



The International Forum to Advance First Responder Innovation

Capability Gap 10 “Deep Dive” Analysis

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International Forum to Advance
FIRST RESPONDER INNOVATION



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Introduction

Background

The International Forum to Advance First Responder Innovation (IFAFRI) is an organization of government leaders from across the globe, focused on enhancing and expanding the development of affordable and innovative technology for first responders worldwide.

IFAFRI does this by:

1. Working with the global first responder community to define a list of common, high priority capability gaps;
2. Providing a platform for international collaboration on innovative research and development (R&D) initiatives and solutions;
3. Characterizing the global first responder markets, to inform and guide industry and academia about market opportunities and to incentivize these actors to develop and produce innovative technology solutions to first responder capability gaps; and
4. Providing information about relevant and available first responder technologies to the first responder community, while not endorsing any specific technology, product, or manufacturer.

In order to respond more safely, efficiently, and effectively to everyday and catastrophic incidents, first responders around the world need technologically advanced tools and equipment that are affordable and innovative. However, there is no centralized mechanism for first responders to identify and discuss shared needs and requirements. In addition, overall purchasing of tools and equipment is fragmented into smaller quantities, which provides little incentive for industry to commercialize innovative technologies. Therefore, the lack of consolidated requirements for first responders, along with fragmented purchasing, results in an inadequate amount of affordable, new technology being available for first responder use.

The purpose of this document is to characterize the markets and identify technology solutions relevant to IFAFRI's Capability Gap 10: *The ability to provide appropriate and advanced personal protective equipment*. IFAFRI is publishing this information to identify potential areas of R&D where there may be opportunity for industry and academia to develop innovative solutions. Further, it is intended to provide industry and academia with key data points and analysis that will inform their decision on entering or expanding into related markets.

IFAFRI Membership

IFAFRI is currently composed of members from 13 different countries and the European Commission, including Australia, Canada, Finland, Germany, Israel, Japan, the Netherlands, New Zealand, Singapore, Spain, Sweden, the United Kingdom, and the United States. The figure below illustrates the global composition of IFAFRI.¹



¹ Note, IFAFRI membership for France and Mexico is pending.

IFAFRI *Common Global Capability Gaps*

This document is focused on the fifth of ten Common Global Capability Gaps identified by IFAFRI. The list of current gaps includes:

Capability Gap 1	The ability to know the location of responders and their proximity to risks and hazards in real time
Capability Gap 2	The ability to detect, monitor, and analyze passive and active threats and hazards at incident scenes in real time
Capability Gap 3	The ability to rapidly identify hazardous agents and contaminants
Capability Gap 4	The ability to incorporate information from multiple and nontraditional sources into incident command operations
Capability Gap 5	The ability to maintain interoperable communications with responders in any environmental conditions
Capability Gap 6	The ability to obtain critical information remotely about the extent, perimeter, or interior of the incident
Capability Gap 7	The ability to conduct on-scene operations remotely without endangering responders
Capability Gap 8	The ability to monitor the physiological signs of emergency responders
Capability Gap 9	The ability to create actionable intelligence based on data and information from multiple sources
Capability Gap 10	The ability to provide appropriate and advanced personal protective equipment

The first four capability gaps on this list were adopted by IFAFRI in 2016. To arrive at this initial set of capability gaps, the IFAFRI membership conducted analyses of first responder capability gaps in their countries. Some of the IFAFRI participants used the methodology presented in the U.S. Department of Homeland Security (DHS) Science and Technology Directorate's (S&T) Project Responder 4 (PR4) report, as a guide in their analyses. Project Responder 4 is the fourth in a series of studies that focuses on identifying capability needs, shortfalls, and priorities for catastrophic incident response. The methodology is based upon discussions with federal, state, and local first responders, as well as technical subject matter experts.

After submission of first responder capability gaps from IFAFRI participants, a comparative analysis of all submitted gaps was conducted. The analysis found a significant level of overlap among the various countries' gaps, which resulted in the proposal and adoption of the first four *Common Global Capability Gaps* in 2016.

Between 2016 and 2018, IFAFRI's Capability Gaps Committee further refined and formalized its process for adding capability gaps to the list. In 2018, individual countries solicited national capability gaps from first responders in their countries and submitted these to the Capability Gaps

Committee. In total, 78 national capability gaps were received from IFAFRI countries. These gaps were then synthesized to eliminate redundancy and provide overarching gaps that aggregate multiple similar gaps when needed, which resulted in a set of 45 gaps. Three of the gaps corresponded to the initial four *Common Global Capability Gaps*, leaving 42 gaps for prioritization. The prioritization process resulted in the addition of the Capability Gaps 5-10 to the *Common Global Capability Gaps* list.

To date, similar “deep dive” analyses have been conducted for each of IFAFRI’s *Common Global Capability Gaps*. Each of these documents has been published to the IFAFRI Web site, and is available for download. It is important to note that continued market research will be required to ensure awareness of current efforts and account for new actors in these capability gap areas.

Capability Gap 10

The ability to provide appropriate and advanced personal protective equipment

The purpose of protective clothing and equipment is to shield responders from injury while operating in hazardous environments and provide the highest level of protection against a range of possible threats. Body protection against individual threats has improved over the last decade; however, it has largely remained limited to the discipline-specific threats that are most likely to be encountered. This stovepiped approach to PPE development and implementation poses several issues. Most notably, responders face a myriad of known and unknown threats during incident response. Therefore, emergency responders often find themselves in situations where they are not outfitted with the best PPE available against the possible range of threats. This approach also does not provide efficient levels of protection across the body and does not allow response agencies to capitalize on economies of scale in purchasing.

The duty uniform is the standard clothing ensemble worn by responders on a daily basis. In many cases, particularly for law enforcement officers and emergency medical technicians (EMTs), it may be the only clothing worn while on duty. Emergency responders' duty uniforms are generally made of cotton, polyester, wool or a blend of fibers. They provide limited, if any, protection from hazards common on the incident scene. The development of a PPE duty uniform that provides limited protection against a range of hazards is a well-established need with the emergency responder community. Responders function in unpredictable environments and may encounter threats before they can don the most appropriate PPE. Advances in materials sciences, such as the development of moisture-wicking fabrics, are not currently approved by international standards so they are not permitted for use in many countries.

Responders don additional garments to protect themselves against specific threats. Firefighters, for example, use an ensemble of a thermal-resistant jacket, pants and boots called "turnout" or "bunker" gear. Many law enforcement officers regularly wear ballistic vests over their duty uniform to protect against projectiles.

Respiratory protection (e.g., self-contained breathing apparatus [SCBA], air-purifying respirators, powered air-purifying respirators, escape masks) is used by emergency responders during operations in oxygen-deficient or hazardous environments. Firefighters generally use respiratory protection during fire suppression and overhaul activities, while emergency medical personnel commonly use it to protect against infectious pathogens. Law enforcement officers do not routinely use respiratory protection outside of tactical situations, but may carry it in their vehicles. Although reductions in size and weight have been made in recent years, a typical SCBA harness, battery, and tank weighs more than 18 kg (40 pounds). Standard tanks are rated for 30 minutes of use, but are often effective for less than that because of the level of exertion by the user. While there is a high level of public and private funding for advancing technology for interoperable communications, emergency responders in IFAFRI nations continue to face challenges. Many factors contribute to this lack of progress, such as country size and degree of centralized response functions, but the main obstacle is a lack of a comprehensive, affordable solution.

While there are a number of solutions in use by responders, these solutions still have shortcomings when considering the state of technology today for personal protective equipment. This study uses the list of existing first responder gear in the SOO document for Gap 10. This list encompasses the

current methods of communication available for first responders. Each method was considered a “technology type” with a corresponding, relevant market. There are 11 technology types for this capability gap:

- Duty uniforms, often made from cotton, polyester, or wool fibers;
- Specialized firefighting garments (e.g., turnout gear, wildfire);
- Body armor;
- Gloves (e.g., fire suppression, chemical resistant, nitrile, cold-weather);
- Boots (e.g., fire suppression, steel toe; cold weather);
- Respiratory protection (SCBA, air-purifying respirators, powered air-purifying respirators, escape masks, N95 masks);
- Weather protective garments (e.g., snow, rain);
- Tactical operation garments (e.g., vests);
- Hazardous materials (HAZMAT) garments (e.g., HAZMAT suits level A-D);
- Head protection (e.g., facepiece; helmets, hats, hard hats); and
- Eye protection (e.g., goggles, safety glasses, sunglasses).

