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Industry Report

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The Connected Worker Revolution:

Portable Gas Detection Leading the Charge in Industrial Safety

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Introduction

Industrial IoT (internet of things) has fundamentally transformed the global economy over the past three decades, driving significant advances in manufacturing and supply chain efficiency through breakthroughs in connected programmable logic controllers (PLCs), radio frequency identification (RFID), and sensor technologies. Until recently, worker safety was often a secondary consideration, with progress limited to a handful of isolated, point-specific solutions that developed slowly and unevenly; however, the tide appears to be turning. Innovations in data collection, cloud computing, and AI are enabling a step-change for infield capabilities, including real-time monitoring, asset tracking and optimization, and worker analytics. This shift is most apparent in the portable gas detection market, where companies are delivering enhanced safety outcomes against a high bar of stringent regulatory requirements.

Based on industry commentary and recent financial results from the portable gas OEMs, we believe connected worker technology has reached an inflection point in the portable gas detection market, positioning it to capitalize on a first-mover advantage in the broader push toward a fully connected worker ecosystem. We estimate that less than 10% of the portable gas detection market has adopted connected worker software, and adoption beyond the initial wave of innovators is accelerating, with evidence of a growing ROI for customers. Technological and safety benefits include:

- ***Enhanced reactive safety.*** In a safety incident, connectivity allows affected workers to communicate their status and location to safety personnel, enabling faster, more effective emergency responses.

- ***Proactive safety additions.*** Real-time data collection and analysis empower safety personnel to preemptively identify workplace hazards, detect unsafe worker behavior, and modify workplace environments to reduce incident rates.

- ***Improved operational efficiency.*** Connected worker technology streamlines fleet management for portable gas detectors, automates compliance reporting, and reduces time spent on administrative tasks.

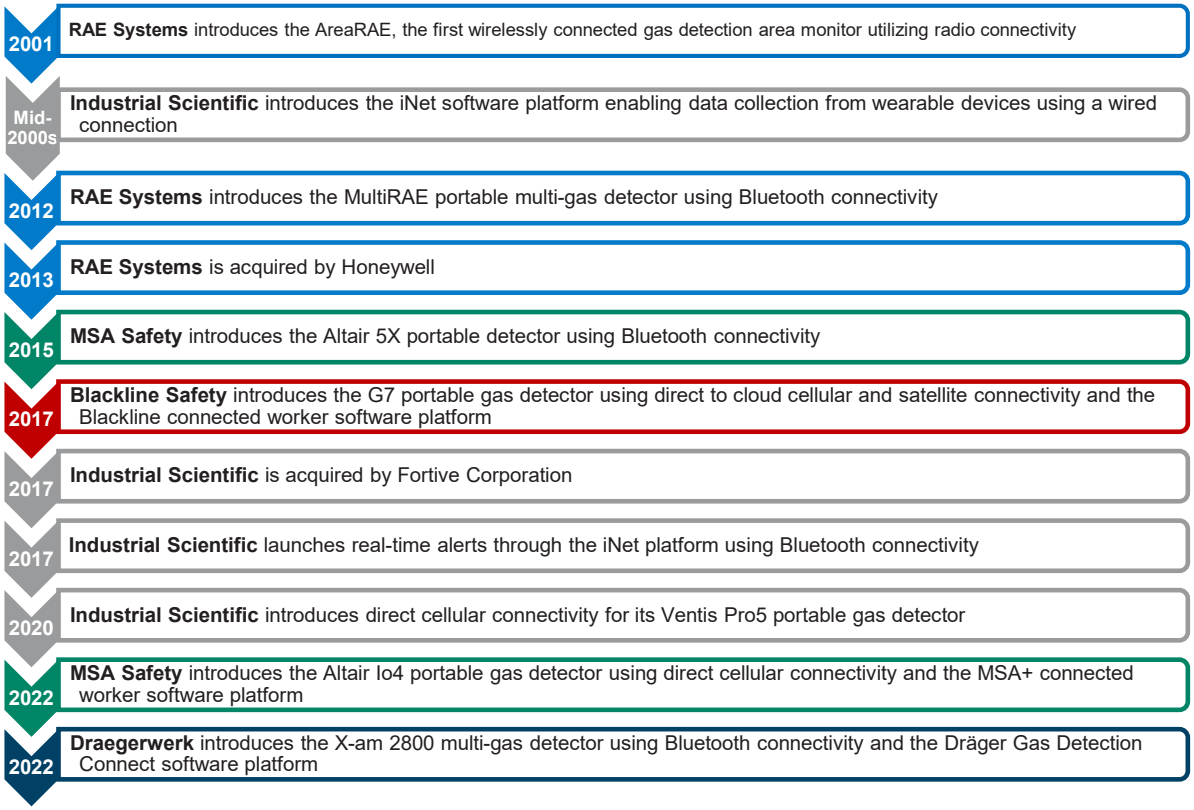
Feedback from our extensive industry discussions has been overwhelmingly positive. We highlight three key points: 1) customers recognize the technology's effectiveness; 2) they view it as a low-cost, critical solution; and 3) competitive dynamics have moved toward a "fear of missing out." This reinforces our confidence in a steep adoption curve for portable gas detection software with 50% market penetration over the next three to five years, as data analytics unlock new use-cases and expand the tangible addressable market. As this trend accelerates in the large and untapped white space for connected worker software, we believe companies that offer hardware-enabled software-as-a-service (HeSaaS) solutions will take market share from those leading with purely hardware.

In this report, we analyze the current portable gas detection hardware and software markets, trace the evolution of connected worker technology within this sector, highlight the key benefits of connectivity for worker safety applications, and assess the implications of accelerated adoption. Published alongside this report is our in-depth analysis of how these trends will benefit MSA Safety—a leading provider of worker safety equipment and connected worker software.

Connected Worker Adoption: Why Now?

Financial results and commentary from across the portable gas detection industry point to an inflection in the adoption of connected worker technology. This industry has evolved slowly over the last few decades. While major competitors developed precursor connected worker hardware and software solutions, the practical and technical limitations of these technologies impaired mass adoption. Early versions of wirelessly connected gas detection devices were introduced by RAE Systems in 2001, but the technology was costly and required a complex implementation process. In the mid-2000s, Industrial Scientific launched iNet, the market's first portable gas detection software platform, which provided data collection, compliance, and device management functionality; however, the lack of real-time connectivity was viewed as a restraining factor in the number of applications. Similarly, the introduction of Bluetooth-enabled devices from RAE Systems, MSA Safety, and Industrial Scientific had little impact on the industry, as this method of connectivity required supplementary cellular devices, which introduce additional costs and integration complexity. Ultimately, these drawbacks meant that the safety and productivity benefits provided by precursor connected worker solutions did not outweigh the cost to warrant broader market acceptance.

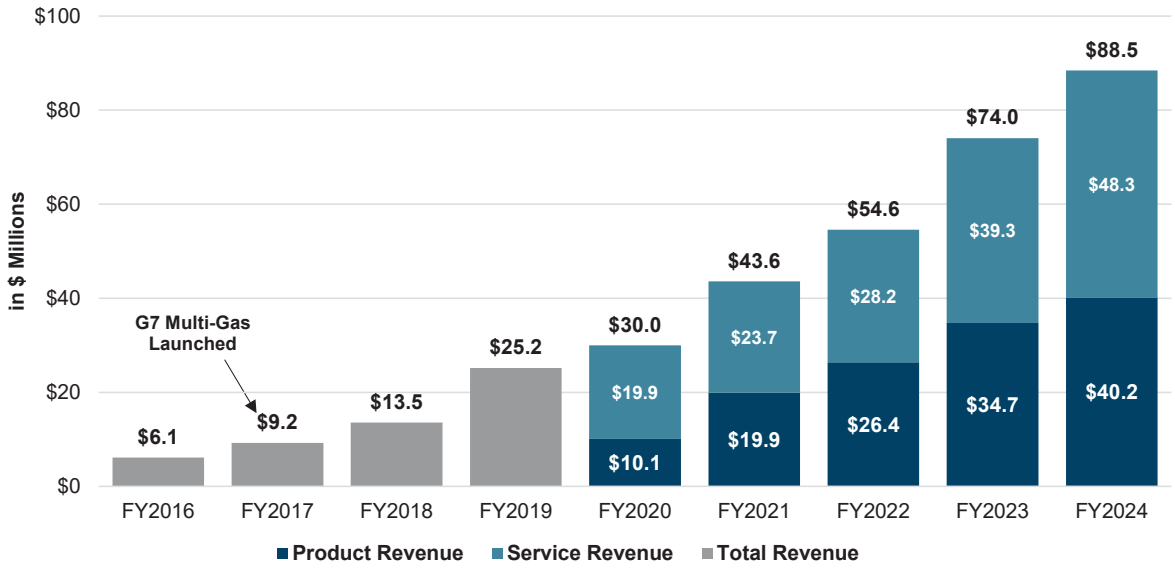
Exhibit 1
The Connected Worker Revolution: Portable Gas Detection Leading the Charge in Industrial Safety
Portable Gas Detection Connected Worker Timeline



