



The International Forum to Advance First Responder Innovation

Capability Gap 4 “Deep Dive” Analysis Synopsis

August 2018



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Table of Contents

Introduction.....	4
Background	4
IFAFRI Membership.....	5
IFAFRI <i>Common Global Capability Gaps</i>	6
Capability Gap 4.....	7
Methodology	9
Research Methods.....	9
Market Definition and Segmentation.....	9
Market Quantification.....	9
Market Phase and Factors	9
Competitive Landscape.....	10
Dominant Solutions	10
Presentation	10
Synopsis Overview	11
Market Definitions and Segmentation	11
Market Quantification.....	11
Competitive Landscape.....	11
Dominant Solutions, Market Factors, and Market Phase	11
Summary	12
Market Overview.....	13
Market Figures	15
All-Source Collection, Integration and Validation of Data.....	15
Market Factors.....	18
Competitive Landscape.....	19
First Responder-Specific Technology Solutions.....	21
All-Source Collection, Integration and Validation of Data.....	21
Appendix A	29
Appendix B	30
Appendix C	34
Glossary	35
References.....	37

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 4: *The ability to incorporate information from multiple and nontraditional sources into incident command operations*. 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 first of four Common Global Capability Gaps identified by IFAFRI in 2016. 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

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 an initial set of *Common Global Capability Gaps*.

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. Furthermore, the IFAFRI membership is currently in the process of identifying additional common global capability gaps, and it is anticipated similar analysis efforts will be conducted for each of these gaps.

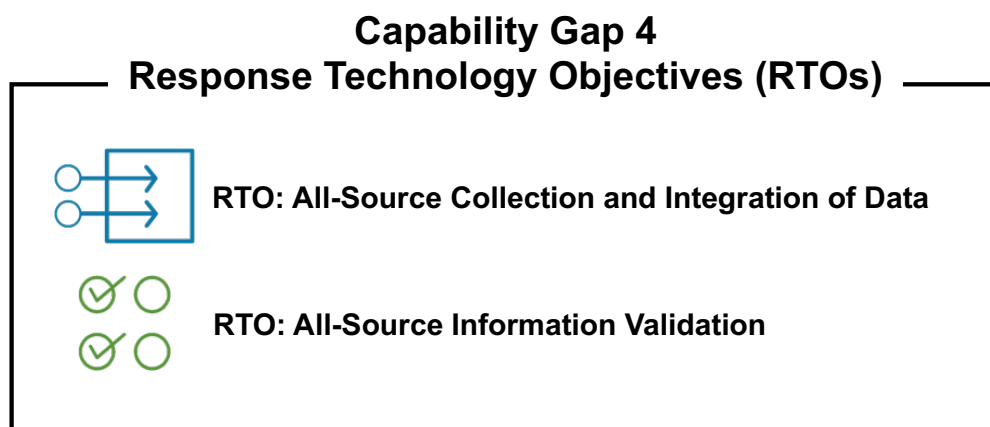
Capability Gap 4

The ability to incorporate information from multiple and nontraditional sources into incident command operations.

Incident commanders rely on multiple information inputs to make decisions. These inputs include field observations, sensor data, model outputs, images and video, media reports, databases and other sources. With advances in technology, responders are exploring ways to integrate these and other nontraditional sources of valuable data (for example, sensors attached to infrastructure, road cameras, social media data) into decision-making processes.^{2,2}

During the Project Responder 4 and subsequent Project Responder 5 studies, responders discussed the increasing importance of information from nontraditional sources and the need to integrate these information streams into a common operating picture. Although responders see value in systems that could aggregate and analyze nontraditional information sources, they also emphasized the need to verify information.

This study uses the Response Technology Objectives (RTOs) identified in PR4 as a starting point for further defining and segmenting Capability Gap 4. RTOs identify broad technology solutions designed to improve the capabilities of the first responder community. There are two corresponding RTOs for this capability gap:



All-Source Collection and Integration of Data refers to the need of first responders to collect data from traditional (e.g., sensor readings, 311 data, weather maps, traffic camera feeds) and nontraditional information sources (e.g., crowdsourcing, social media) and integrate this data into a common operating picture that is user-configurable.³

All-Source Information Validation refers to the need of first responders to validate and establish credibility of data collected from traditional and nontraditional information sources. This need is a particular concern for information or data collected from public repositories, such as social media feeds, which often lack standards and regulatory bodies and are consequently more difficult to validate.⁴

² Appendix A contains a further discussion of traditional and nontraditional information sources.