Methodology

This section provides a brief overview of the processes used to obtain and assess the findings presented in this report.

Research Methods

The data presented in this report was gathered from publicly-available information sources, including market reports and company web sites. The study team conducted a global scan of existing and in-development technology solutions with the aim of identifying and assessing the primary market for technologies related to this gap. However, the data presented in this report should not be considered exhaustive. This document does not contain any proprietary data, nor does it endorse or advocate for any of the technology solutions described herein. Further, the study team did not validate any of the manufacturers' claims found in their product descriptions.

Market Quantification

All relevant markets are quantified utilizing overall global revenue figures, unless otherwise noted, for the forecast period 2019 to 2023. The Compound Annual Growth Rate (CAGR) within each segment is used to measure growth within the forecast period and to extrapolate data when figures were not publicly available. Data for the primary market is used in the aggregated findings presented in the body of this report.

Market Phase and Factors

Market phase is determined using factors in the Industry Life Cycle Model. The adapted market phase definitions are presented in the following table.² Market factors are assessed by examining barriers to entry and market opportunities, as determined through secondary research.

Nascent	New market need with dominant solutions not yet determined; growth begins increasing toward end of cycle
Growth	Dominant solutions begin to emerge; high growth rates
Mature	Often fewer firms than growth phase, as dominant solutions continue to capture the majority of market share and market consolidation occurs; lower growth rates that are typically on par with the general economy
Decline	Further market consolidation; rapidly declining growth rates

Competitive Landscape

This study also examines the competitive landscape within each market, accounting for the total number of firms, along with the number of responder-specific solutions. Total number of firms was estimated using the number of key players given within publicly available market reports for each segment. Responder-specific solutions were identified using a more tailored search. This search included examining the product offerings of key players listed in publicly available market reports to determine their relevance to the capability gap and conducting targeted keyword searches in order to identify solutions from additional companies.

Presentation

This report includes a “Market Overview” that summarizes the overall market and provides the market quantification data for each segment. The report also presents the key findings for each market segment in the “Market Highlights” section, with a one-page summary for each segment. In addition, the “Competitive Landscape” section further categorizes the total number of firms participating in the market by segment and highlights responder-specific solutions currently available or in-development.

Synopsis Overview

IFAFRI has been conducting an ongoing global capability gaps market analysis in order to meet its objectives characterizing global first responder markets to inform and guide industry and academia. The key objective of this study is to characterize the markets relevant to Capability Gap 10. This synopsis highlights key data and analysis identified as part of this study.

Market Definitions and Segmentation

This study uses the list of existing first responder gear in the *Statement of Objectives 10* (SOO 10) document to further define and segment the relevant markets for Capability Gap 10. For the 11 types of gear given for this capability gap, it was determined that one market best represents these technology types, and therefore only one primary market was selected. This primary market is used for market definition, segmentation, quantification and further assessment.

Market Quantification

The primary market is quantified utilizing overall revenue figures derived from global markets. Growth is measured using an estimated CAGR. The Global Personal Protective Equipment Market is estimated to be worth more than **\$40 billion USD** in 2017 and is projected to grow at a Compound Annual Growth Rate (CAGR) of 6.1% through 2023. This equates to a market value of more than \$57 billion USD in 2023.

Competitive Landscape

Based upon third-party market research reports, there are seven key players and innovators identified within the global, primary market for Capability Gap 10. These key global players and innovators appear to offer solutions that address, in part, the ability to provide appropriate and advanced personal protective equipment. However, none of the solutions identified within this assessment appear to meet all of first responders' target objectives for this gap.

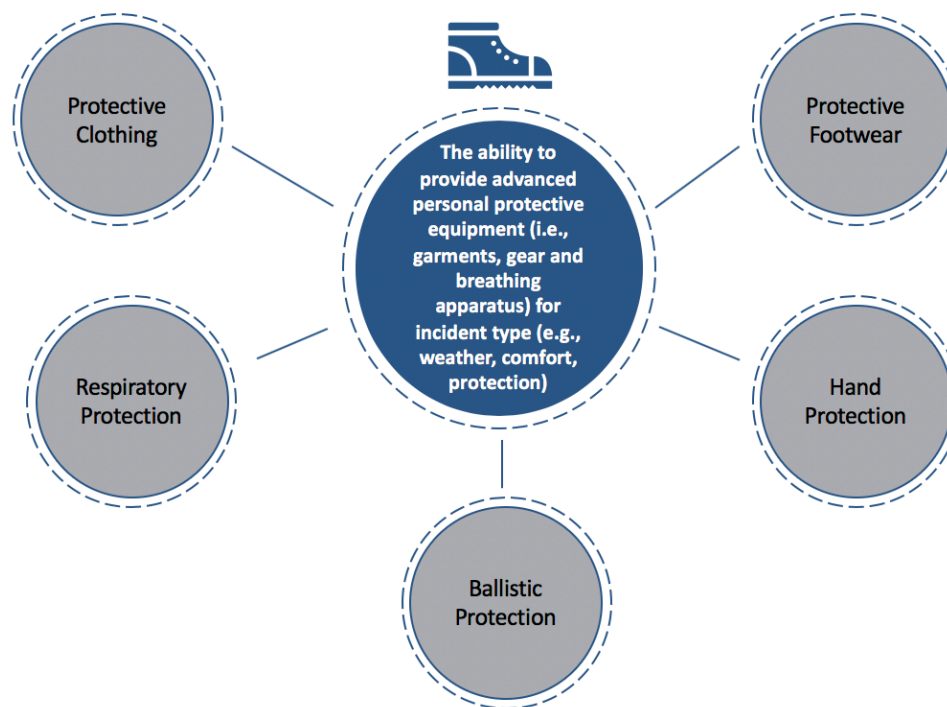
Summary

In summary, the primary market identified to represent this capability gap is relatively large and growing. This growth in and of itself presents a great opportunity for new solutions to enter the market. When examining 76 existing solutions and three developing solutions in this assessment, none fulfilled all of the objectives for this gap. Therefore, any solutions that address these target objectives as well as incorporate more durable materials and increase functionality in extreme conditions.

Market Overview

Capability Gap 10 is **the ability to provide appropriate and advanced personal protective equipment**. This gap is largely focused on responders having the protective equipment they need to safely perform their duties.

Market Segmentation



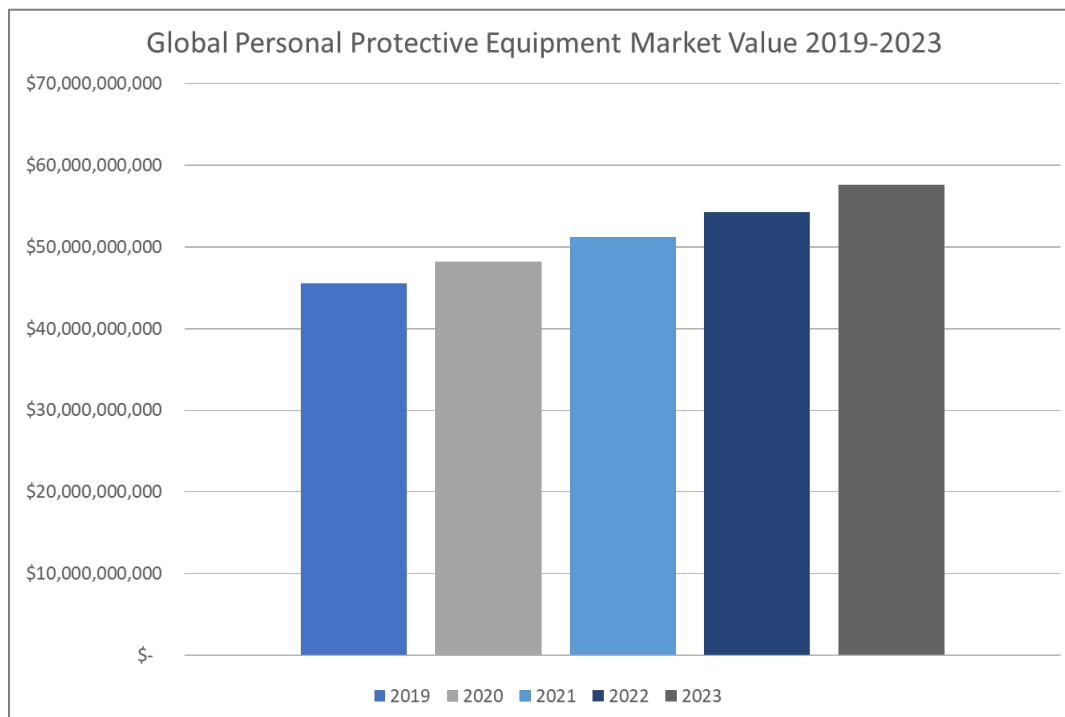
The **Global Personal Protective Equipment Market** was used to quantify market figures for this capability need. This market includes protective clothing and footwear, respiratory protection and hand protection, among other segments.