Source: Company reports, William Blair Equity Research

Addressing the need for a direct-to-cloud connected worker solution, Blackline Safety entered the market in 2017 with the introduction of its G7 portable gas detector. At the time of its release, the G7 was the only all-in-one connected multi-gas detector with both cellular and satellite direct-to-cloud connectivity, as well as a proprietary connected worker software platform. Following the G7's introduction, Blackline's revenue surged from just $6.1 million in fiscal 2016 to $88.5 million as of fiscal 2024.

Exhibit 2
The Connected Worker Revolution: Portable Gas Detection Leading the Charge in Industrial Safety
Blackline Safety Revenue Growth

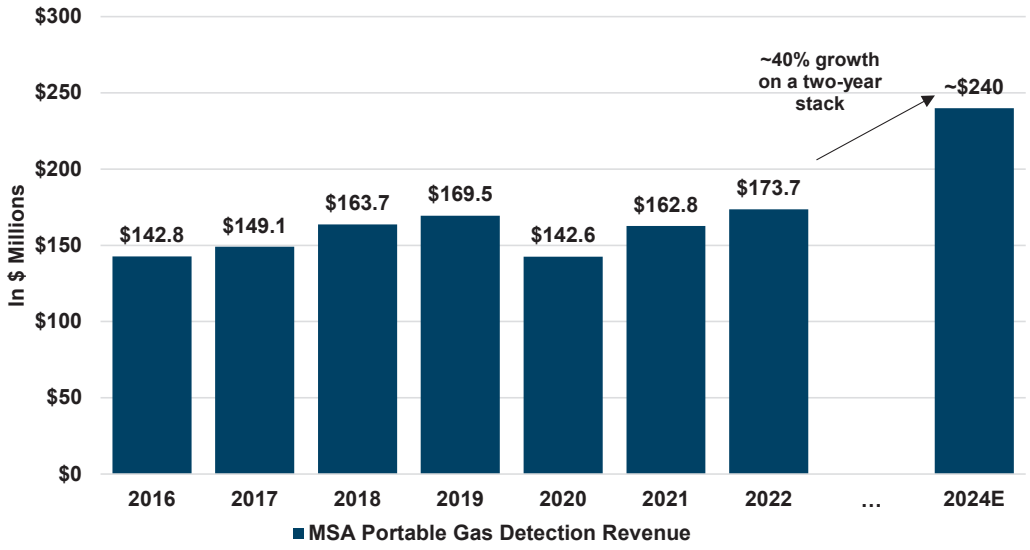


Source: Factset, William Blair Equity Research

We believe Blackline's early efforts to prove out the technology's ROI and to introduce the HeS-aaS model primed the market for the adoption of connectivity. In response, other large portable gas hardware incumbents (notably MSA Safety and Industrial Scientific) increased their focus and R&D efforts toward developing their own connected worker platforms. In late 2020, Industrial Scientific introduced the cellularly connected version of the Ventis Pro5, alongside an expansion of its existing iNet software platform; and in early 2022, MSA Safety introduced the cellularly connected Altair Io4 and the MSA+ software platform. Both companies experienced strong adoption from new and existing customers, albeit with some disruptions related to Industrial Scientific's rollout driven by a few missteps (direct-to-cloud connectivity using less reliable 5G and sidestepping distributors with a direct-to-customer go-to-market strategy).

MSA Safety, Blackline Safety, and Industrial Scientific have all seen meaningful growth following the introduction of their respective connected worker software platforms. Blackline Safety's first-mover advantage enabled the company to capture a significant portion of the early adopters, generating a 40% revenue CAGR since the G7 was launched. Whereas MSA Safety and Industrial Scientific have benefitted from their ability to roll the technology out to existing customers across their large installed bases. In October 2024, MSA Safety reported 40% revenue growth on a two-year stacked basis (implying roughly $240 million of revenue inclusive of roughly $20 million of software revenue by our estimate) for its portable gas detection business, driven by growth in the connected worker software, with roughly half from new and half from existing customers.

Exhibit 3
The Connected Worker Revolution: Portable Gas Detection Leading the Charge in Industrial Safety
MSA Safety Portable Gas Detection Revenue Growth

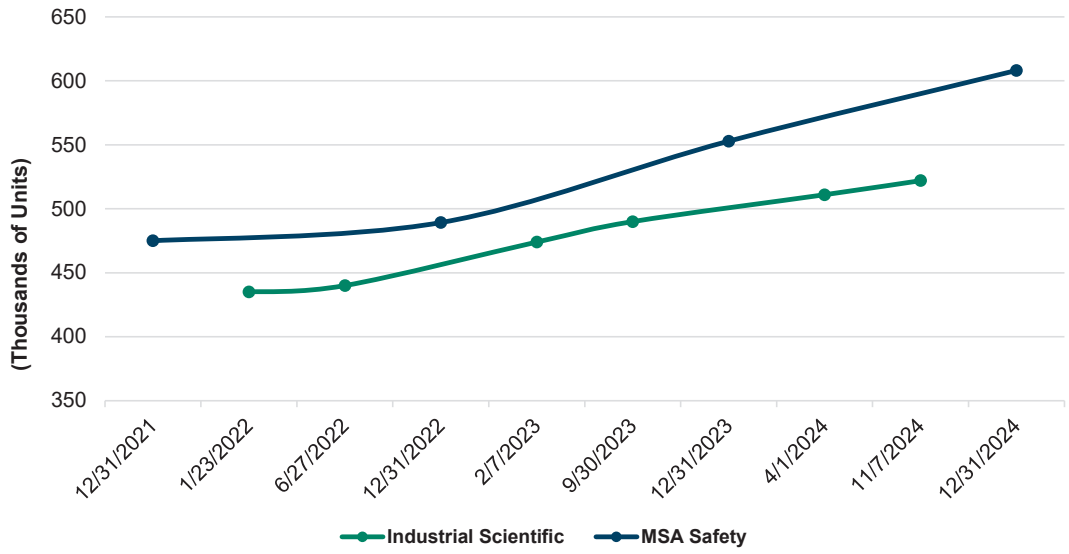


Notes:
1) MSA stopped disclosing revenue by product type in 2023
2) 2024E revenue represents William Blair estimate
Source: MSA Safety, William Blair Equity Research

Industrial Scientific's revenue figures are not disclosed, although we believe the company has seen a similar benefit following the launch of its connected worker platform. According to the company's website, Industrial Scientific's portable gas detector installed base increased from roughly 435,000 in January 2022 to roughly 522,000 in November 2024, representing a CAGR of approximately 6% over three years. Given the company's similar unit growth trajectory to our estimated 8.5% for MSA Safety over this time, we believe it suggests a strong lift in its recurring revenue profile from connected worker software.