Note: Each other “deep dive” analysis completed for the IFAFRI capability gaps defines, quantifies and assesses a primary market for each RTO. For this gap, however, one primary market is used to define, quantify and assess both RTOs. This was done because there are no markets or solutions for validation that are independent of collection and integration. Performing validation of information inherently requires data to be collected and integrated. There are multiple solutions that collect, integrate, and validate data, but none that only perform the validation function.

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 Definition and Segmentation

As described above, the RTOs developed as part of the Project Responder 4 study, were used as a starting point for further defining and segmenting technologies associated with Gap 1. More specifically, each RTO was considered to represent one segment of the market for the overall capability gap. Then, each RTO description was mapped to a corresponding primary market within open-source market research reports with a market definition similar to the RTO description. However, for the two RTOs given for this capability gap, it was determined that one market was representative of both RTOs, and therefore only one primary market was selected.

Market Quantification

All relevant markets are quantified utilizing overall global revenue figures, unless otherwise noted, for the forecast period 2018 to 2022. 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.⁵ 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. Although there may be additional firms operating in the market, this figure captures just the market leaders. 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.

Dominant Solutions

Dominant solutions are determined by examining market share breakdown, as available in publicly available market reports. These market reports provide data regarding which solutions are capturing the majority of market share. Solutions capturing the majority of the market share are considered to be dominant.

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 4. This synopsis highlights key data and analysis identified as part of this study.



The ability to incorporate information from multiple and nontraditional sources into incident command operations.

Market Definitions and Segmentation

This study uses the RTOs identified in *Project Responder 4* to further define and segment the relevant markets for Capability Gap 4. For the two RTOs given for this capability gap, it was determined that one market was representative of both RTOs, and therefore only one primary market was selected. This primary market is used for market definition, segmentation, quantification and further assessment. The primary market associated with this gap is presented below:

Capability Gap 4: Primary Market



Global Public Safety Analytics Market

Market Quantification

The primary market is quantified utilizing overall revenue figures derived from global markets. Growth is measured using an estimated CAGR. The Global Public Safety Analytics market is estimated to be worth more than **\$6 billion USD in 2018** and is projected to grow at a Compound Annual Growth Rate (CAGR) of 16.7% through 2022. This equates to a market value of more than \$11 billion USD in 2022.

Competitive Landscape

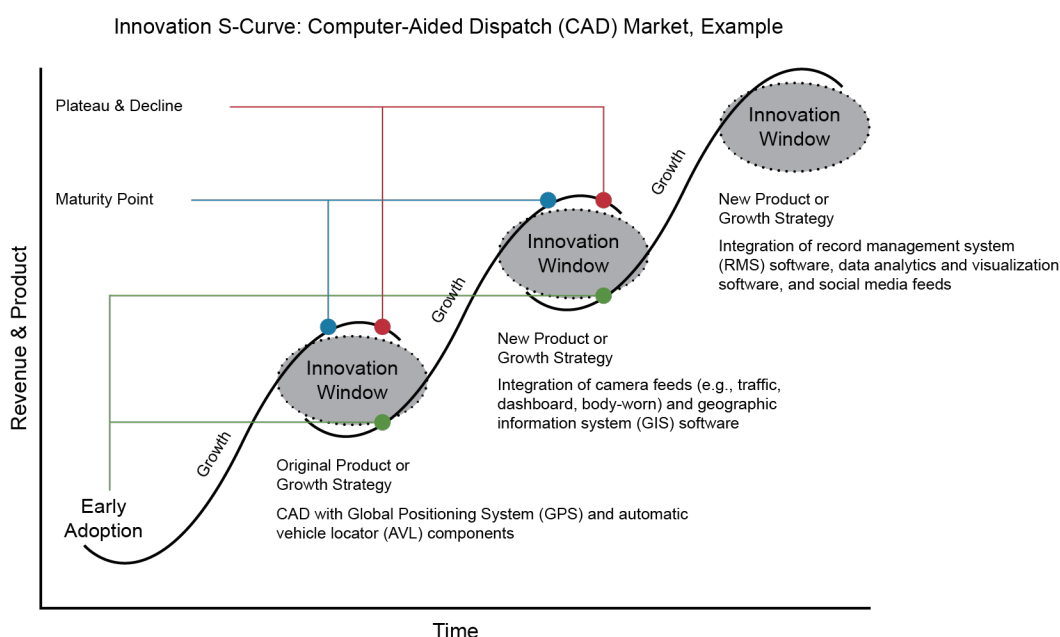
Based upon third-party market research reports, there are 12 key players and innovators identified within the global, primary market for Capability Gap 4. These key global players and innovators appear to offer solutions that address, in part, the ability to collect, integrate, and validate data from traditional and nontraditional information sources. However, none of the solutions identified within this assessment appear to meet all of first responders' target objectives for this gap.