Capability Gap 10 – The ability to provide appropriate and advanced personal protective equipment

Responders would like protective garments that are appropriate for their mission. Ideally, the duty uniform should help protect responders against the most likely threats encountered, including fire, blood-borne pathogens, extreme weather and projectiles. Mission-specific garments should provide varying levels of protection as needed, but with enhanced comfort and wearability. All garments should accommodate differences in gender and body size. Some military and commercial systems use a modular concept that allows the user to customize their level of protection to meet the specific incident or threat. Application of the modular concept has been suggested as a potential solution for emergency responders. Potential solutions that reduce the weight strain of PPE would be beneficial.

A myriad of personal protection equipment solutions currently exist within the market. However, not one of these solutions appears to meet all of responders' target objectives, which include garments that protect responders against the most likely threats encountered, including fire, blood-borne pathogens, extreme weather and projectiles; garments that increase the comfort, breathability, and durability of PPE; and respiratory protection that is light-weight, longer-duration, and low-profile.

The Global Personal Protective Equipment Market is used to define, quantify and assess the various types of solutions available. This market is worth more than \$40 billion USD in 2017 and is projected to grow at a Compound Annual Growth Rate (CAGR) of 6.1% through 2023. This equates to a market value of more than \$57 billion USD in 2023.




Market Figures

The following table presents the estimated revenue figures for the various sub-markets identified for the Capability Gap 10 market. The colored row represents the primary market used to quantify this gap in this study.

Disclaimer

Note, all figures have been rounded to the nearest hundred thousand. The market forecast period examined is 2019 to 2023. When a market value was not available, it was estimated using the corresponding CAGR given over the forecast period to represent growth or decline. For consistency, data that fell outside of the forecast period has been extrapolated, as denoted by an asterisk (*). A more detailed explanation of how the extrapolated figures were estimated can be found in Appendix C of this report.

Personal Protective Equipment

	Revenue by Year (in \$1,000,000 USD)					CAGR
	2019	2020	2021	2022	2023	
Global Personal Protective Equipment Market ³	\$45,470.3	\$48,239.4	\$51,177.1	\$54,293.6	\$57,600.0	6.1%
Global Protective Clothing Market ⁴	\$8,800.0	\$9,347.5	\$9,929.1	\$10,546.8	\$11,203.0	6.2%
Global Respiratory Protective Equipment Market ⁵	\$6,634.0	\$7,098.4	\$7,595.3	\$8,126.9	\$8,695.8	7.0%
Global Ballistic Protection Market ⁶	\$1,785.8	\$1,876.0	\$1,970.7	\$2,070.3	\$2,174.8	5.1%
Global Personal Protective Gloves Market ⁷	\$9,638.9	\$10,151.5	\$10,691.4	\$11,260.0	\$11,858.8*	5.5%
Global Protective Footwear Market ⁸	\$4,232.2	\$4,532.2	\$4,853.4	\$5,197.5	\$5,565.8	7.5%

Market Highlights



The ability to provide advanced personal protective equipment (i.e., garments, gear, and breathing apparatus) for incident type (e.g. weather, comfort, protection) describes the need to shield first responders from injury while operating in hazardous environments and provide the highest level of protection against a range of possible threats.

Advanced
Personal
Protective
Equipment
(PPE)

Current Capability:

Current solutions related to PPE for first responders for focused on traditional design. A growing number of solutions are being developed using newly improved and more durable materials. There is limited ability to obtain PPE that is fully functional in all potentially extreme environments.

Market Quantification

Market Size (2019):	\$45,470.3 million	Compound Annual Growth Rate (2016-2023):	6.1%
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Competitive Landscape

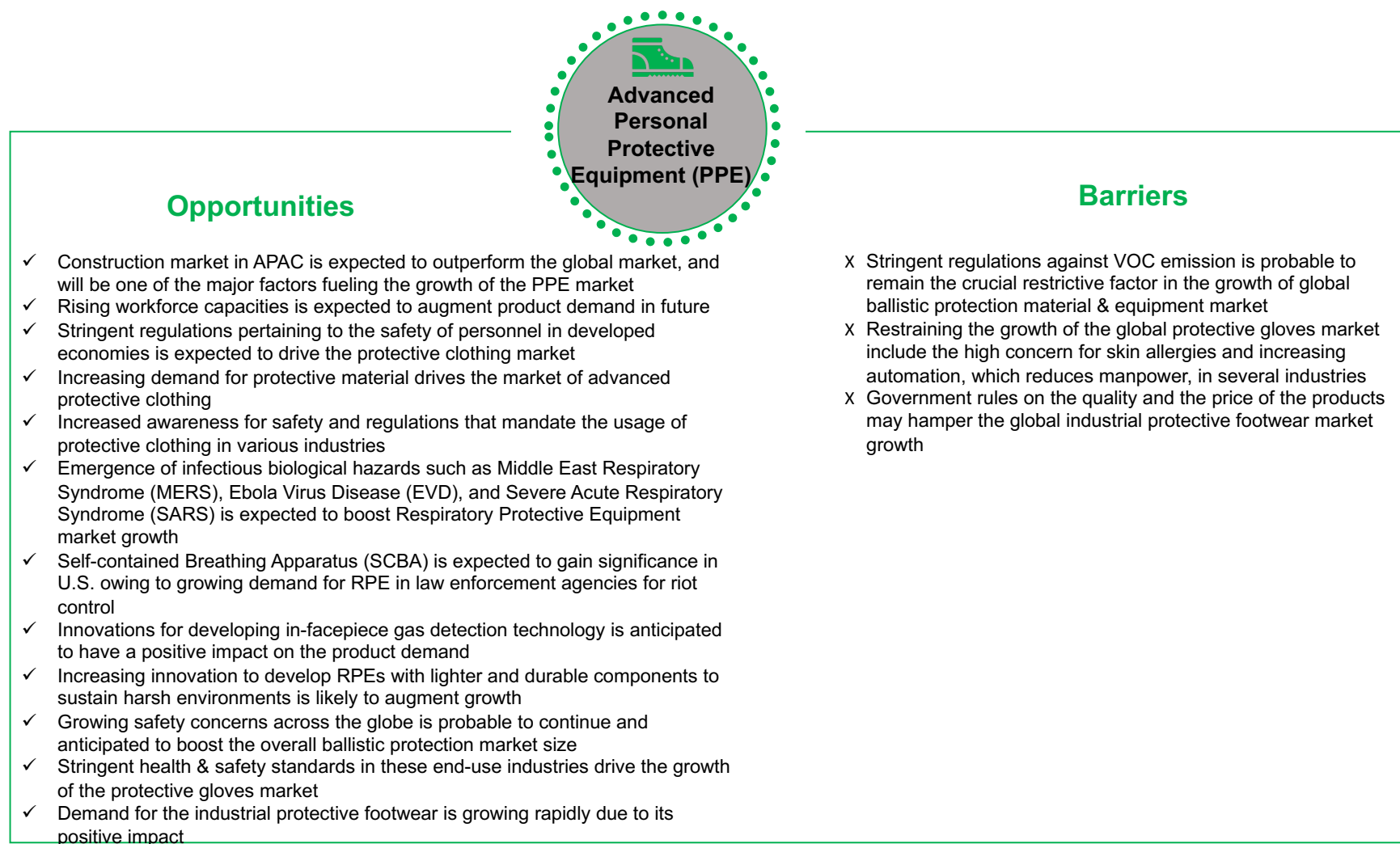
Number of Firms:	37	Number of Responder-Specific Solutions:	75
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Market Phase

GROWTH

Market Factors

The figure below summarizes the market factors associated with the collection, integration, and validation of data from multiple sources.



