Air Management in Big Box Structures

By Brian Schaeffer

The size of the big box stores lends itself to be likely the most difficult search for any firefighter, incident commander and even the largest fire department.
Photo by Tod Sudmeier

Any current or future fire service professional should passionately study our history and take measures to learn from it. If we ignore the tragedies in history, we will be destined to repeat them and, unfortunately, we already have, over and over again.

That statement is challenging for me to write, but pragmatism is unquestionably a trait many people in the fire service share. We survive by finding simple solutions to complex situations and are known for having a "can-do" culture, sometimes even against all the odds.

The concepts of fire service culture and learning from our past are important when considering our response to large horizontal structures, also known as "big box" fires. In the case of innovative solutions to surviving predictable outcomes, our can-do culture is extremely beneficial, particularly when combined with technology that makes our jobs easier—and safer.

To illustrate some of the challenges we face on the fireground, as well as the impact of technological innovations, we need to review two important cases where firefighters were tragically lost in big box incidents.

Why focus on big box incidents?

Big box occupancies can be found in nearly every small and large community in the United States. The structures are routinely Type II construction where the walls and roofs are commonly constructed of non-combustible materials. The structural walls are typically reinforced masonry or tilt-wall, and the roofs are flat with metal structural members and many different types of decking, such as foam, membrane or even solid lightweight concrete slab.

Because big box stores are a contemporary building type, most are constructed with requirements that mandate fire suppression systems and other life safety requirements for the public. Fire codes are often designed to protect the public and the firefighter, but in the case of firefighter safety and big box fires, we can do much better.

We know that placing firefighters on the roofs of these buildings is inherently dangerous due to the premature failure of metal roofs when exposed to heat. Moreover, the vast spans of big box roofing systems are designed for essential loads—not water, firefighters or heavy snow. We also know that the size of the buildings lends itself to be likely the most difficult search for any firefighter, incident commander (IC) and even the largest fire department. These buildings are routinely occupied 24 hours a day and may have hundreds of employees or shoppers who can quickly become victims.

These structures should be in every agency's preplans, their training plans and especially their response plans, because when the incident occurs, the challenges can be incredibly difficult to overcome. Successfully extinguishing a fire in a big box structure will take an enormous amount of resources.

One critical piece to the success of an offensive operation with a big box structure is the ability to sustain firefighters' air within the work cycle—a feat that is challenging to accomplish when the majority of air is expended during travel time into the vast structure. To change the incident's outcome in favor of a safe and successful outcome, we must have SCBA air available to firefighters close to the work and available in the case of a disaster. Firefighters running out of air in big box structure fires are a predictable event as history demonstrates.

With this in mind, let's review two big box incidents so as to never repeat these tragedies again.

Southwest Supermarket Fire – Phoenix, AZ

LODD: Firefighter Bret Tarver

On March 14, 2001, the Phoenix Fire Department (PFD) received a call for a debris fire behind a hardware store. The fire was small, so the second closest neighborhood fire company was sent initially, as the closest was committed to another call. A nearby battalion chief noticed a growing amount of smoke from the area of the dispatched address, and based on intuition, placed himself in the incident and added three additional companies to assist.

The closest engine (Engine 14) ended up clearing the previous call and added itself to the incident. The battalion chief ordered Engine 14's company to enter the businesses that backed up to the growing debris fire. They were directed to evacuate occupants and determine if fire had spread to the inside of these businesses, specifically a large big box structure known as the Southwest Supermarket.

When Engine 14 entered the supermarket, they reported light smoke at the ceiling of the large building. The smoke was misleading and coaxed them farther into the vast maze of the supermarket. As they moved through the building, they found heavier heat and smoke near a storage area. Eventually, a hoseline was extended to the storage area, and water was applied to the fire.

As time on air by the company increased, visibility in the building was rapidly deteriorating and described as being near zero. PFD Engine 14 Firefighter Bret Tarver told his supervisor that he was running low on air and needed to exit. The crew subsequently gathered together and began to follow the hoseline out to the exterior.

During the process of following the hoseline, Firefighter Tarver became disoriented and separated from his crew. He called for assistance as the fire was viewed from the exterior as rapidly increasing in the supermarket. Multiple layers of leadership heard Tarver's requests for help, and RICs were sent with extra breathing air equipment to search for Firefighter Tarver. The attempts were unsuccessful, and the supermarket became fully involved.