Dominant Solutions, Market Factors, and Market Phase

The aspects of each market, which include dominant solutions, market factors and market phase are summarized within the *Market Highlights* section of this synopsis. Notably, it appears that

the primary market is in a market phase of growth on the S-Curve Life Cycle model. During an S-Curve life cycle, the performance of a new technology starts out poor and improves slowly to early adoption. Then, as the technology becomes more familiar, its performance improves rapidly during its growth phase. Eventually, the technology reaches a ceiling or maturity point and plateaus to a decline.

The figure below illustrates the S-Curve Life Cycle model using the Computer-Aided Dispatch (CAD) Market as an example. Originally, CAD systems integrated Global Positioning System (GPS) and Automatic Vehicle Locator (AVL) data. Then, they expanded to integrate camera feeds and geographic information system (GIS) data. Today, these systems are working to integrate record management system (RMS) software, data analytics and visualization software and social media feeds.



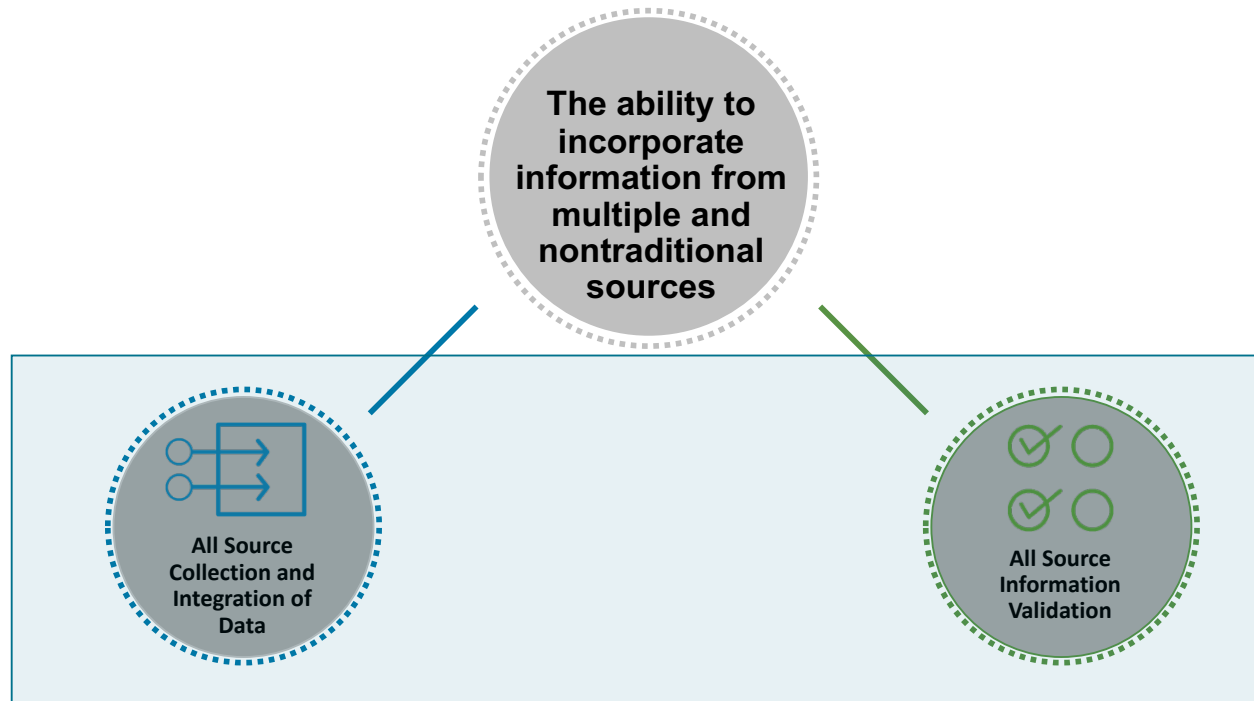
Summary

In summary, the primary market identified to represent both of the RTOs for 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. However, different segments of each market may fall at different places on the innovation S-Curve. Therefore, specific types of solutions may have better opportunity than others. When examining 85 existing solutions and 13 developing solutions in this assessment, only a small number claimed to provide data validation. Therefore, those integrated solutions that address first responders' target objectives of collecting and integrating data, validating information, and being user-configurable (for both traditional and nontraditional sources) will likely have the greatest commercial potential.