Competitive Landscape

A total of 37 firms were identified as operating in the markets listed above, 7 of which are considered key global market players, including:

- Honeywell (United States)
- 3M (United States)
- DuPont (United States)
- MSA Safety (United States)
- Ansell (United States)
- Dräger (Germany)
- Kimberly-Clark (United Kingdom)

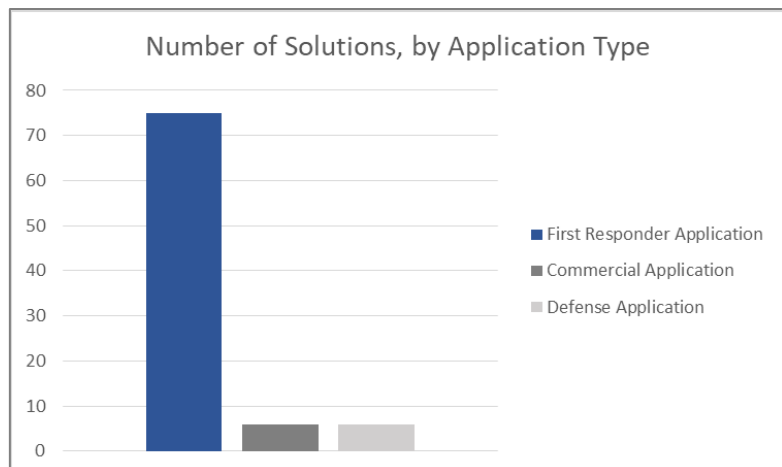
Within this study there are a total of 76 existing solutions and three research and development (R&D) initiatives with relevance to Capability Gap 10 identified. This landscape is non-exhaustive, as the number of solutions is vast and ever-changing at a rapid pace.

Among the existing and developing solutions identified, 75 solutions (99 percent) appear to have first responder applications and three solutions (100 percent) appear to be in development for first responder use. These numbers may indicate that industry is aware that a first responder need exists within this technology space. However, when examining how existing solutions meet responders' needs related to this capability gap, it does not appear that any existing solution meets all of responders' target objectives. These objectives include:

1. Garments that protect responders against the most likely threats encountered, including fire, blood-borne pathogens, extreme weather and projectiles;
2. Garments that increase the comfort, breathability, and durability of PPE ; and
3. Respiratory protection that is light-weight, longer-duration, and low-profile.

It appears that the greatest gap exists in the incorporation of more durable materials and increased functionality in extreme conditions. Most of the existing solutions are focused on traditional designs.

While the greatest number of existing solutions (75) identified in this assessment appear to have first responder applications, six solutions have commercial applications and six have defense applications.

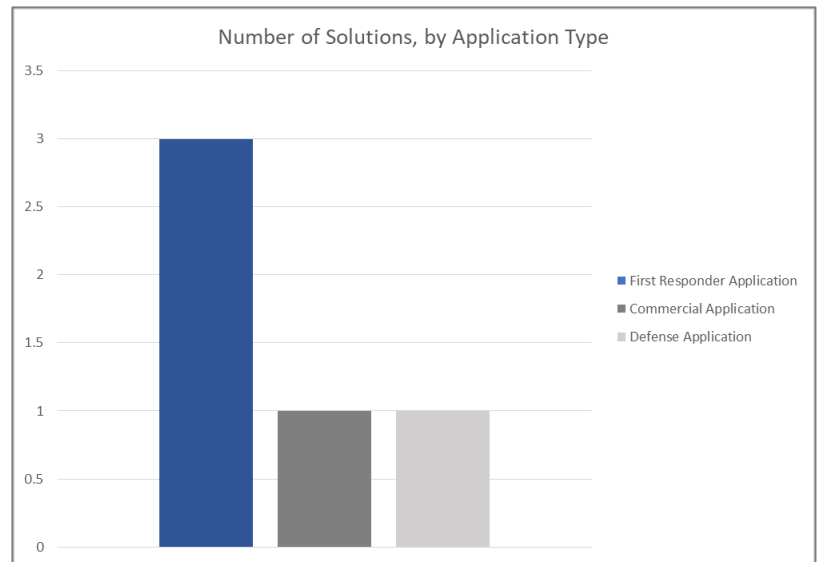


There is also a total of three R&D initiatives related to Capability Gap 10 identified in this assessment. Among the developing solutions identified, industry is involved in the development of three solutions, academia is not involved, and government is involved in the development of two solutions. Two developing solutions are focused on first responder applications, one is focused on commercial applications and four are focused on defense applications.

Based upon the data presented, 99 percent of all existing and developing solutions surveyed appear to be targeting first responder applications. Therefore, industry is likely aware that a first responder need exists within this technology space.

Looking more closely at these solutions, the ability of any identified existing or in development solutions would not meet all the needs of responders' target objectives cited previously. More specifically, the ability to provide fully functional PPE designed for extremely harsh environments is particularly underserved. This presents any opportunity for industry to develop solutions that can fit all of the target objectives, with a special focus on object two.

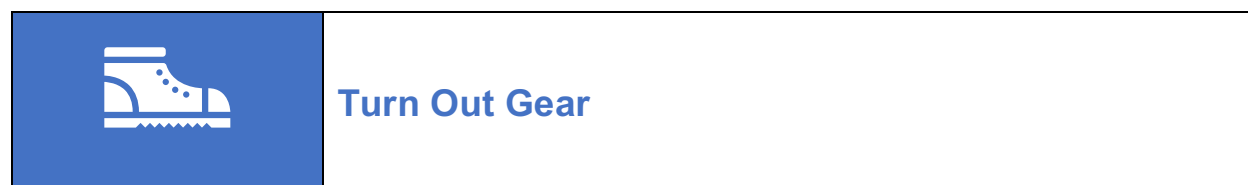
For questions or comments about the information presented in this assessment, please contact IFAFRI at info@internationalresponderforum.org.



First Responder-Specific Technology Solutions

The following section presents a selection of the first responder-specific technology solutions that align with responder requirements for this gap. The responder requirements are identified in the IFAFRI-developed Capability Gap 10 Statement of Objectives (SOO) document. None of the solutions identified during this study meet all of the requirements detailed in the SOO document. However, those presented below offer increased levels of integration or newer features than what is generally used by response agencies currently. There are a large number of potential solutions that exist or are in-development and therefore this section should not be considered exhaustive. Further, additional concepts exist in academic literature but these are not included in this study. A complete list of responder-specific technology solutions identified during this study can be found in Appendix A of this report.

The data and information provided in this section is publicly available from manufacturers' web sites. The study team did not validate product claims made by the manufacturers.



INNOTEX®

Innotex (Canada) designs and produces firefighting gear. The company develops turnout gear based on four design principles: protection without compromise, comfort, increased durability, and efficient design. Innotex merged the know-how of extreme sports and fire retardant for industrial and military use in the designing and manufacturing of apparel. The company's mission is to continuously innovate through textile. In 2001, Innotex developed the first UL® certified turnout gear.⁹

Innotex offers **INNOe4000** turn out gear. The gear is tested and certified against European Standard EN-469. This line of turn out gear is designed for high performance, noticeable comfort, and enhanced mobility. The full line of products in this line is completely customizable. Features include:¹⁰

- Inverted “L” shaped stormflap with integrated throat closure that eliminates gaps around throat
- Various styles of black Nomex® wristlets (e.g., shaped, with thumb loop, with thumb hole)
- Reinforcement available on shoulders, elbows, cuffs, knees and pockets
- Three variations of outer shell materials composed of varying combinations of Kevlar and Nomex
- Preformed multi-panel legs for improved range of motion and better fit
- Retroreflective lettering using 3M™ Scotchlite™ Reflective Material in 2” or 3” letters or numbers



Figure 1: Innotex INNOe4000 turn out gear

Globe Holding Company LLC

Globe Holding Company (United States) operates two plants that build turnout gear and one that builds footwear. These plants incorporate some of the latest manufacturing technology available and employ 425 employees in more than 130,000 square feet of manufacturing space. On July 31, 2017, Globe Holding Company, LLC was acquired by MSA Safety Incorporated. Globe and MSA serve firefighters by providing innovative, head-to-toe PPE solutions that advance innovation in firefighter performance and safety.¹¹