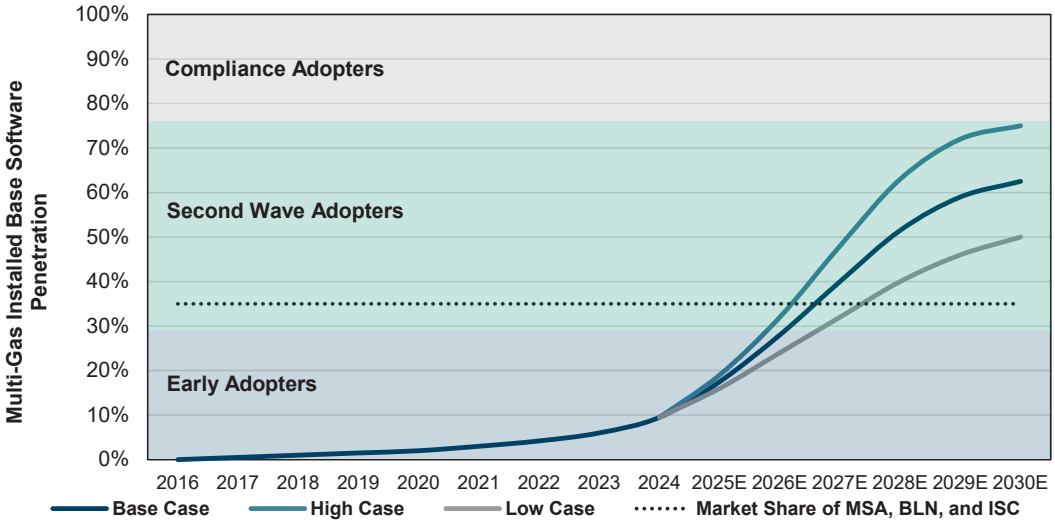
Based on discussions with industry leaders, connected worker software is expected to exceed 50% share of the multi-gas (four or more gases) portable gas detection market over the next three to five years, absent any additional regulations. As this transition occurs, we believe the three largest connected worker software providers—MSA Safety, Blackline Safety, and Industrial Scientific, which together represent roughly 35% of the total installed base within the multi-gas market—have a path toward market outgrowth, within a fragmented industry of smaller competitors.

Exhibit 4
The Connected Worker Revolution: Portable Gas Detection Leading the Charge in Industrial Safety
MSA Safety and Industrial Scientific Portable Gas Detection Installed Base



Note:
1) Installed Base includes single and multi-gas detectors
1) MSA Safety Installed base is a William Blair estimate
Source: www.indsci.com/en/inet-platform, web.archive.org, William Blair Equity Research

Exhibit 5
The Connected Worker Revolution: Portable Gas Detection Leading the Charge in Industrial Safety
Connected Worker Software Adoption Curve



Source: William Blair Equity Research

Value Proposition Evolution

To understand what is driving the accelerating adoption of connected worker software, we believe it is important to examine how the technology has changed the portable gas detection value proposition. Prior to the introduction of connectivity, portable gas detectors provided an exclusively reactive safety solution that notified workers of a threat only after they had been exposed. While reactive safety measures are necessary, they do not prevent accidents from occurring. With the introduction of connectivity and the benefits provided from advanced reporting and real-time monitoring, end-users are now able to avoid accidents. In addition, we believe the technology's perceived operational savings have meaningfully accelerated customer adoption, as enhanced functionality and streamlined fleet management, electronic worker permitting, and compliance reporting have created tangible cost savings.

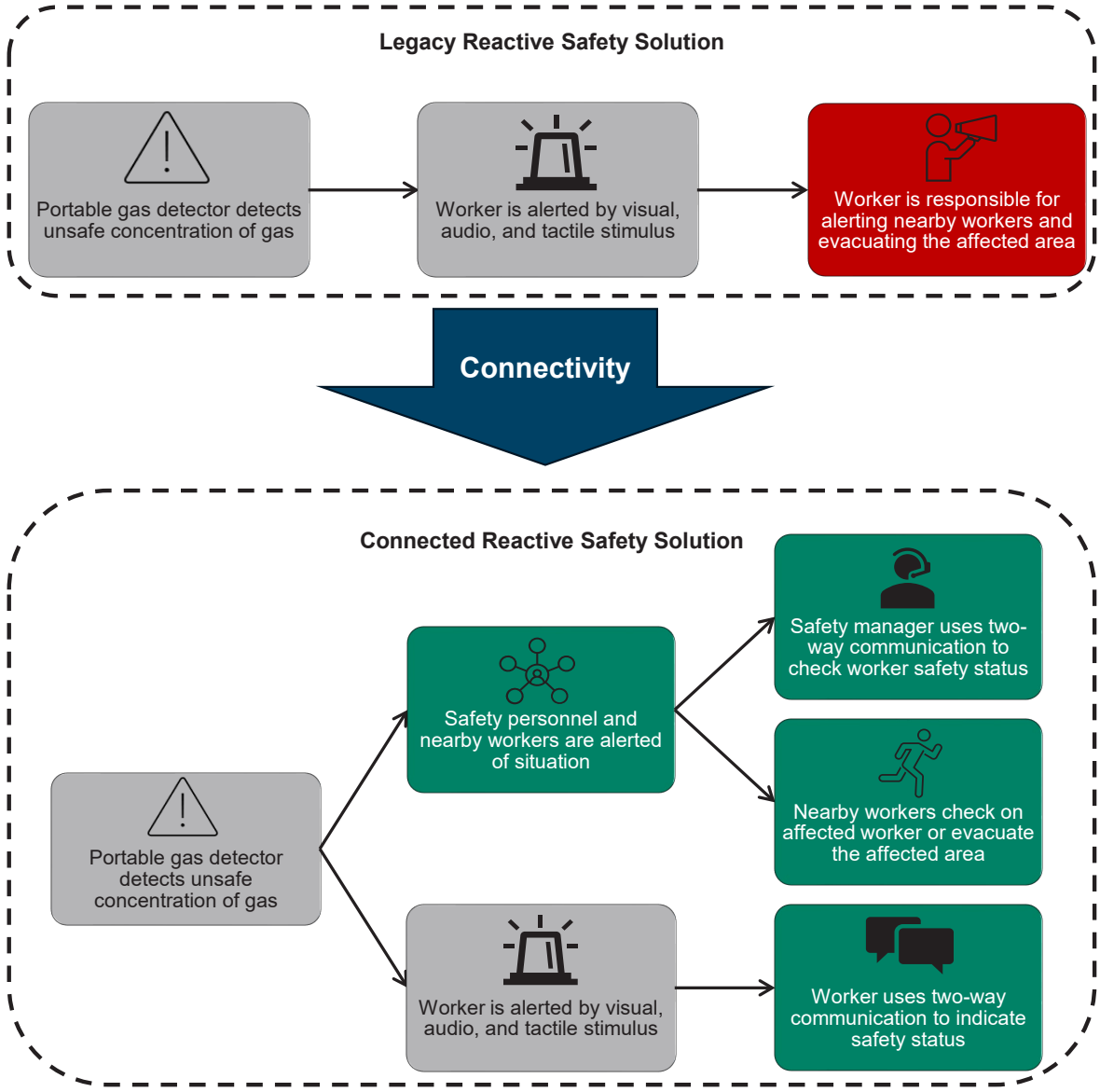
Improving Reactive Worker Safety

The primary issue with non-connected portable gas detectors has been their limited warning capabilities. When a non-connected device is triggered, only the worker and those in the immediate vicinity are alerted of the potential threat. This is ineffective in the event that the worker is alone or unable to remove themselves from the affected areas. By enabling these devices with real-time cloud connectivity, managers and nearby workers in the field will also be immediately alerted if a coworker's monitor detects an unsafe concentration of gas or other safety hazard. This allows managers to call for an evacuation and coordinate with first responders.

In addition, connectivity enables two-way communication, which allows workers to indicate their safety status and communicate their need for immediate emergency services. This is a key concern for lone workers, as there have been many cases where an alert has been passed along to first responders only to be triaged, sometimes over 24 hours, as there had been no reply from the employee that help was required, forcing first responders to move to other more immediate emergency situations.

See exhibit 6, on the following page, for a look at the value proposition of connected reactive safety.

Exhibit 6
The Connected Worker Revolution: Portable Gas Detection Leading the Charge in Industrial Safety
Reactive Safety Value Proposition



Source: William Blair Equity Research

Adding Proactive Worker Safety Functionality

The real-time data collection enabled by connectivity replaces the time-consuming and manual reporting structure that is prone to errors and often results in overlooking potentially high-risk areas. Through data collection and analysis, connected worker software can flag hotspots with elevated levels of hazardous gases, allowing managers to quickly pinpoint the source of the leak and eliminate risk. In addition, real-time data collection identifies detectors that may require maintenance or recalibration as well as improper use by personnel; this ensures that devices in the field are able to provide their full safety benefit. In the case of an accident, the software can provide managers with the cause of the incident within minutes—versus the previous process that could take several hours and up to one day—providing a clear benefit in the form of timely risk mitigation, decreased chance of repeat alerts, and increased uptime in the field.