Firefighters re-entered the structure from a different location, locating Tarver and painstakingly moving him into the main storage room. The engineer and senior firefighter from Engine 6 repositioned Firefighter Tarver and were able to remove him from the main storage room. They were relieved by a series of other crews that moved Firefighter Tarver, with great difficulty, to the south exit of the supermarket storage room.

Tarver was transported to the hospital where he was pronounced dead.

On March 14, 2001, Phoenix Firefighter Bret Tarver died while battling a fire at the Southwest Supermarket.
Photos courtesy of the Phoenix Fire Department

The cause of death was identified as thermal burns and smoke inhalation, and his carboxyhemoglobin level was 61 percent. He too ran out of air.

Warehouse Fire – Kansas City, MO

LODD: Battalion Chief John Tvedten

On Dec. 18, 1999, Battalion Chief John Tvedten was assigned to the interior of a manufacturing and warehouse building. The building was a 300,000-sq.-ft. warehouse, and Chief Tvedten was assigned as the chief to manage the interior operations at the incident.

The strategy was declared as offensive, and Tvedten donned an SCBA and took his companies to the interior to locate and extinguish the fire. The fire was located in an area where large paper bales were stored and had subsequently caught fire. As time elapsed, the paper bales were causing the structure to fill with dense white smoke.

According to the NIOSH report, Kansas City, MO, firefighters battled the fire for approximately 52 minutes in the offensive strategy until the conditions deteriorated so much that both the IC and Chief Tvedten concurred in ordering a withdrawl of the structure and declaring a defensive strategy. Despite the IC's radio order for evacuating, countless firefighters did not hear the order. Numerous firefighters ran out of air and became disoriented in the large, horizontal maze and needed emergency assistance to escape.

Chief Tvedten himself became disoriented, and he was extremely low on air while lost in the structure. He called for help, and his brothers and sisters responded. Despite the fact that he was in direct radio communication with the IC, and two rapid-intervention crews were assigned to locate him, the rescue attempts were met with no success. Both RICs re-entered the structure but ultimately ran low on air and were forced to exit without locating the victim.

Additional RICs were put together as more resources arrived, and they eventually found Chief Tvedten roughly 90 minutes after the initial dispatch. He was transported to a nearby hospital where he was pronounced dead. His cause of death was asphyxiation. He, like many of our firefighters, ran out of air in a big box structure.

Rules of Air Management

The doctrine that became the Rules of Air Management was the genesis of a few fire service leaders from Seattle: Mike Gagliano, Casey Phillips, Phil Jose and Steve Bernocco. They had a passion for changing our minds about how we measure air capacity and how we deployed SCBA-reliant resources into a hazard zone. They ultimately changed our industry by preaching the importance of air management throughout North America and by being pivotal in leading changes to NFPA 1404: Standard for Fire Service Respiratory Protection Training.

Many of us learned from the "Seattle Guys" and adopted the Rules of Air Management into daily practice on the bread-and-butter house or apartment fires. Big box fires do not occur daily in any jurisdiction, and they are anything but routine. Expecting our firefighters to survive a working fire in a big box structure equipped with only their SCBAs and a reliance on the Rules of Air Management is a recipe for failure—and we can do better. We have to step outside the box, like so many of those before us in fire service history, and consider technology and a different method of delivering air to our workforce inside buildings like big box structures.

The air supply standpipe

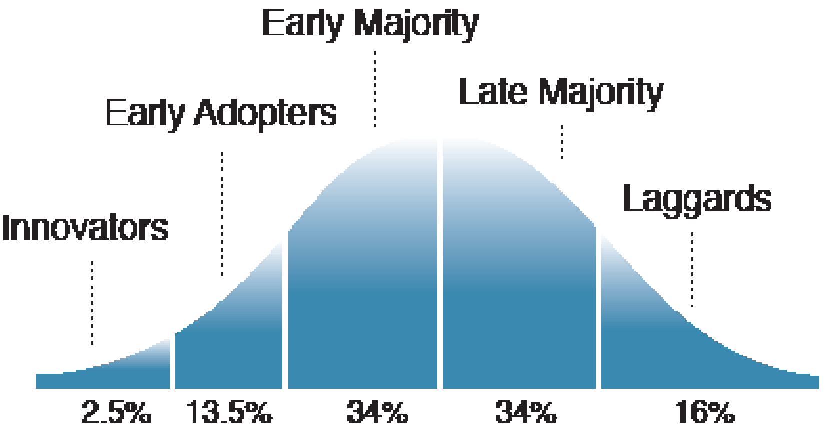
The fire service is slow to adopt most technological advancements that are brought forward until they are proven by years of experience, and even then we tend to be laggards (remember, many of us still wear helmets made from cowhide).