Globe offers the **ATHLETIX** line of turn out gear. New material technology (KOMBAT™ STRETCH PBI®/KEVLAR®) enables athletic design with stretch fabrics that allow closer, body-contoured fit to provide expanded range of motion with less bulk, more flexibility, and lighter weight. Features of the ATHLETIX line include:¹²

- Less bulky, softer, and more adjustable collar
- Drag rescue device (DRD) opening in the collar that can be tucked away when not in use
- Stretch panels
- Elasticized side panels
- Articulated elbows
- Overlapping front closure with optional Zippergripper™
- Telescoping sleeve band with double wristers
- Liner access opening to allow access between layers



Figure 2: Globe ATHLETIX turn out gear

VIKING

VIKING (Denmark) was founded in 1960 and is a privately held market leader in maritime and fire safety. VIKING supplies and services a wide range of essential safety equipment and solutions for passenger carrying and commercial vessels, offshore installations, the defense sector, leisure yachts, fishing vessels, and firefighting. Products are manufactured in Denmark, USA, Norway, Bulgaria, Thailand, China and Greece.¹³

VIKING offers **MACS** turn out gear. All VIKING turn out suits meet international quality standards and requirements, such as EN469 and NFPA 1971. VIKING fire suits are engineered to offer optimum protection and energy conservation. A key feature of the MACS range of turnout gear is that the firefighter coat features a detachable outer shell, designed to protect firefighters and their surroundings from exposure to carcinogens and other dangerous particles. After a fire and before entering the fire truck, the outer shell can be removed and placed in a dissolvable washing bag. The inner liner will continue to protect you against the elements and



Figure 3: VIKING MACS turnout gear

even against the most common chemicals and dangerous fluids. Other features include:¹⁴

- Military-inspired system of webbed loops that can be used to attach modular pouches, pockets or other equipment
- Ergonomic pre-bent elbows and knees
- Detachable internal kneepads
- Removable under-boot straps

Rosenbauer Group

The Rosenbauer Group (Austria) is one of the world's three largest manufacturers of fire-service vehicles and firefighting equipment. Rosenbauer supplies the fire-fighting sector in over 100 countries with a wide range of custom fire and rescue apparatus and services. The company develops and produces vehicles, fire extinguishing systems, equipment and telematics solutions for professional, industrial, plant and volunteer fire services, and systems for preventive firefighting.¹⁵

Rosenbauer offers **Fire Flex**. Fire Flex is certified according to EN 469, EN 1149-5, EN 61482-2, EN 343 and EN 14360. The suit is designed to fit like a second skin and offer comprehensive armor-like protection. Features include:¹⁶

- Ergocut design guarantees a high degree of agility
- Improved sleeve cuts and a special shoulder-arm construction for improved mobility
- Reflective stripes offer freedom of movement combined with high breathability
- Due to the absence of seams, there is no abrasion load on the material
- Robust absorption barriers at all critical points prevent moisture from penetrating through to the inside of the protective suit



Figure 4: Rosenbauer Fire Flex



Self-Contained Breathing Apparatus (SCBA)

MSA Safety Incorporated

MSA Safety Incorporated (United States) is a leader in the development, manufacture and supply of safety products that protect people and facility infrastructures. The company's comprehensive product line is used in a broad range of markets, including the oil, gas and petrochemical industry, fire service, construction industry, mining, and the military. MSA's core products include self-contained breathing apparatus, fixed gas and flame detection systems, portable gas detection instruments, industrial head protection products, fire and rescue helmets, and fall protection devices.¹⁷

MSA offers the **G1 5500 SCBA**. The G1 5500 is MSA's lowest profile, streamlined and balanced SCBA. The SCBA can be configured with the lightest weight cylinders on the market today, reducing stress and fatigue while increasing maneuverability in confined spaces. The G1 5500 accommodates 30-, 45-, or 60-minute duration cylinders which allows the user to keep the same operating system, while reducing additional training time and overall expenses. Features include:¹⁸

- Faceplate- open port design with cross-contamination protection, low breathing resistance on and off air, and zero electronics thus reducing weight
- Control- integrated Thermal Imaging Camera (TIC) allows firefighter to see within dark, smoke-filled environments, improved visibility through buddy lights, and display automatically turns on when control module is lifted into viewing position
- Situational Awareness- seven three-stage buddy lights providing 360-degree visibility of pressure status
- Information- heads up display can be customized to meet user needs; provides cylinder pressure, battery status, and evacuation (optional)
- Communications- intelligently removes background and inhalation noise, helping commands to be heard



Figure 5: MSA G1 5500 SCBA

Dräger

Dräger (Germany) is an international leader in medical and safety technology and has been operating since 1889. The company's products are used in clinical, industrial and mining applications, as well as in firefighting or rescue services.¹⁹

Dräger offers **PSS 7000 SCBA with Sentinel 7000**.

The PSS 7000 carrying systems built for extended wear and frequent use. Key features include: Aramid-blend webbing for long-lasting wear; compression-molded comfort padding for high-temperature performance and wear resistance; vulcanized chloroprene rubber for a high-grip, anti-slide outer surface that keeps the harness securely in position; cooling channels in shoulder and waist pads to reduce the likelihood of compression burns; first-stage reducer snap-fit connection for fast and easy fitting and removal of pneumatics; and supply hoses that are neatly integrated into the backplate to minimize the risk of snagging and damage. Each Dräger SCBA can be outfitted with a monitoring system that features: PASS device; visual and audible warnings and alarms; streamlined design that reduces snag points; configurable settings to suit individual preferences; and data logging for improved post-incident analysis. The full face mask key features include: a polycarbonate visor with anti-scratch coating; one-way valve that distributes air evenly over the visor to prevent fogging and cross-contamination; and mechanical speech diaphragm for sound clarity. Dräger's line of cylinders are made of aircraft-grade materials and fabricated by processes that exceed industry norms. These easy-to-use cylinders provide a number of benefits including: extended durability, chemical and corrosion resistance, increased strength, flame resistance, and low weight.²⁰



Dräger
Dräger. Technology for Life®



Figure 6: Dräger PSS 7000 SCBA

LALIZAS

LALIZAS (Greece) manufactures and distributes products related to marine accessories, safety equipment, ship suppliers, chandleries, marine stores, shipyards and boat builders. Products include: immersion suits, lifejackets, safety harnesses, inflatable boats, hatches, switch panels, compasses, navigation lights, bilge pumps, canopies, ladders, paddles, boathooks, blocks, cleats, fenders, clothing, binoculars, boat covers, rulers, IMO signs and many other marine products.²¹

LALIZAS offers **SOLAS/MED SCBA**. The SOLAS/MED is an industrial breathing apparatus, designed to offer maximum respiratory protection to the user during entrance or escape from a hazardous environment. Key features are:²²

- Open circuit on demand positive pressure SCBA
- Anatomic carbon fibers composite material back frame with harness for easy donning
- Both back frame and harness are flame retardant, waterproof and antistatic
- Warning whistle providing a continuous sound of high intensity (>90Db) warning the user that the air is dropping down.



Figure 7: LALIZAS SOLAS/MED SCBA



Respirators and Escape Hoods

3M Scott Fire and Safety

3M Scott Fire and Safety (United States) is a manufacturer of respiratory and personal protective equipment and safety devices for firefighters, industrial workers, police squads, militaries, homeland security forces, and rescue teams around the world. 3M Scott products are designed to protect from environmental hazards including smoke, toxic fumes, combustible gases, falling objects, and contaminants. The product line includes self-contained breathing apparatus (SCBA), supplied air and air-purifying respirators, PPE, gas and flame detection instruments, thermal imaging cameras, and firefighter communications and accountability devices.²³

3M Scott offers the **First Responder Respirator (FRR)**. The FRR is approvable to worldwide regulatory standards and has filled capability requirements for chemical, biological, radiological, and nuclear (CBRN) individual respirator protection. The Scott FRR offers a certified respiratory protection system designed for use with CBRN and industrial chemical filters with threaded connections and offers several levels of operational flexibility. Features include:

- Compatible with all military, law enforcement and industrial DIN 40mm threaded filters able to be mounted on either side of mask
- Low breathing resistances
- Manufactured from chemically hardened materials that have proven comfort characteristics for 24 hour wearing
- Flexible, hard coated lens providing a wide field of view and impact protection in excess of EN166, Class 1 requirements
- Vision correction capability that includes the use of progressive (vari-focal) lenses
- Re-breathed CO₂ levels significantly below 1%