Exhibit 7
The Connected Worker Revolution: Portable Gas Detection Leading the Charge in Industrial Safety
Proactive Safety Value Proposition

Connected Software Platform

Identify High-Risk "Hotspots"
- Map gas concentration levels across worksite
- Identify potential gas leaks/danger areas
- Investigate potential gas leaks
- Add audio/visual warning equipment to high risk areas

Monitor Detector Performance
- Track calibration and maintenance across fleet
- Identify detectors requiring calibration or maintenance
- Ensure devices are operating correctly

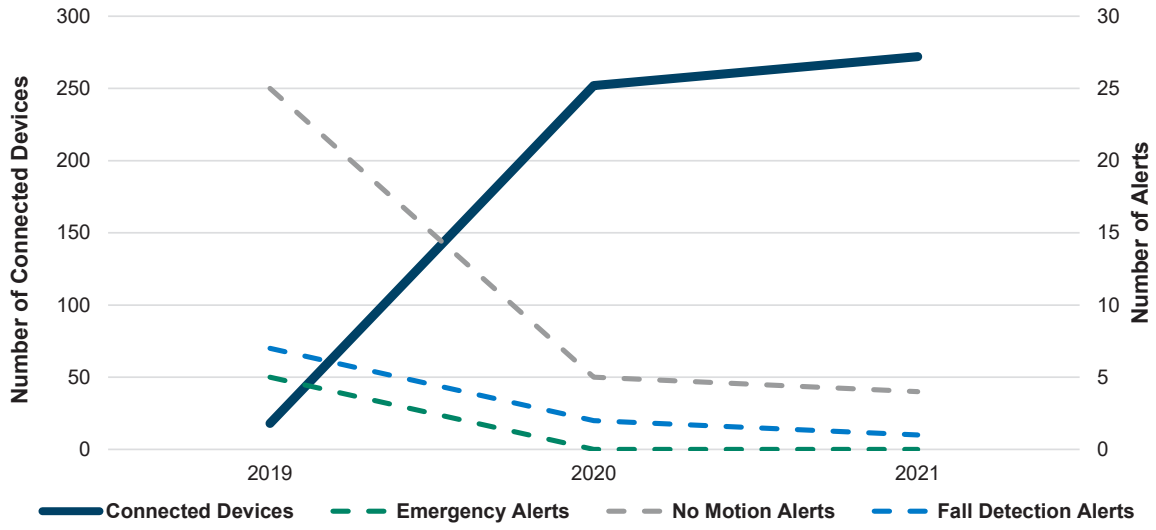
Monitor Device Usage
- Track device usage patterns
- Identify workers who are misusing devices
- Provide additional worker training

Identify Incident Cause
- Accelerate discovery of incident cause
- Inform workforce of incident cause
- Implement additional safety protocol
- Eliminate cause of incident

Source: William Blair Equity Research, MSA Safety

Quantifying the benefits from proactive safety features can be difficult; however, the correlation between widespread use of connected gas detectors and declining worksite safety incidents strongly supports the efficacy of this functionality. The exhibit below displays the impact of connected gas detector adoption at a large North American oil and gas facility that began using Blackline's G7 gas detector in 2019. The decline in no motion alerts points to a significant change in device usage habits (i.e., workers wearing the device at all times) that ultimately drove meaningful declines in both emergency alerts and fall detection alerts.

Exhibit 8
The Connected Worker Revolution: Portable Gas Detection Leading the Charge in Industrial Safety
Blackline Safety Proactive Safety Case Study



Source: Blackline Safety Data Driven Safety Analytics Whitepaper (June 2023)

Driving Operational Savings

Managing a fleet of portable gas detectors for any workforce is a complicated process with significant time requirements for both compliance personnel and the workers themselves. Portable gas detectors need to be regularly tested, calibrated, and charged to ensure that the devices provide adequate protection to workers and that employers are in compliance with regulatory standards. In addition to maintaining the equipment, regulatory standards dictate that workers must obtain permits before entering certain confined spaces and compliance personnel must document safety incidents.

When using legacy non-connected portable gas detection fleets, the device maintenance, permitting, and incident documentation are performed manually; this creates a significant time burden but also introduces the possibility of human error to critical safety systems. In the case of permitting, enabling workers to apply for and receive approved permits through their portable gas detectors (often referred to as e-permitting) eliminates the need for travel to and from centralized compliance locations. Ultimately, connected worker platforms significantly reduce the regulatory burden on workers as well as the number of labor hours spent on compliance tasks, thus driving tangible operational savings.

To date, the connected worker software applications have been primarily focused on streamlining fleet management and compliance functions; however, the increasing volume of workforce data also enables the development of new software applications that focus on broader workforce productivity. These applications allow employers to track the location, activity, and movement of employees, offering valuable real-time insights into worksite trends.

What's Next for the Connected Worker Market?

As the adoption of connected worker technology accelerates, we believe the portable gas detection and wider connected worker market will undergo three major transitions. First, we believe the portable gas detection market will become a blueprint for connected worker technology, and in turn displace other emerging point solutions within the broader industrial marketplace (connected hard hats, glasses, etc.). Second, increased data collection and improving software capability will drive predictive analytics across a number of use-cases, increasing customer ROI and expanding the total addressable market (TAM) for software within portable gas detection. Lastly, companies will leverage the shared learnings developed in gas detection for use in adjacent hardware markets, as the safety and productivity benefits far outweigh the incremental cost of connectivity. We believe that additional government regulation would act as an immediate accelerant on adoption and R&D funding. While industry consensus is currently split on if or when regulators will ultimately step in, an ability to prove out the safety benefits from connected worker software will only pressure governments to introduce regulations and insurance providers to require companies to use the technology in an effort to reduce claims.

Portable Gas Detection's Competitive Moat

Across the worker safety landscape, established companies and start-ups alike have introduced connected worker devices, including headwear, wrist, and arm devices, and eyewear (see exhibit 15), that aim to provide a version of the connected worker value proposition. While these devices do not directly compete with legacy non-connected portable gas detectors, they do provide the enhanced safety benefits of a connected worker platform. That said, these technologies have not seen the same levels of adoption currently taking place in the portable gas detection market, primarily due to the following factors.

- ***Limited use-cases.*** Competing connected worker hardware solutions typically focus on niche applications and lack key functions offered by connected portable gas detectors, including direct-to-cloud connectivity, two-way communication, and compliance management software.

- ***Go-to-market strategy.*** Without strong partnerships with major distributors, competing connected worker solutions are often forced to manage most or all the sales and support processes, thus limiting the speed at which they can deploy their systems to new customers, and thereby the R&D flywheel provided through data collection.

- ***Lack of regulatory framework.*** Non-gas detection connected worker solutions lack a defined regulatory framework mandating their use, representing a significant barrier to adoption as potential customers look to simplify their safety protocols instead of adding pieces of equipment or layers of IoT software.

Of these three factors, we believe the portable gas detection regulatory framework represents the most important competitive advantage. OSHA's standard for permit-required confined spaces mandates the use of portable multi-gas detectors across a wide range of industrial end-markets. These regulations make it difficult for point solutions to displace a connected gas detector that is already required for workers to wear and that is already integrated into the customer's safety and compliance program. As the incumbent solution, we believe portable gas detection will face limited competition from other connected worker devices and ultimately become the preferred solution and proving ground for future versions of connected worker technology.