Despite a significant number of fire-related tragedies experienced throughout the United States before modern fire protection systems, there were many in our field who were critical of the technology until it demonstrated its effectiveness. However, fire protection systems in North America protect millions of citizens and firefighters each day in areas where they are installed, without much consideration.

Sprinkler systems, highly technical detection systems, emergency lighting and so many others are now considered routine expectations for the public and those sworn to protect it. Those before us who advocated against the anti-sprinkler lobbies and wayward politicians trying to protect builders were early-adopters—they challenged the status quo and would not stand for lives being needlessly lost. Those early-adopters won several arduous battles and eventually convinced members of the fire service to embrace an expectation of building fire protection systems. They won because they were persistent, demonstrated their belief through evidence-based research, and focused on a long-term strategy that permeated the innovation throughout all of the different sociological groups in our industry.

Today, one of our largest opportunities available to prevent firefighter deaths from large big box structure fires is the advent of a firefighter air replenishment system (FARS) that can be installed within all big box buildings. FARS is fundamentally an air supply standpipe that can be mandated for big box structures through the adoption of the 2015 International Fire Code, Appendix L Requirements for Fire Fighter Air Replenishments Systems. The code's principle is based on recognizing the fire department's limited capability of replenishing firefighter breathing air during emergency operations in these structures.

Fixed FARS systems are installed to allow firefighters to safely and unfailingly refill SCBA cylinders deep within a structure where the transportation of air bottles becomes problematic. The installation of a FARS system in a big box structure will reduce the amount



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of travel distance, time and operational support needed to manage air supply during emergency operations.

As an industry and a brotherhood, this innovation must be adopted throughout North America. To understand how to be successful in this complex of a change, we need to better understand the concept of innovation and look into all of our organizations to determine how to successfully move FARS forward.

An organization's "innovativeness" can be identified as the degree to which an organization is relatively earlier in adopting new ideas than the other members of a system (Rogers, 2003). In the case of the FARS system, it is considered an innovative life safety system in the eyes of the International Fire Code, and not many communities have adopted it. Much like the other fire protection systems in our industry's history, FARS has been met with measurable resistance from many of the special interest groups, but the tools have had some limited acceptance by what sociologists would identify as early-adopters.

The Innovation Adoption Lifecycle is often referred to by sociologists and can help illustrate the five levels, or groups, of acceptance of something new. The process of a group's (or society's) acceptance can be modeled through a normal distribution or bell curve (see chart above).

The model identifies the first group—the ones who are risk-takers; they are called innovators. Innovators are active problem-solvers and continually seek out new ideas. In the case of FARS, the PFD has indeed led the way with an aggressive building code that mandates FARS in big box structures as well as high-rise buildings. The PFD made an early commitment after the loss of Firefighter Tarver to improve the survivability of its firefighters at every opportunity—and that commitment resonates with the Innovator Model.

The early-adopters are often the agencies that will ask the tough questions, visit innovators systems and take measured risks to implement new systems, even if there may be bugs and nuances to be worked out.

The early majority organizations may deliberate for some time before ultimately adopting a new idea like FARS, but they follow with deliberate willingness to adopt innovations, but seldom lead efforts in their communities.

The late majority and laggards are where most fire service leaders like to tread. The late majority remains skeptical, regardless of the pressures and science. In fact, the late majority often will not adopt a change like FARS until most of the other agencies in their area have done so, or only if they are mandated.

The laggards are the traditionalists. Laggards are organizations whose leaders possess no opinions, are not connected to the larger fire service and are concerned with only themselves. The decisions in these organizations are based on tradition and past generations' decisions, and their innovations move at a crawl.

The Diffusion of Innovations Theory is relevant to any organizational or societal change, but it is quite illustrative in the case of FARS and the fire service. FARS is available today, to everyone, and is critical to the safety of the public and to the firefighters. The technology adds a higher level of safety and efficiency to the big box structure fireground, as well as high-rise and tunnel operations, and with persistence and pressure, even the laggards will eventually adopt it, and we may never have to read another line-of-duty fatality report from another firefighter dying from asphyxiation inside a big box structure. ■

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