Market Overview

Capability Gap 4 is **the ability to incorporate information from multiple and nontraditional sources into incident command operations**. This gap is largely focused on the collection, integration, and validation of data from public and private information sources for enhanced situational awareness.

Market Segmentation



The [Global Public Safety Analytics Market](#) was used to quantify market figures for this capability need. This market includes video, social media, sensor data, identity, crowd, speech, and text analytics (among others) that are designed to identify, prevent, respond, and prepare for emergency incidents.

As noted above, the RTOs described in PR4 are combined for the purposes of this study because there are no markets or solutions that focus solely on the validation function.

Capability Gap 4 – The ability to incorporate information from multiple and nontraditional sources into incident command operations

During an incident, first responders utilize disparate sources of information in their decision-making processes. As availability of data grows significantly, particularly from nontraditional sources, gaps exist for responders in the collection, integration and validation of information. In order to improve responder safety, efficiency and effectiveness, the ability to incorporate these multiple and nontraditional sources of data into operations is needed. Having this capability will likely improve situational awareness and decision-making in response operations.

A myriad of data collection, integration and validation solutions currently exist within the market. However, not one of these solutions appears to meet all of responders' target objectives, which beyond collecting, integrating and validating data include being user-configurable, for both traditional and nontraditional sources.

The Global Public Safety Analytics market is used to define, quantify and assess both of this capability gap's RTOs. This market is worth more than \$6 billion USD in 2018 and is projected to grow at a Compound Annual Growth Rate (CAGR) of 16.7% through 2022. This equates to a market value of more than \$11 billion USD in 2022.