Exhibit 9
The Connected Worker Revolution: Portable Gas Detection Leading the Charge in Industrial Safety
OSHA Permit-Required Confined Spaces

OSHA Standard Number 1910.146	
Scope and Application	This section contains requirements for practices and procedures to protect employees in general industry from the hazards of entry into permit-required confined spaces.
Key Definitions	***Acceptable entry conditions*** means the conditions that must exist in a permit space to allow entry and to ensure that employees involved with a permit-required confined space entry can safely enter into and work within the space.
	Confined space means a space that: (1) Is large enough and so configured that an employee can bodily enter and perform assigned work; (2) Has limited or restricted means for entry or exit (for example, tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry); and (3) Is not designed for continuous employee occupancy.
	Hazardous atmosphere means an atmosphere that may expose employees to the risk of death, incapacitation, impairment of ability to self-rescue (that is, escape unaided from a permit space), injury, or acute illness from one or more of the following causes: (1) Flammable gas, vapor, or mist in excess of 10 percent of its lower flammable limit (LFL); (2) Airborne combustible dust at a concentration that meets or exceeds its LFL; (3) Atmospheric oxygen concentration below 19.5 percent or above 23.5 percent; (4) Atmospheric concentration of any substance for which a dose or a permissible exposure limit is published in subpart G, Occupational Health and Environmental Control, or in subpart Z, Toxic and Hazardous Substances, of this part and which could result in employee exposure in excess of its dose or permissible exposure limit; (5) Any other atmospheric condition that is immediately dangerous to life or health.
	Entry permit means the written or printed document that is provided by the employer to allow and control entry into a permit space and that contains the information specified in paragraph (f) of this section.
Key Requirements	**1910.146(d)(3)** Develop and implement the means, procedures, and practices necessary for safe permit space entry operations, including, but not limited to, the following: - Specifying acceptable entry conditions; - Providing each authorized entrant or that employee's authorized representative with the opportunity to observe any monitoring or testing of permit spaces; - Isolating the permit space; - Purging, inserting, flushing, or ventilating the permit space as necessary to eliminate or control atmospheric hazards; - Providing pedestrian, vehicle, or other barriers as necessary to protect entrants from external hazards; - Verifying that conditions in the permit space are acceptable for entry throughout the duration of an authorized entry.
	1910.146(d)(4) Provide the following equipment at no cost to employees, maintain that equipment properly, and ensure that employees use that equipment properly: - Testing and monitoring equipment needed to comply with paragraph (d)(5) of this section; - Ventilating equipment needed to obtain acceptable entry conditions; - Personal protective equipment insofar as feasible engineering and work practice controls do not adequately protect employees; - Any other equipment necessary for safe entry into and rescue from permit spaces.
	1910.146(d)(5) Evaluate permit space conditions as follows when entry operations are conducted: - Test conditions in the permit space to determine if acceptable entry conditions exist before entry is authorized to begin, except that, if isolation of the space is infeasible because the space is large or is part of a continuous system (such as a sewer), pre-entry testing shall be performed to the extent feasible before entry is authorized and, if entry is authorized, entry conditions shall be continuously monitored in the areas where authorized entrants are working; - Test or monitor the permit space as necessary to determine if acceptable entry conditions are being maintained during the course of entry operations; and When testing for atmospheric hazards, test first for oxygen, then for combustible gases and vapors, and then for toxic gases and vapors.
	1910.146(e)(1) Before entry is authorized, the employer shall document the completion of measures required by paragraph (d)(3) of this section by preparing an entry permit.

Source: OSHA.gov

Software TAM Expansion

Historically, the portable gas detection TAM was defined by the market's annual hardware and consumable sales; however, the introduction of connected worker software has created an adjacent software TAM. This software TAM if a function of three factors: 1) the number of multi-gas detectors in the field, 2) the upward limit on software adoption rates, and 3) the monthly software subscription price per device. The first of these factors is well defined, as we estimate there are approximately 3 million multi-gas detectors globally.

The second of these factors is admittedly more difficult to define, although our discussions with a variety of industry participants strongly support a market adoption rate of at least 50%, with the potential for up to 75% of devices to be equipped with connectivity, absent additional regulations. While these two factors define the number of potential connected devices, we believe the third factor, the monthly software subscription price per device, represents the most meaningful growth driver for the connected worker software TAM, as providers continue to add new functions to their software platforms delivering incremental value to customers and enabling further monetization.

At roughly $35 per month, standard software packages are quickly becoming viewed as a low-cost, critical solution by the market. As key competitors move to introduce additional functionality to their platforms in the form of premium and add-on software packages, the expectation is for consistent price increases as new features are enabled on each device. For example, the MSA+ platform offers starter, standard, and complete packages, with monthly subscription costs increasing alongside functionality.

See exhibit 10, on the following page, for a look at the MSA+ platform's subscription tiers.

Exhibit 10
The Connected Worker Revolution: Portable Gas Detection Leading the Charge in Industrial Safety
MSA+ Subscription Tiers

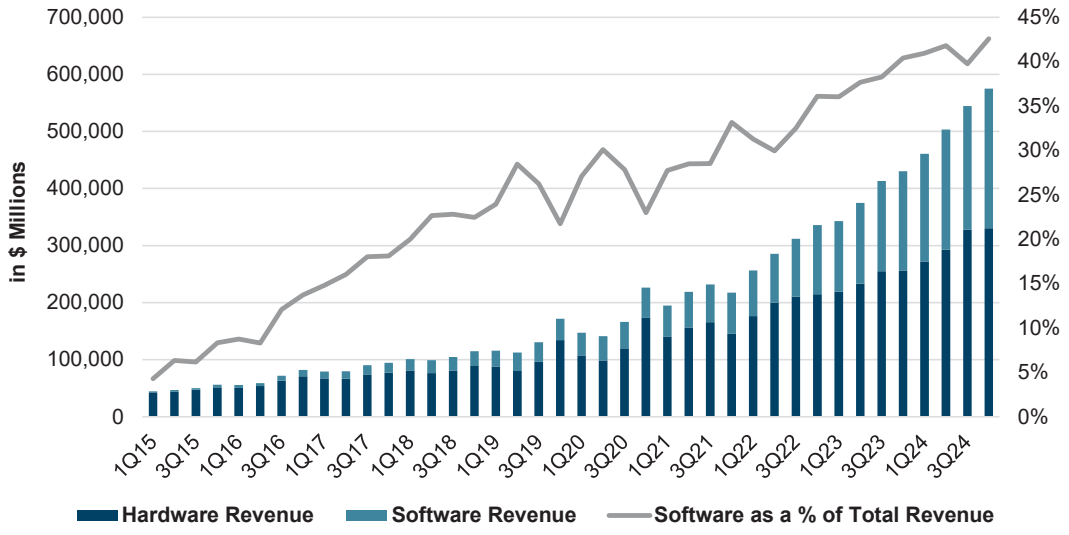
	Starter	Standard	Complete
Monthly Subscription Cost:	**$22**	**$35**	**$48**
Grid Compliance Service			
Cellular Connectivity	✓	✓	✓
Emergency Live Monitor	✓	✓	✓
OTA Software Updates	✓	✓	✓
MSA ID Digital Device Assignment	✓	✓	✓
Fleet Cloud Configuration	✓	✓	✓
Cloud Logs	✓	✓	✓
Grid Fleet Manager Service			
Fleet Manager Dashboard		✓	✓
Streamlined Device Compliance		✓	✓
Fleet Manager Reporting		✓	✓
Altair io Dock Monitoring		✓	✓
Grid Live Monitor Service			
Full Event Live Monitoring			✓
Shared Alerts			✓
Live & Historical Location Monitoring			✓
Event Management			✓
Location Awareness			✓
Mobile Notifications			✓

Source: MSA Safety Company Materials

Similar to the MSA Safety standard software subscription, Blackline's base software package for portable gas detectors starts at $34 per month; however, the company offers additional software features (24/7 monitoring, two-way talk, and custom data analytics) that can result in a subscription cost of $100-plus per month. As connected worker software platforms evolve, and customer acceptance grows, we believe that competitors will continue to expand the number of use-cases provided by their software stacks, leading to a steady increase in the average monthly subscription price.

As a result, we believe growth in the connected worker software market will outpace growth in the portable gas detection hardware market, similar to what we have seen across other industries that have benefited from the transitioned to a HeSaaS model. Most notably, as leading law enforcement technology provider Axon Enterprise introduced and monetized new software features, its software subscription revenue increased from just 6% of revenue in 2015 to 41% of revenue in 2024, and its software TAM increased significantly.

Exhibit 11
The Connected Worker Revolution: Portable Gas Detection Leading the Charge in Industrial Safety
Axon Enterprise Software Revenue Growth



Source: Axon Enterprise Inc., William Blair Equity Research

Hardware TAM Expansion

We believe that the stringent regulatory environment and distinct safety requirements within the portable gas detection market have rendered the portable gas detection platform a proving ground for connected worker technology. As connected worker software platforms collect an increasing volume of data, we expect the technology's existing safety functionality will improve and additional features will be added, with an increasing focus on operational efficiency and worker productivity. As this focus shifts, we believe the connected worker value proposition will become appliable across additional safety hardware markets and ultimately expand the technology's hardware TAM.