Figure 8: 3M Scott FRR

AVON Protection

Avon Protection (United States) is a leader in Respiratory Protective Equipment (RPE) providing solutions for air, land and sea-based personnel in military, law enforcement, and first responder communities. The company's experience in designing and manufacturing respirators has makes Avon a specialist and provider of general personal respiratory protection solutions for a wide range of CBRN applications.²⁴

AVON offers the **EZAIR Powered Air Purified Respirator**. Avon EZAIR is a single filter airflow system that is much smaller and lighter than traditional powered air units. The EZAIR is the first CBRN air-system that delivers the benefits of a traditional Powered Air Device in a more compact and integrated system. The respirator's continuous fresh airflow helps relieve the burden of heavy breathing enabling responders to easily communicate and reduce fatigue. Features include:²⁵

- Increased operational time of up to eight hours with hot swap ability for rapid exchange of battery
- Intelligent control systems that adjust to filter type, alert to low battery and low flow
- Optimized integration allows for secure mounting to other protective equipment
- Use of novel materials such as military grade plastics



Figure 9: AVON EZAIR

AVON offers the **NH15 Combo Escape Hood**. The NH15 Combo is a carbon monoxide (CO) resistant, super compact CBRN escape hood. The NH15 Combo offers respiratory protection for escape from hazardous environments, particularly when dangerously high levels of CO are present. The NH15 Combo hood has a five year shelf life and provides a high level of respiratory, eye and face protection for a minimum of fifteen minutes. Its low cost makes it ideal for police, emergency medical services, and firefighters seeking immediate or emergency respiratory protection in a CBRN or CO scenario. The clear material aids with recognition of the wearer and also allows for superior visual communication. Twin low-profile filters feature a filtration media which reduces breathing resistance and a front reflector makes it easier to identify colleagues in low light environments.²⁶



Figure 10: AVON NH15 Combo



Boots

LION Protection

LION Protection (United States) is a technology company devoted to utilizing smart technology to develop life-saving products. The company's mission is to apply cutting-edge technology to improve the life-safety conditions of the global workforce. LION is the largest provider of training equipment and facilities for first responders, having built the three of largest first responder training facilities in the world.²⁷

LION offers **HELLFIRE Kevlar Insulated Boots**. HELLFIRE boots offer protection and comfort in rubber insulated structural bunker boots with a flame- and heat-resisting lug outsole. A stainless steel puncture-resistant bottom plate provides a barrier between the foot and ground. An oversized steel toe and a Kevlar® yellow knit one piece liner as well as cushioned shin guards provide comfort. Vulcanized construction guarantees a durable, shock-absorbing fit that does not melt or degrade in extreme heat or cold. The removable superknit-covered polyurethane insole absorbs shocks. And finally, these boots are National Fire Protection Association (NFPA) 1971 and 1992 approved.



Figure 11: LION HELLFIRE Boot

Rosenbauer Group

The Rosenbauer Group (Austria) is one of the world's three largest manufacturers of fire-service vehicles and firefighting equipment. Rosenbauer supplies the fire-fighting sector in over 100 countries with a wide range of custom fire and rescue apparatus and services. The company develops and produces vehicles, fire extinguishing systems, equipment and telematics solutions for professional, industrial, plant and volunteer fire services, and systems for preventive firefighting.²⁸

Rosenbauer offers the **Twister Boot**. These boots are certified according to EN 15090:2012 F2A HI3 CI AN SRC and AS / NZS 4821:2006. Features include:²⁹

- Fitted with the BOA® lacing system which allows for quick and easy doffing and donning
- With Sympatex® membrane and the hydrophobic waterproof leather make the boot largely waterproof
- 4 Flex zones for more freedom of movement, even when crawling, kneeling and driving
- Ankle protection as well as steel inserts and steel toe caps protect the foot from injuries



Figure 12: Rosenbauer Twister Boot

- Reflective elements in the visible area offer maximum visibility, even in combination with overpants
- Multi-layer sole design with airbags between provides cold and heat insulation

Globe Holding Company LLC

Globe Holding Company (United States) operates two plants that build turnout gear and one that builds footwear. These plants incorporate some of the latest manufacturing technology available and employ 425 employees in more than 130,000 square feet of manufacturing space. On July 31, 2017, Globe Holding Company, LLC was acquired by MSA Safety Incorporated. Globe and MSA serve firefighters by providing innovative, head-to-toe PPE solutions that advance innovation in firefighter performance and safety.³⁰

Globe offers the **SUPRAFLEX** boot. These boots are designed with continuous segmented flex panels make them feel like a pair of athletic shoes. Recessed pull-on handles are inset on the sides and hidden when not needed. Flexible NOMEX® webbing carry loops allow easy carrying when installed in turnout pants. These boots are certified to NFPA 1971 and 1992. Additional features include:³¹

- DRAGONHIDE® Fabric
- Flame-Resistant, Water-Resistant Leather
- KEVLAR® Blend Protective Shield
- Padded Shin Guard
- Composite Safety Toe Cap
- Dual Density Enhanced 3D Removable Footbed System
- Composite Puncture Protection
- Slip-Resistant Tread



Figure 13: Globe SUPRAFLEX Boot



Gloves

LION Protection

LION Protection (United States) is a technology company devoted to utilizing smart technology to develop life-saving products. The company's mission is to apply cutting-edge technology to improve the life-safety conditions of the global workforce. LION is the largest provider of training equipment and facilities for first responders, having built the three of largest first responder training facilities in the world.³²

LION offers **Structural Protective Gloves**. These gloves are available in a wide range of sizes and are designed to interface with turnout for better comfort and protection. Gloves are NFPA 1971-certified. Each structural protective glove model is field-tested. Additional features include:³³

- Knuckle padding Lite-N-Dri™ to increase thermal and impact protection in high-heat and high-abrasion areas on the back of hand
- A combination of CROSSTECH® insert and Kovenex® lining for lightweight, flexible and comfortable liquid and thermal protection



Figure 14: LION Structural Gloves

Pro-Tech 8

TechTrade LLC (United States) is the holding company for Pro-Tech 8 Gloves. Pro-Tech 8 was started in 2003 after seeing a need to improve personal protective equipment and bring to the market new 21st century global innovations. Pro-Tech 8 strives to combine technology with performance. The Pro-Tech 8 design and manufacturing teams work collaboratively to choose materials, create designs and develop innovative products that provide safety and confidence.³⁴

Pro-Tech 8 offers **TPR GOLD** Structural Firefighting Glove. TPR Gold gloves are certified compliant to NFPA 1971-2018 and feature an NFPA 1971-2018 compliant Porelle PTFE moisture barrier. The glove's moisture barrier provides chemical and viral protection while keeping hands dry and maintaining breathability. The cut-level 8, fire retardant TPR knuckle guard, as well as the multi-layer design using Kevlar and Nomex, provides maximum protection, durability, flexibility and comfort. The TPR Gold is made from 100% water-resistant, fire-retardant treated goatskin. The glove is available with a convertible cuff/debris blocker that extends the glove body for protection at the vulnerable glove-sleeve interface.³⁵



Figure 15: Pro-Tech 8 TPR Gold Glove

INNOTEX®

Innotex (Canada) designs and produces firefighting gear. The company develops turnout gear based on four design principles: protection without compromise, comfort, increased durability, and efficient design. Innotex merged the know-how of extreme sports and fire retardant for industrial

and military use in the designing and manufacturing of apparel. The company's mission is to continuously innovate through textile. In 2001, Innotex developed the first UL® certified turnout gear.³⁶

Innotex offers **INNOTEX880S™ 3D** gloves. These gloves are NFPA 1971 certified. The glove is styled with complete fourchettes on all sides of each finger and thumb. The Kangaroo shell is lightweight and touch providing increased dexterity, cut resistance, secure grip, and minimal water absorption. The NOMEX/KEVLAR thermal lining provides heat and slash protection.