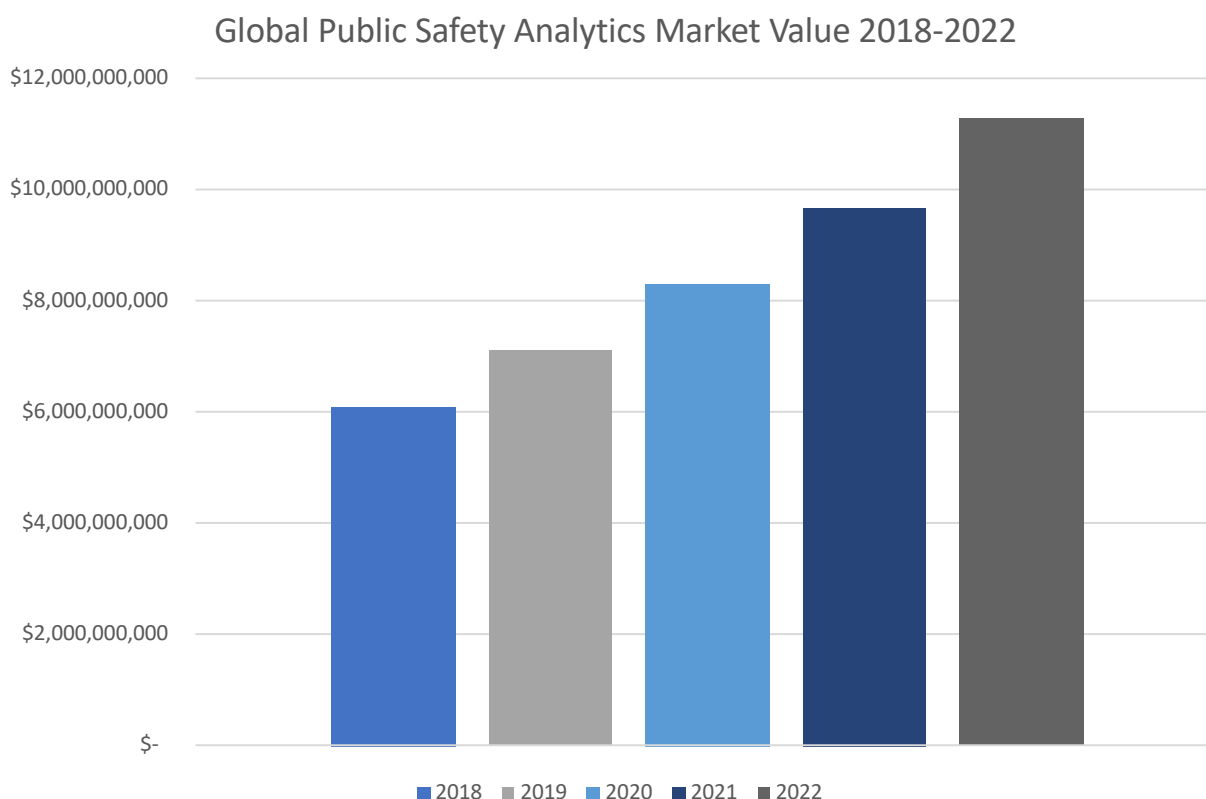


Figure 1. Global Public Safety Analytics Market Value



Market Figures

The following table presents the estimated revenue figures for the various sub-markets identified for the Capability Gap 4 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 2018 to 2022. 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.

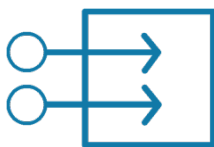
All-Source Collection, Integration and Validation of Data

 	Revenue by Year (in \$1,000,000 USD)					CAGR
	2018	2019	2020	2021	2022	
Global Public Safety Analytics Market ⁶	\$6,090.8	\$7,106.9	\$8,292.5	\$9,675.9	\$11,290.0	16.7%
Global Big Data & Data Analytics in Homeland Security & Public Safety Market ⁷	\$5,770.9	\$6,780.8	\$7,967.4	\$9,361.7	\$11,000.0	17.5%
Global Cognitive and Artificial Intelligence (AI) Systems Market ⁸	\$16,704.3	\$24,421.7	\$35,704.5	\$52,200.0	\$76,316.4*	46.2%
Global Command and Control Room and Public Safety Answering Point (PSAP) Market ⁹	\$6,629.0	\$7,097.9	\$7,600.0	\$8,137.6*	\$8,713.3*	7.1%
Global Command and Control Systems Market ¹⁰	\$29,970.8	\$31,299.6	\$32,687.3	\$34,136.5	\$35,650.0	4.4%
Global Computer-Aided Dispatch (CAD) Market ¹¹	\$1,257.6	\$1,403.4	\$1,566.0	\$1,747.5	\$1,950.0	11.6%
Global Internet of Things (IoT) for Public Safety Market ¹²	\$985.2	\$1,140.1	\$1,319.4	\$1,526.9	\$1,767.1	15.7%

Global Next Generation 911 (NG911) Market ¹³	\$184.3	\$215.7	\$252.5	\$295.5	\$345.8	17.0%
Global Physical Security Information Management (PSIM) System Market	\$1,374.5	\$1,630.6	\$1,934.6	\$2,295.2	\$2,723.0	18.6%
Incident and Emergency Management Market ¹⁴	\$92,267.1	\$97,718.4	\$103,491.7	\$109,606.1	\$116,081.8	5.9%
U.S. Crowdsourcing Service Providers Market ^{3, 15}	\$1,371.0	\$1,879.6	\$2,577.0	\$3,533.1	\$4,843.8	37.1%

³ Revenue figures of the crowdsourcing service providers market represent the U.S. market, only. Revenue figures for the *global* crowdsourcing service providers market did not appear to be publicly available.

Market Highlights



This capability gap reflects the need of first responders to collect, integrate, and validate data from both traditional and nontraditional information sources into a user-configurable, common operating picture.

**All-Source
Collection,
Integration
& Validation**

Current Capability:

Current solutions related to the collection and integration of data from multiple sources are focused on enhanced computer aided dispatch (CAD) or records management systems. A growing number of products include the ability to integrate nontraditional data sources such as social media feeds. There is limited ability to validate data from nontraditional sources as part of the products currently available to emergency responders.

Primary Market Quantification

**Market Size
(2018): \$6,091M**

**Compound Annual Growth
Rate (2018-2022): 16.7%**

Competitive Landscape

**Number of Key
Market Players: 12**

**Number of Responder-
Specific Existing Solutions: 68**

**Number of Responder-
Specific R&D Solutions: 12**

Dominant Solution

None, to date

While existing Computer-Aided Dispatch (CAD) systems represent the dominant solution for data collection and integration, the ability to integrate multiple data sources, particularly of the nontraditional nature, and to validate information is underdeveloped within the technology landscape for this gap. Therefore, a dominant solution addressing all of the needs within this market does not currently exist.