Considering connected worker software adoption is still in the early stages within the portable gas detection market, the timing of the software's application across new hardware markets is difficult to predict. That said, there are a number of tangential hardware markets where current software providers are either already applying the technology or exploring its potential. The single-gas detector market represents an obvious opportunity to expand the application of connected worker software, albeit this would likely require regulatory changes for widespread adoption.

Of note, Honeywell, the largest competitor within the single-gas market with an estimated 50% share, announced a partnership with Google Cloud in October 2024 to integrate AI across the company's product portfolio. While the impact of this partnership is still uncertain given the potential disruption implied by recently announced separation of the company into three standalone businesses, we believe the introduction of connectivity to the single-gas market would be a natural adjacency for existing providers of connected multi-gas detectors.

Elsewhere, MSA Safety has connected more than 200,000 of its self-contained breathing apparatuses (SCBAs) with its FireGrid platform, leveraging much of the same MSA+ software. MSA Safety has not yet monetized these SCBAs, although we believe shared learnings from gas detection software development will enable the company to add additional functionality and ultimately commercialize the technology using a HeSaaS model.

Longer term, we expect the connected worker hardware market will move toward increasingly compact wearable devices, leading to solutions similar to current smartwatch technology. In addition to being less cumbersome and more ergonomic, wearable devices can also be equipped with sensors to collect biometric data (heart rate, internal temperature, exertion, etc.), which can then be leveraged by existing connected worker platforms, allowing employers to monitor worker health data in real time. Large-scale adoption of this technology is likely years away, although today's first movers should be best positioned to capture the connected wearable market as their technological leadership, access to worker data, and network effects across their existing installed base represent key competitive advantages.

Market Overview

Product Overview

The portable gas detection market comprises three types of detectors: single-gas, four-gas, and five-plus-gas. Single-gas detectors are considered the basic compliance purchase and primarily serve customers seeking a minimally viable solution to meet current safety regulations. Multi-gas (four and five-plus gases) detectors are required in enclosed working environments per OSHA's permit-required confined spaces standard (see exhibit 9). Single gas detectors are designed to detect one singular type of gas; however, multi gas detectors can be equipped with an interchangeable combination of different gas sensors including, but not limited to, the list shown below.

Exhibit 12
The Connected Worker Revolution: Portable Gas Detection Leading the Charge in Industrial Safety
Portable Gas Detection Product Categories and Sensor Types

	Single Gas Detector	4-Gas Detector	5-Plus Gas Detector
Use-Case	Basic compliance requirements	Standard detector for workers within enclosed areas	Specialized detector for complex safety environments
Average Lifespan	1 - 2 Years	4 - 5 Years	6 - 7 Years
Cost per Detector	~$100	$500 - $1,000	$1,500+

Sensor Types		
Amonia	Combustable Gases	Nitrogen Dioxide
Carbon Dioxide	Hydrogen Sulfide	Oxygen
Carbon Monoxide	Methane	Sulfur Dioxide

Source: William Blair Equity Research, MSA Safety

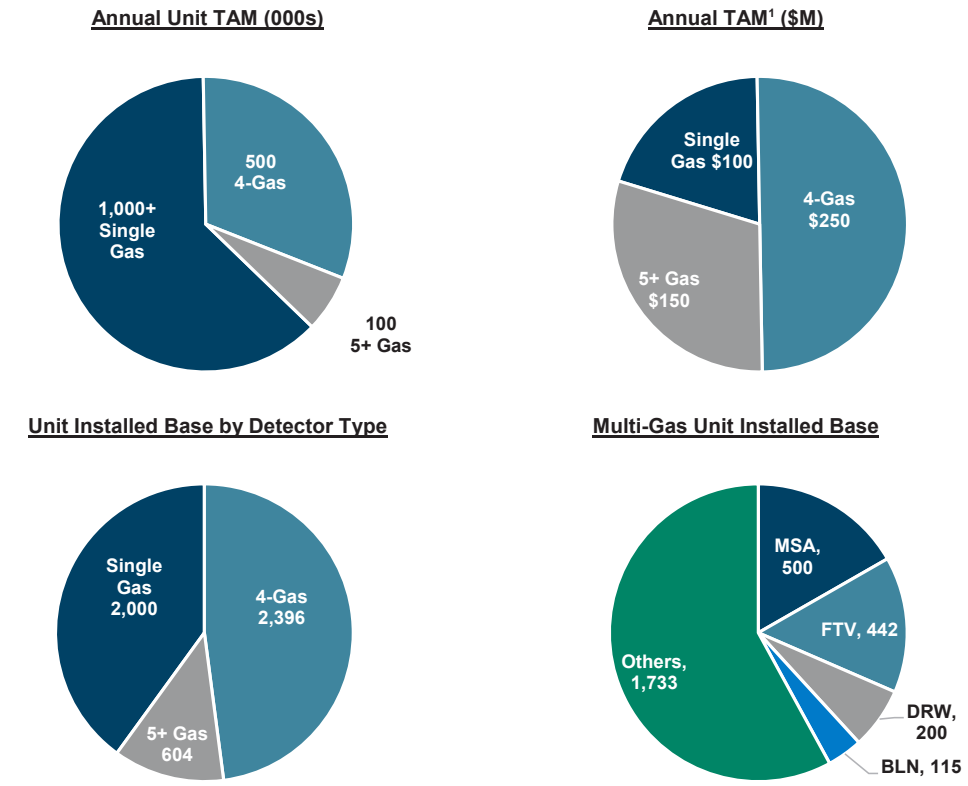
Hardware TAM

On a volume basis, we estimate that the single-gas segment of the portable gas detection market (dominated by Honeywell, with an estimated 50% market share) represents roughly two-thirds of total annual portable gas detection unit sales; however, we estimate the annual dollar value of this segment represents less than one-quarter of the portable gas detection TAM. Despite representing roughly one-third of annual portable gas detector volumes, multi-gas detectors represent roughly three-fourths the portable gas detector TAM on a dollar basis and more than half of all portable gas detectors currently in the field. Of note, while replacement sensors, calibration gases, and calibration equipment represent a significant piece of the wider multi-gas detector market, we exclude them from our hardware TAM estimates, as we believe installed base unit count is the best way to examine competitive dynamics and market share within the portable gas detection market.

Across single- and multi-gas detectors, industrial employment represents the primary underlying growth factor driving unit volumes, with incremental tailwinds from increasing global regulatory standards, the energy transition and decarbonization, and growth in global infrastructure spending. We believe portable-gas-detection hardware TAM growth ranges from a low- to midsingle-digit percent range on a through-cycle basis, benefiting from low-single-digit annual price increases.

We estimate MSA Safety, Industrial Scientific (Fortive), and Blackline Safety currently represent roughly 35% of the total multi-gas detector installed base, with the remaining market comprising Draeger (the only other large competitor without a direct-to-cloud offering) and a long tail of smaller competitors also without a comparable connected worker solution.

Exhibit 13
The Connected Worker Revolution: Portable Gas Detection Leading the Charge in Industrial Safety
Portable Gas Detection Hardware TAM Summary

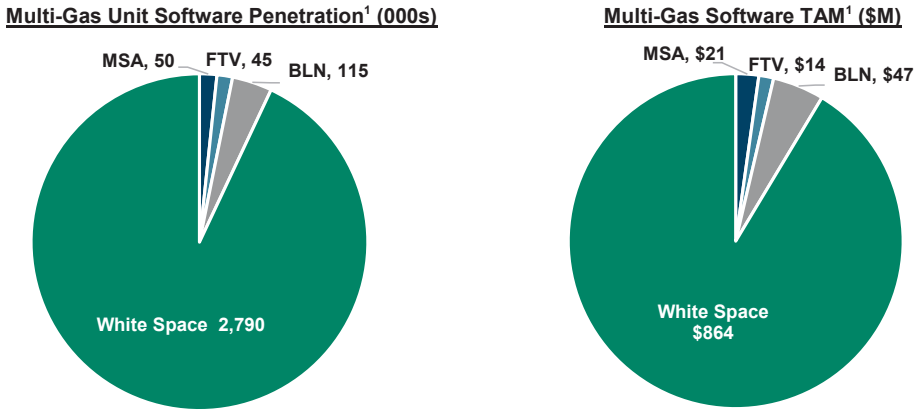


1) TAM estimates exclude sensor and support equipment revenue
Source: William Blair Equity Research

Software TAM

By our estimate, connected worker software comprises less than 10% of the total multi-gas detector market, with providers having just begun to add new features to their platforms. As a result, estimating the portable gas detection software TAM is subject to both the upper limit of software penetration across the multi-gas installed base and the upper limit on monthly subscription revenue per device. In estimating the software TAM, we assume software penetration will reach 75% of the total multi-gas installed base and the average monthly software subscription package is roughly $35 per month (MSA's standard package is $35 per month and Blackline Safety's base software package is $34 per month). Ultimately, we estimate that the current software TAM is roughly $0.95 billion, of which white space represents more than 90% of the market. In addition to hardware installed base growth, we believe the largest driver of software TAM growth is increasing average monthly subscription revenue per device.