*Figure 16: Innotex880S
3D Gloves*



Station Wear

LION Protection

LION Protection (United States) is a technology company devoted to utilizing smart technology to develop life-saving products. The company's mission is to apply cutting-edge technology to improve the life-safety conditions of the global workforce. LION is the largest provider of training equipment and facilities for first responders, having built the three of largest first responder training facilities in the world.³⁷

LION offers **StationWear**. StationWear is engineered for easy care and maintenance. The full line is available in traditional uniform colors and a variety of materials. The StationWear line features:³⁸

- Professional designs with features that facilitate job performance
- Durable construction and reinforcements that meet the challenges the job
- Moisture-wicking fabrics that transport sweat away from the body and toward the bunker gear's breathable moisture barrier
- Lifetime warranty to be free from defects in material and workmanship
- NFPA 1975 Compliance



Figure 17: LION StationWear

Lion offers the **TR51 Rescue Coat and Pants**. TR51 is offered in male and female models certified to both NFPA 1999 and 1951 (can use it for EMS duty and urban search and rescue (USAR) tasks). The NOMEX outer shell is tough and durable (NOMEX IIIA Ripstop, PBI TriGuard, and Tencate Millenia SR outer shell options available). Reflective trim is 3M Scotchlite Reflective Material with three inch NFPA-style (red-orange/silver or lime-yellow/silver options). The CROSSTECH SR liner provides liquid penetration resistance to water, blood and bodily fluids. The coat and pant have adjustable features for a more personalized fit.³⁹



Figure 18: LION TR51

Blauer Manufacturing Company

Blauer (United States) has set the standard for public safety apparel in the United States through continuous innovation in materials, design, and engineering, as well as working closely with those who use their products in the field. The company offers a full suite of offerings from apparel, footwear, outerwear, accessories, and more (including high-performance, breathable CBRNE/HAZMAT ensembles). Blauer Manufacturing was founded in 1936 as a contract sewing company garments for department stores in the Boston area.⁴⁰

Blauer offers the **Performance Polo Shirt**. This is a quick dry long sleeve polo shirt with a colorblock design with reflective piping and accents that increases visibility during the day and at night. Features of this shirt include:

- Lightweight, moisture wicking polyester and mesh inserts combine to ensure breathability and long-lasting comfort
- Anti-microbial technology prevents odor formation
- Loose athletic cut with stretch materials for full range of motion
- Long shirt tails stay tucked during active wear



Figure 19: Blauer Performance Polo Shirt

GALLS

Galls (United States) is a source for public safety equipment and uniforms. The company services the needs of law enforcement, military, security, fire, EMS, postal, public transportation and more.⁴¹

Galls offers **Ripstop BDU Pants**. The 6-pocket BDU Pants are constructed to mil-spec MIL-T- 44047E standards with 65/35% Poly/Cotton Ripstop fabric. A button fly eliminates zipper failure during dynamic operations. Knees and seat are reinforced for long-lasting durability. These BDU Pants feature adjustable waist tabs for better fit and comfort. Pants have a drawstring bottom for blousing into duty boots.⁴²



Figure 20: Galls BDUs



Body Armor

ARMOR EXPRESS

Armor Express (United States) is one of the leading designers, manufacturers and suppliers of life-saving, protective solutions. The company began provides service products to the U.S. Military, Federal Law Enforcement, First Responders, and Corrections professionals globally. Through the company's manufacturing facility, Ballistics Research Laboratory, and R&D Design Armor Express designs concealable, overt and tactical carriers, National Institute of Justice (NIJ) and 'Quad-Compliant' ballistic armor packages and hard armor products (helmets, plates and shields).⁴³

Armor Express offers **FMS**. FMS™ is a cost effective body armor system that meets Department of Defense Frag Protection specifications. The armor offers level II and IIIA NIJ 0101.06 ballistic protection. The FMS IIIA is the primary armor system trusted by the US Army Military Police. The soft armor comes protected in a seam-sealed ripstop pad cover. Each configuration is certified to the National Institute of Justice (NIJ) Standards. FMS comes in male and structured female options.⁴⁴



Figure 21: Armor Express FMS

Amor Express offers **Gemini**. Gemini is a dual purpose body armor for providing ballistic and spike protection. The armor is a versatile performer and comfortable to wear. The soft armor comes protected in a seam-sealed ripstop pad cover. Each configuration is certified to NIJ Standards, as well as vigorously tested in-house at our Ballistic Research Laboratory (BRL). Gemini is only offered in a gender neutral option.⁴⁵

DFNDR Armor

DFNDR Armor (United States) has been developing armor lightweight armor systems for over a decade for the US military. The company designs solution for today's modern threats including handguns and rifles.⁴⁶

DFNDR offers **BODY ARMOR + QRC** package. The package allows the user to choose a set of DFNDR Armor® plates along with the DFNDR Quick Release Carrier. Additionally, the user gets to choose between Small Arms Protective Insert (SAPI) Cut or Shooters Cut options. The package comes with a five year warranty. The complete system includes:⁴⁷

- 1 Front Plate Pocket
- 1 Rear Plate Pocket
- 2 Waistband Sides
- 2 Tri-Fold Shoulder Strap Covers w/ Velcro One-Wrap Loops



Figure 22:DFNDR Armor Package

-
- 2 Detachable QRC MOLLE Front Panels
 - 2 Duraflex Quick Attach MOLLE Web Mount Female Buckles
 - 2 Duraflex Quick Attach Male Buckles



Ballistic Vests

GALLS

Galls (United States) is a source for public safety equipment and uniforms. The company services the needs of law enforcement, military, security, fire, EMS, postal, public transportation and more.⁴⁸

Galls offers **ACTIVE SHOOTER BODY ARMOR KIT**.

This body armor kit is worn over the uniform to quickly provide added protection during critical situations. The kit includes two Paraclete Triple Curve Level IV Rifle Plates, providing stand-alone protection against rifle rounds up to and including .30-06 AP. The 5ive Star Gear Bodyguard Plate Carrier features front and back internal sleeves soft armor and plates. The kit is engineered with a triple curve design, giving maneuverability and comfort. The vest is level IV protection meets NIJ-Standard-0101.04 Additional features include:⁴⁹

- Front map/document pocket
- Hook and loop on front and back for identification patches
- Emergency drag handle



Figure 23: Galls Active Shooter Body Armor

ARMOR EXPRESS

Armor Express (United States) is one of the leading designers, manufacturers and suppliers of life-saving, protective solutions. The company began provides service products to the U.S. Military, Federal Law Enforcement, First Responders, and Corrections professionals globally. Through the company's manufacturing facility, Ballistics Research Laboratory, and R&D Design Armor Express designs concealable, overt and tactical carriers, National Institute of Justice (NIJ) and 'Quad-Compliant' ballistic armor packages and hard armor products (helmets, plates and shields).⁵⁰

Armor Express offers the **FEARLESS PC MOLLE**. The MOLLE offers many of the core features of the Fearless PC in a more cost-effective build. The spacer mesh lining improves comfort, and the Dynamic Cummerbund can be out fitted with optional soft armor inserts for added side protection. MOLLE features include:

- Front and Back ID placard attachment points
- Reinforced drag handle
- Adjustable Shoulder Straps
- Bottom loading front and back rifle plate pockets
- Accepts plate backers



Figure 24: Armor Express MOLLE

Angel Armor

Angel Armor (United States) was founded in 2013 out of passion for law enforcement. The company has a vision to bring cutting edge, innovative products to law enforcement through new product lines.⁵¹

Angel Armor offers **RISE 2.0 Armor System**. RISE 2.0 was designed for external or concealable use. The system is NIJ 0101.06 certified. The technology developed for the RISE 2.0 provides a lightweight, comfortable system designed for all-day rifle protection. The ballistic suspension system provides weight distribution for maximum agility. The RISE 2.0 vest provides a moisture wicking, antimicrobial inner lining for evaporative cooling and odor management. Two ballistic package options provide either NIJ Level II or IIIA protection



Figure 25: Angel Armor RISE 2.0



Wildland Fire Equipment

CrewBoss

CrewBoss was formed in 1988 in response to western wildfires, where grueling conditions call for gear that could stand up to thick brush and intense heat for weeks on end. The company provides quality protective clothing with well-known toughness and increased levels of comfort.⁵²

CrewBoss offers **CrewBoss Interface Brush Pants - Advance Kevlar**. This line of protective clothing offers a list of standard features built into a garment with an emphasis on form, function and fit. The brush pants offer freedom of movement and cool comfort with a full cut. The brush pants feature Nomex zipper fly with snap closure, Nomex zippered side pass through pockets, double fabric knees, and two inch elastic backband. Pants have Nomex zippered leg openings for easy on and off, and hook and loop cuff closures for a tight fit around the boot. The pants come standard with 3M Scotchlite Triple Trim around the calves. Certified to NFPA 1977 Standard on Protective Clothing and Equipment for Wildland Fire Fighting.⁵³



Figure 26: CrewBoss Brush Pants

PGI Inc.