Market Factors

Opportunities

- Small number of existing or developing solutions focused on validation
- Overall growth of data analytics in general and specifically within public safety
- Need for user-configurable solutions

Market Phase

GROWTH

Barriers

- Technical ability to validate information from disparate sources with varying levels of credibility
- Cost of system implementation
- Privacy and security

Market Factors

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

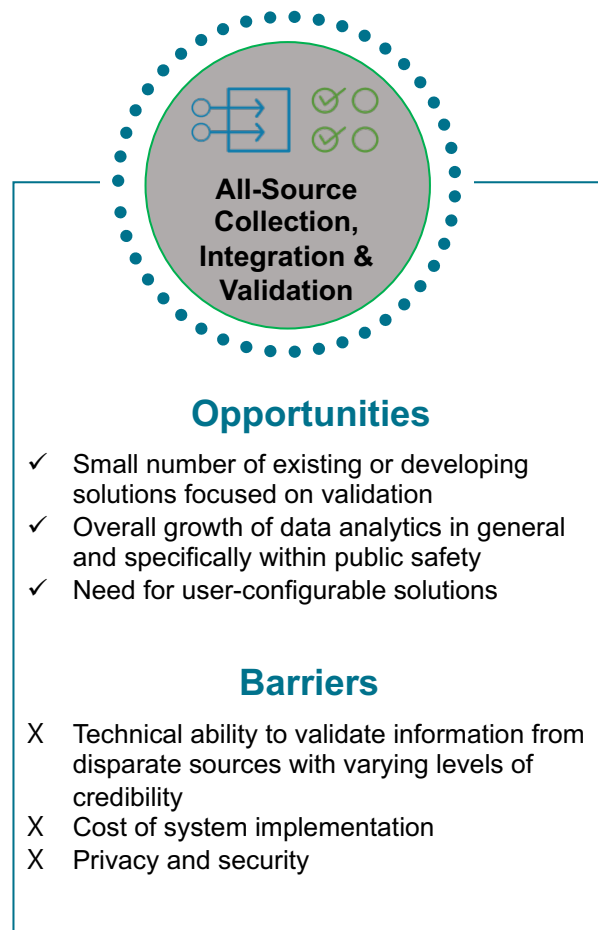


Figure 2. Gap 4 Market Opportunities and Barriers

Competitive Landscape

A total of 12 firms were recognized as key global market players within the Global Public Safety Analytics market, including:

- Cisco Systems (United States)
- Environmental Systems Research Institute (ESRI) (United States)
- Haystack Technology Inc. (United States)
- Hexagon AB (Sweden)
- Hitachi Vantara Corporation (Japan)
- International Business Machines (IBM) Corporation (United States)
- NEC Corporation (Japan)
- NICE Ltd. (Israel)
- SAP SE (Germany)
- Statistical Analytics Software (SAS) (United States)
- Splunk Inc. (United States)
- Verint Systems (United States)

Within this study there are a total of 85 existing solutions and 13 research and development (R&D) initiatives with relevance to Capability Gap 4 identified. This landscape is non-exhaustive, as the number of solutions, particularly related to the social media component of the capability need, is vast and ever-changing at a rapid pace.

Among the existing and developing solutions identified, 68 solutions (80 percent) appear to have first responder applications and 12 solutions (92 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 collecting, integrating and validating data, as well as being user-configurable, for both traditional and nontraditional sources. It appears that the greatest gap exists in the validation of information. Firms with existing collection and integration solutions may find opportunity in adding information validation capabilities for both traditional and nontraditional sources.