Exhibit 14
The Connected Worker Revolution: Portable Gas Detection Leading the Charge in Industrial Safety
Portable Gas Detection Software TAM Summary



Notes:
1) White space includes multi-gas detectors without direct-to-cloud connectivity
Source: William Blair Equity Research

Competitive Landscape

The portable gas detection market largely comprises five major competitors (MSA Safety, Industrial Scientific, Drägerwerk, Blackline Safety, and Honeywell), with the remainder including a number of smaller often regionally focused competitors. As discussed above, the multi-gas detection market is typically divided into single-gas detectors, four-gas detectors, and five-plus-gas detectors, with the latter two frequently combined into a multi-gas category. Nearly all competitors offer both single- and multi-gas devices; however, the volume mix between these product categories varies across the industry. Excluding Honeywell's gas detection business, which consists almost entirely of single-gas detectors, the four remaining major portable gas detection competitors focus on the higher-value, more differentiated multi-gas detector market, with a smaller mix of single-gas detectors. Of these four major multi-gas competitors, all have developed a connected worker software platform; however, Drägerwerk remains the only major competitor that does not offer direct-to-cloud connectivity.

Beyond the portable gas detection market, the connected worker market consists of a variety of point solutions ranging from connected wearables and pendants to standalone connected worker software and industrial smart glasses. While the functionality of these solutions overlaps with connected gas detection platforms, we believe they offer an incomplete value proposition or provide a solution that lacks applicability across the wider industrial market. That said, we believe portable gas detection providers increasingly compete with these connected worker solutions for customers outside of the traditional portable gas detection market.

Exhibit 15
The Connected Worker Revolution: Portable Gas Detection Leading the Charge in Industrial Safety
Portable Gas Detection Competitive Landscape

Major Multi-Gas Detector Competitors		
MSA Safety	**Headquarters:** Cranberry Township, Pennsylvania **2024 Portable Gas Detection Sales:** ~$240 Million[1] **Multi-Gas Installed Base:** ~500,000[1]	**Company Description:** MSA Safety is a global provider of safety products, including fixed gas, portable gas, and flame detection equipment; firefighter apparel and equipment; and industrial head protection, fall protection, and other personal protective equipment. **Software Offering:** The MSA+ software platform enables connected worker functionality on the cellularly connected Altair Io4 four gas monitor, as well as roughly 200,000 of the company's self-contained breathing apparatuses. **Key Markets:** The company maintains a particularly strong market share in the fire safety and mining markets, with meaningful market share across all other end-markets. Roughly 75% of the company's portable gas detection revenue is generated in the Americas, with the remaining 25% generated in Europe and APAC.
Industrial Scientific (Fortive Corp.)	**Headquarters:** Pittsburgh, Pennsylvania **2024 Portable Gas Detection Sales:** ~$200 Million[1] **Multi-Gas Installed Base:** ~442,000[1]	**Company Description:** Industrial Scientific is a pure-play portable gas detection business that was acquired by Fortive Corporation in 2017 for approximately $600 million. **Software Offering:** The iNet software platform enables connected worker functionality for 4G cellularly connected Ventis Pro5 detectors as well as limited fleet management and compliance reporting functionality for non-connected devices. **Key Markets:** Oil & gas customers represent roughly half of the company's multi-gas installed base, with mining and utilities also representing end-markets for the company. Roughly 70% of the company's revenue is generated within the Americas, with the remaining 30% generated in Europe and APAC .
Draegerwerk	**Headquarters:** Lübeck, Germany **2024 Portable Gas Detection Sales:** ~$100 million[1] **Multi-Gas Installed Base:** ~200,000[1]	**Company Description:** Draegerwerk is a leading global provider of medical equipment including anesthesia workstations, ventilators, and patient monitoring solutions, as well as safety technologies, including firefighter apparel and equipment, fixed and portable gas detection equipment, industrial PPE, and alcohol and drug detection devices. **Software Offering:** The company offers its connected worker software platform Dräger Gas Detection Connect across its suite of portable gas detectors; however, its hardware is not direct-to-cloud enabled and requires a Bluetooth connection to a secondary device to facilitate live monitoring and data collection. **Key Markets:** The company maintains a strong European presence, particularly in its domestic market Germany.
Blackline Safety	**Headquarters:** Calgary, Canada **2024 Portable Gas Detection Sales:** ~$90 Million **Multi-Gas Installed Base:** ~115,000[1]	**Company Description:** Blackline Safety is a pure-play provider of connected worker safety software and hardware including portable gas detectors and lone worker monitors. Blackline was the first to introduce direct-to-cloud connectivity and an integrated connected worker platform to the portable gas detection industry. **Software Offering:** The company offers a suite of connected worker software solutions alongside its 4G cellular and satellite connected hardware offering, in addition to a unique 24/7 in-house live monitoring service. **Key Markets:** Energy customers represent 36% of revenue followed by industrial (33%), consumer packaged goods (27%), and fire & hazmat (4%). Forty-six percent of the company's revenue is generated within the United States, followed by Europe (24%), Canada (21%), and rest of world (9%).
Major Single-Gas Detector Competitors		
Honeywell	**Headquarters:** Charlotte, North Carolina **Single-Gas Installed Base:** ~1,000,000[1]	**Company Description:** Honeywell is a diversified industrial conglomerate providing a broad range of products and software to a diversified global customer base. **Software Offering:** The company offers its connected worker software platform BW Connect across its entire single- and multi-gas detector product lineup; however, connectivity is facilitated by a supplementary attachment that plugs into the detector and enables a Bluetooth connection to a third device (typically a smartphone or tablet). **Key Markets:** Honeywell is the dominant player within the disposable single-gas detector market maintaining an estimated 50% market share.

1) William Blair estimate

Source: Company reports, William Blair Equity Research

Exhibit 15 (Continued)
The Connected Worker Revolution: Portable Gas Detection Leading the Charge in Industrial Safety
Portable Gas Detection Competitive Landscape

Secondary Portable Gas Detector Competitors		
Crowcon (Halma)	**Headquarters:** Oxfordshire, United Kingdom	**Company Description:** Crowcon is a provider of fixed and portable gas detection equipment operating as a division within Halma Plc. **Connectivity/Software:** The company does not offer real-time connectivity; however, the company offers Crowcon Connect, a software platform that collects data through docking stations and provides compliance automation and data analytics.
Gas Clip Technologies	**Headquarters:** Cedar Hill, Texas	**Company Description:** Gas Clip Technologies is a pure-play provider of portable gas detectors. **Connectivity/Software:** The company does not offer connectivity or supplementary software.
GfG Instrumentation	**Headquarters:** Dortmund, Germany	**Company Description:** GfG Instrumentation is a global supplier of fixed and portable gas detection equipment. **Connectivity/Software:** The company offers TeamLink, a radio-based connected worker software platform that enables live gas-level monitoring and two-way connectivity through a supplementary modem.
Macurco Gas Detection	**Headquarters:** Sioux Falls, South Dakota	**Company Description:** Macurco Gas Detection is a provider of fixed gas detection equipment, portable gas detection equipment, and audio and visual alarm systems. **Connectivity/Software:** The company does not offer connectivity or supplementary software.
mPower Electronics	**Headquarters:** Santa Clara, California	**Company Description:** mPower Electronics is a provider of fixed and portable gas detection equipment. **Connectivity/Software:** The company offers a real-time, radio-based warning system through a modem but no software platform.
Riken Keiki	**Headquarters:** Tokyo, Japan	**Company Description:** Riken Keiki is a provider of fixed gas detection equipment, portable gas detectors, and other measurement devices. **Connectivity/Software:** The company offers Bluetooth-based connectivity on some multi-gas detectors that require a smartphone or tablet. The company began offering connected worker software in 2022 using software from Aatmunn, a provider of connected worker software solutions.
WatchGas Detection	**Headquarters:** Rotterdam, Netherlands	**Company Description:** WatchGas Detection is a private provider of fixed gas detection equipment, portable gas detection equipment, and audio and visual alarm systems. **Connectivity/Software:** The company offers its WatchGas SST connected worker platform that allows for real-time safety monitoring and automated compliance reporting. WatchGas Detection's gas detectors do not have direct-to-cloud capabilities and require a Bluetooth connection to a smartphone or tablet.