PGI, Inc. (United States) is a manufacturer of flame resistant and protective clothing for the Fire Fighting, Electric Arc, Gas, Utilities, Forestry, and Food Service Markets. PGI has been in product development for the protective clothing industry for over 70 years. The PGI line of products includes Cobra™, Cobra NextGen™ and Cobra BarriAire™ Hoods, FireLine™ and FireLine Multi Mission™ gear, and DriGuard™ FR Base Layer garments.⁵⁴

PGI offers the **FireLine Smokechaser Field Coat**. The coat features a four inch high Alpine style collar can be worn folded down to allow venting or zipped up to completely cover the neck providing additional protection from heat and flame. Seamless shoulders eliminate bulky seams and allow maximum mobility while reducing wear and seam pressure under weight of a pack harness. The radial sleeve design allows full arm movement. Articulated elbows promote freedom of movement and a more contoured fit. 3M Scotchlite Flame Resistant Retro Reflective Lime/Yellow two inch wide Triple Trim is sewn around arms, bottom and across shoulders in back. The coat meets the NFPA 1977 standard on Protective Clothing and Equipment for Wildland



Figure 27: PGI Smokechaser Coat

Fire Fighting as well as requirements for Cal-OSHA Title 8 GISO Sections 3406 (c)(1) and/or 3410(d)(1).⁵⁵

Appendix A

The following section includes tables that list the potential first responder-specific solutions, both existing and in-development, as identified in this analysis activity. It is likely that there are additional potential solutions in the market and therefore, this section should not be considered exhaustive.

All-Source Collection, Integration and Validation of Data		
Existing Solutions		
Solution	Solution Provider(s)	Country
Morning Pride TAILS First Responder Turnout Gear	Honeywell	United States
Morning Pride Proximity Gear	Honeywell	United States
Honeywell Morning Pride® Gear Shield and Heat Stress Relief Package	Honeywell	United States
Morning Pride® Dual-certified Gear	Honeywell	United States
Honeywell MED-TECH EMS 2-layer Coat and Pant	Honeywell	United States
V-Force turnout gear	LION	United States
ATHLETIX™ Jacket	Globe	United States
Darley Armor AP™	Darley	United States
KOMBAT FLEX	TenCate Fabrics	United States
INNOe4000	INNOTEX	Canada
FXR Turnouts	Fire Dex	United States
Valor	Veridian	United States
MACS Turn Out Gear	VIKING	Denmark
Lakeland Fire Premium Turnout Gear	Lakeland Industries	United States
FIRE FLEX	Rosenbauer	Austria
MSA G1 5500 SCBA	MSA	United States
PSS 7000 SCBA with Sentinel 7000 (NFPA 1981/1982 2013 Compliant)	Dräger	Germany
TITAN SCBA (NFPA 1981/1982 2013 Compliant)	Honeywell	United States
ST53 SCBA	AVON Protecton	United States
Scott Safety™ Air-Pak X3 Pro SCBA, NFPA 1981/1982 2018 Compliant	3M	United States

First Responder Respirator	Scott	United States
Avon PC50	AVON Protection	United States
EZAIR Powered Air Purified Respirator	AVON Protection	United States
NH15 Combo™	AVON Protection	United States
7800 Series Reusable Silicone Half Mask Respirator	Moldex-Metric	United States
Scott's First Responder Respirator (FRR)	3M	United States
HELLFIRE Kevlar Insulated	LION	United States
Twister Boot	Rosenbauer	Austria
FDXL100 Leather Boot	Fire Dex	United States
Wildland Tactical Firefighter Boot	Danner	United States
Black Diamond Rubber Fire Boot	Black Diamond	United States
SUPRAFLEX™ 14"	Globe	United States
StationWear	LION	United States
LONG SLEEVE COLORBLOCK PERFORMANCE POLO SHIRT	Blauer	United States
TECASAFE® STATIONWEAR	TenCate Fabrics	United States
Workrite Fire Service station wear	WorkRite	United States
GALLS 6 POCKET POLY COTTON RIPSTOP BDU PANTS	5.11	United States
5.11 TACTICAL MEN'S CARGO PDU PANTS	Harris Corporation	United States
TR51	LION	United States
LION Structural Protective Gloves	LION	United States
Protective Gloves	Rosenbauer	Austria
Shelby Pigskin Firefighting Gloves	Shelby	United States
SuperCuff Rescue Gloves	Ringers	United States
Pro-Tech 8 TPR GOLD Structural Firefighting Gloves	Pro-Tech 8	United States
INNOTEX885S™ 3D GLOVES	INNOTEX	Canada
Dex-Pro	Fire Dex	United States
Smokeshow™	Protective Industrial Products	United States
Fire Knight	Veridian	United States

GALLS ACTIVE SHOOTER BODY ARMOR KIT	Galls	United States
Point Blank Active Shooter Kit with NIJ 06 Level IV Plates	Point Blank	United States
UNITED SHIELD INTERNATIONAL GSA/TXMAS COMPLIANT LIGHTWEIGHT LEVEL IV ACTIVE SHOOTER KIT	United Shield International	United States
Rise 2.0	Angel Armor	United States
FEARLESS PC MOLLE	Armor Express	United States
OCS-UVIR	Armor Express	United States
Hardcore FE	Armor Express	United States
FMS	Armor Express	United States
Gemini	Armor Express	United States
Vortex	Armor Express	United States
TRITON UP ARMOR RIFLE PLATE	Armor Express	United States
BODY ARMOR + QRC PACKAGE	DFNDR Armor	United States
High-Vis First Response Enhanced Multi-Threat Vest Level IIIA+	Safe Life Defense	United States
Hardwire Multi-curve NIJ 0101.06 Type III plate	HardWire	United States
Hardwire® Level IIIA Ballistic Panel	HardWire	United States
BPI- FIRST RESPONDER (RTF) Rescue Task Force Vest	BullerProof It LLC	United States
V1 External EMS Carrier	SAFARILAND	United States
DAMASCUS WORLDWIDE DFX2 IMPERIAL ELITE HARD SHELL UPPER BODY PROTECTION SYSTEM	Damascus Worldwide Inc	United States
CrewBoss Wildland Clothing- CrewBoss Interface Brush Pants - Advance Kevlar	CrewBoss	United States
Dragon Slayer Wildland Clothing- Dragon Slayer Wildland Pant - Advance Kevlar/Nomex	True North	United States

Interface Clothing- Lakeland Wildland Fire Pants - Style WLSPT Nomex	Lakeland and CrewBoss	United States
CrewBoss Interface Brush Coat - Advance	CrewBoss	United States
Lakeland Wildland Fire Shirt - Style WLSHN Nomex	Lakeland and CrewBoss	United States
Wildland NFPA 5002 Proximity Gloves	Shelby	United States
Danner Flashpoint II All Leather 10" Fire Work Boots	Danner	United States

In-Development Solutions		
Solution	Solution Developer(s)	Country
Flatpack SCBA	MSA	United States
High-Flex 808 low-profile pack, AKA SCBE Slim-system	Vulcore	United States
AIRFLOW	INNOTEX	Canada

Appendix B

The following section includes notes (where applicable) regarding extrapolation methods for some of the revenue figures presented in the “Market Figures” section of this report. In addition, there are instances when the CAGR cited by a third-party data source does not equate to the market figures presented. In these cases, the CAGR as calculated based upon the market figures presented is utilized.

- Global Personal Protective Gloves Market
Market figures and a CAGR were available for the time period 2017 through 2022. A CAGR of 5.3 percent was used to estimate the revenue values for 2023.

Glossary

Compound Annual Growth Rate (CAGR)

The average annual growth rate when compounding is taken into account; its formula is as follows:

$CAGR = (FV/PV)^{(1/n)} - 1$, where FV is the future or ending value, PV is the present or starting value, and n is the number of years between PV and FV.

First Responder

Those individuals who, in the early stages of an incident, are responsible for the protection and preservation of life, property, evidence, and the environment, including fire service, law enforcement, and emergency medical services.

Project Responder 4

The fourth in a series of studies that focuses on identifying capability needs, shortfalls, and priorities for catastrophic incident response. The methodology is based upon discussions with federal, state, and local first responders, as well as technical subject matter experts.

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