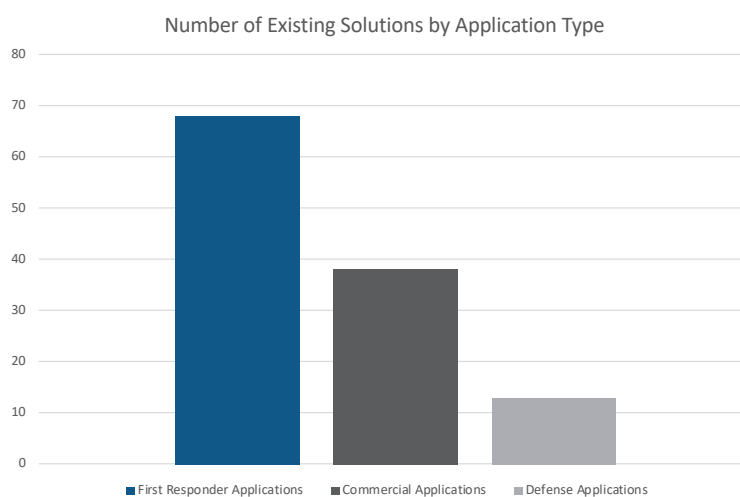


Figure 3. Gap 4 Existing Solutions by Application Type

While the greatest number of existing solutions (68) identified in this assessment appear to have first responder applications, 38 solutions have commercial applications and 13 have defense applications. Note that these numbers add to more than the total number of solutions because some solutions have more than one intended application (e.g.: one solution may have both first responder and commercial applications).

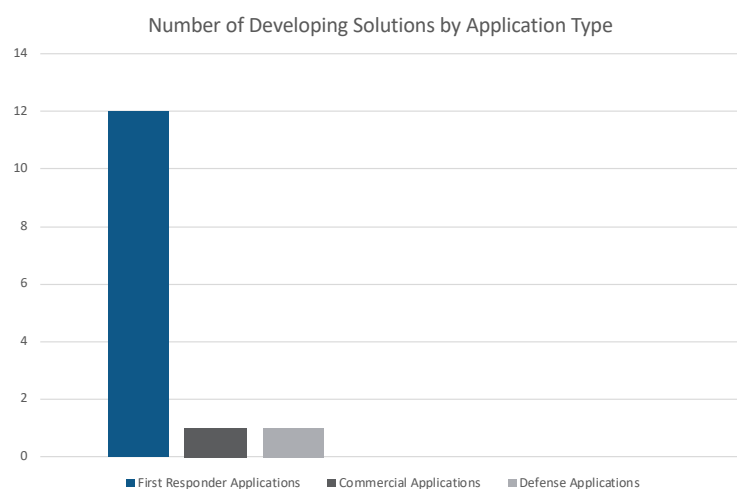


Figure 4. Gap 4 Developing Solutions by Application Type

There are also a total of 13 R&D initiatives related to Capability Gap 4 identified in this assessment. Among the developing solutions identified, industry is involved in the development of 7 solutions, academia is involved in the development of 11 solutions, and government is involved in the development of 13 solutions. 12 developing solutions are focused on first responder applications, one is focused on commercial applications and one is focused on defense applications.

Based upon the data presented, more than half of all existing and developing solutions appear to be targeting first responder applications. Therefore, industry is likely aware that a first responder need exists within this technology space. With closer examination of these solutions though, the reason why this gap still exists is apparent. Not one of the existing or developing solutions identified meets all of responders' target objectives cited previously. In particular, the ability to validate data is under-developed within the technology landscape. However, it is critical to making the data collected and integrated trustworthy and useful. This presents an opportunity for firms that have focused on data collection and integration to enhance their capabilities by adding validation of information.

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 4 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 B 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.



All-Source Collection, Integration and Validation of Data

beAWARE (Horizon 2020 Initiative)

beAWARE is coordinated by the Center for Research and Technology Hellas – Information Technologies Institute (Greece) and received funding from the European Union's Horizon 2020 research and innovation program. The primary objective of beAWARE is the creation of an integrated solution to support forecasting, early warnings, transmission, and routing of emergency data. More specifically, beAWARE will collect heterogeneous data from several resources such as environmental sensors, social media, input from first responders, and/or people in danger. The solution will support aggregated analysis of multimodal data and manage the coordination of first responders and provide decision support services to crisis management centers.¹⁶

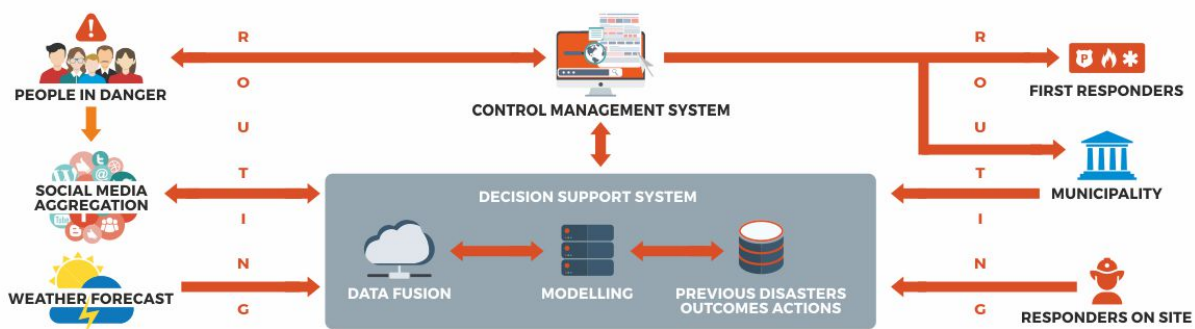


Figure 5: beAWARE

Chorus Analyzer

Chorus Analyzer from Chorus Intelligence Ltd. (United Kingdom) is an analytics software for law enforcement personnel that has the ability to ingest all forms of digital data, such as communications (including social network streams), automatic number plate recognition (ANPR)