Source: Company reports, William Blair Equity Research

Exhibit 15 (Continued)
The Connected Worker Revolution: Portable Gas Detection Leading the Charge in Industrial Safety
Portable Gas Detection Competitive Landscape

Connected Worker Competitors		
Aatmunn (Formerly GuardHat)	**Headquarters:** Detroit, Michigan	**Company Description:** Aatmunn is a pure-play connected worker software provider offering solutions for compliance, productivity, and remote monitoring. Prior to 2023, Aatmunn operated as GuardHat, providing a suite of connected hardware devices, including helmets and other wearable devices. **Connected Worker Product Offering:** Aatmunn's software offering includes its Safety Inspection Manager (SIM), which digitizes and automates safety and compliance tasks and its Safety Control Center (SCC), which enables real-time safety monitoring, two-way communication, and safety analytics. **Customers:** Aatmunn serves a variety of customers across industrial, energy, and manufacturing markets. In 2022, Aatmunn entered the portable gas detection market through a software partnership with Riken Keiki.
Grace Industries	**Headquarters:** Fredonia, Pennsylvania	**Company Description:** Grace Industries provides a suite of worker safety, visual warning, and arson detection equipment. **Connected Worker Product Offering:** In 2023, Grace Industries launched the Grace Connected Safety platform, which comprises wearable pendants equipped with a direct-to-cloud connectivity, a panic button, fall/no motion detection capabilities, and GPS location tracking in addition to a connected worker software platform offering real-time alerts, data logging, and safety analytics. **Customers:** Grace Industries serves fire departments and other fire safety customers in addition to mining, oil & gas, and other industrial end-markets.
Slate Safety	**Headquarters:** Atlanta, Georgia	**Company Description:** Slate Safety provides wearable safety monitoring equipment and area safety monitors. **Product Description:** Slate Safety offers the direct-to-cloud enabled BAND V2 wearable safety armband, which collects a variety of physiological metrics, including temperature, heart rate, and exertion, alongside the BEACON V2 connected area monitor, which collects temperature, humidity, and heat index data. Slate Safety also offers a software platform enabling real-time worker health monitoring. **Customers:** Slate Safety serves a variety of customer types including industrial workers, fire service professionals, and military personnel.
RealWear	**Headquarters:** Vancouver, Washington	**Company Description:** RealWear is a wearable computing company focused on creating technology solutions for the frontline worker market. **Product Description:** RealWear's offers its Navigator smart glasses product with built in audio and visual recording capabilities that enable workers to access information, communicate with coworkers, and record events in real time. RealWear offers a suite of software solutions that facilitate real-time collaboration, hands-free operation, and data collection. Navigator smart glasses typically require a Wi-Fi or Bluetooth connection to operate but can be configured to use cellular connectivity with additional accessories. **Customers:** RealWear's end-markets include automotive, oil & gas, warehousing, manufacturing, and healthcare.

Source: Company reports, William Blair Equity Research

The prices of the common stock of other public companies mentioned in this report follow:

Alphabet Inc. (Outperform)	$147.74
Axon Enterprise, Inc. (Outperform)	$497.13
Blackline Safety Corp.	C$6.36
Draegerwerk AG & Co.	€51.20
Fortive Corporation	$64.13
Honeywell International Inc.	$190.99
MSA Safety Corp. (Outperform)	$134.16

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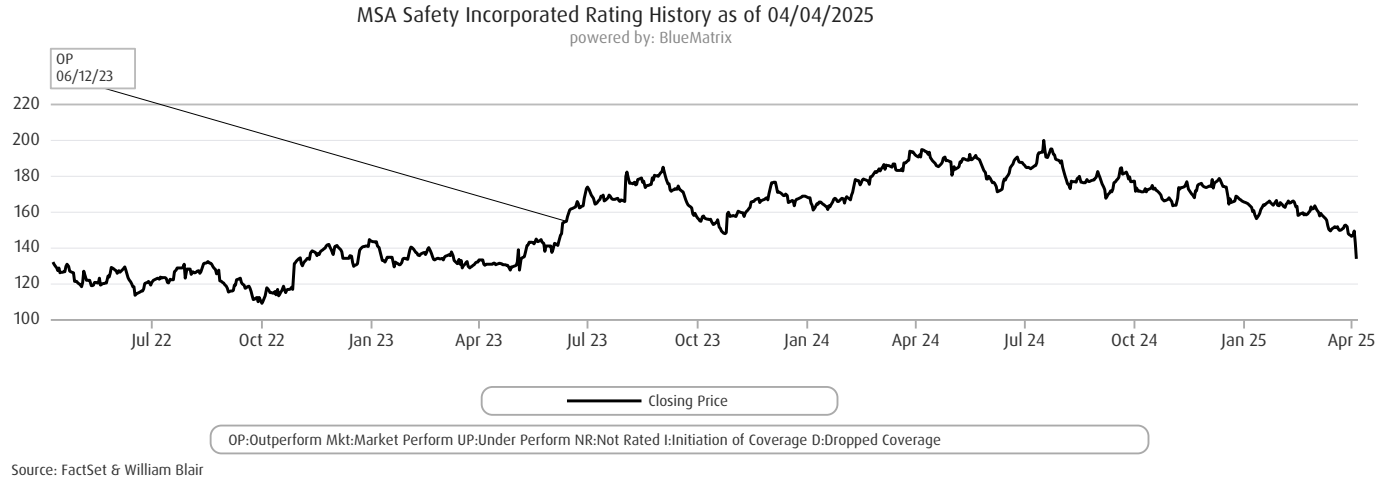
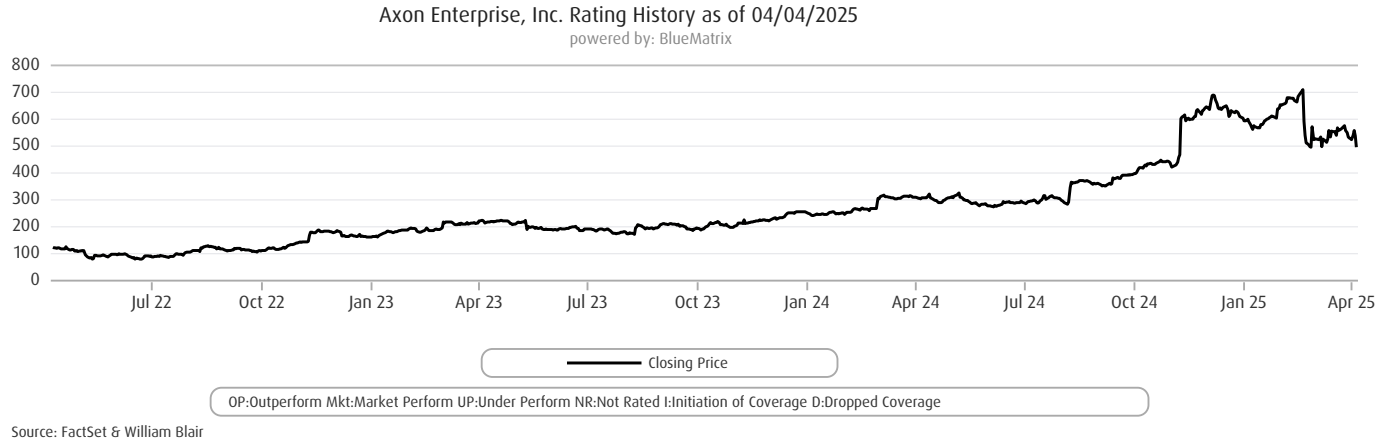


Source: FactSet & William Blair



Source: FactSet & William Blair

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