from burnt-out bulbs at the emergency scenes. Lower voltage also allows more lights to be designed into the vehicle at the manufacturer. Reflective striping and brighter lights can provide a safer work environment to fire personnel who are working on roadway emergencies.