data, wireless (RF) survey data, and handset downloads. The solution also uses geospatial analysis to overlay each data type in one customizable dashboard to help users identify trends and support investigation activities. According to Chorus Intelligence Ltd., 90 percent of police forces in the United Kingdom use Chorus Analyzer. However, information regarding specific deployment in the first responder community, as well as pricing, does not appear to be publicly available.^{17,18}



Figure 6: Chorus Analyzer

CommandCentral Suite

The Command Central Suite from Motorola Solutions, Inc. (United States) offers three products that are designed to integrate data for first responders:

- *CommandCentral Analytics* integrates data from a Computer-Aided Dispatch (CAD) or Records Management System (RMS) into a configurable dashboard. Users are able to recognize patterns through customized maps, graphs, and charts to target specific problems and drill down into the details of recurring incidents. The data can be shared and is accessible from any device.¹⁹
- *CommandCentral Aware* aggregates and integrates data into a command and control single interface. This product combines streaming video, real-time alerts, advanced data analytics, resource tracking, social media analytics, voice, CAD data, records information and other sources into a single, intuitive interface with layered geospatial mapping.²⁰
- *CommandCentral Inform* allows users to quickly access real-time event data into one map-based platform. This product combines CAD data, camera locations, resource location and status, open-

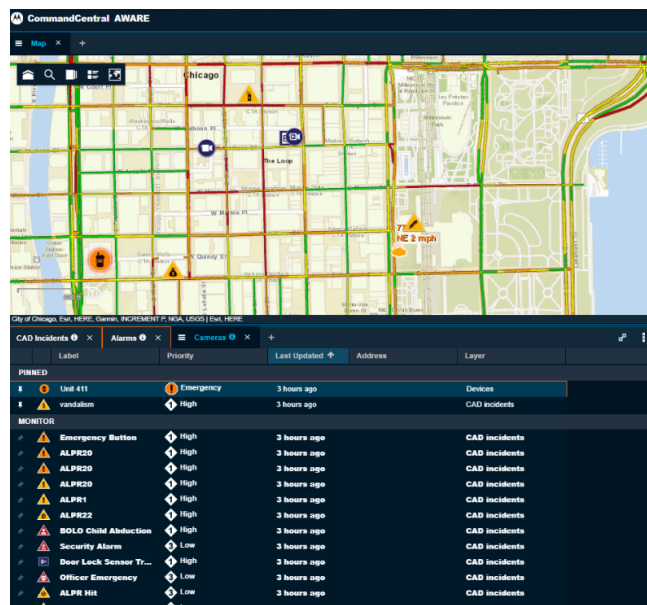


Figure 7: CommandCentral Aware

source data alerts, sensor alarms, etc. on a single map. Users can turn data layers on or off to filter what is needed and not needed at a particular time.²¹

Information regarding price and specific deployment within the first responder community does not appear to be publicly available.

E2mC (Horizon 2020 Initiative)

E2mC is coordinated by e-GEOS S.p.A (Italy) and received funding from the European Union's Horizon 2020 research and innovation program. The primary objective of E2mC is to “demonstrate the technical and operational feasibility of the integration of social media analysis and crowdsourced information within both the mapping and early warning components of the Copernicus Emergency Management Service (EMS),” which provides geo-spatial information of emergency incidents to first responders and other authorities.^{22,23} Researchers of E2mC aim to develop a service feature of Copernicus EMS that will exploit social media analysis and crowdsourcing capabilities. Specifically, the service feature, *Copernicus Witness*, will analyze heterogeneous social media streams (e.g., Twitter, Facebook, Instagram) and other data (e.g., text, image, video), as well as sparse crisis-specific and generic crowdsourcing communities (e.g., Tomnod, EpiCollect) to enhance situational awareness and improve decision-making during emergency incidents.²⁴

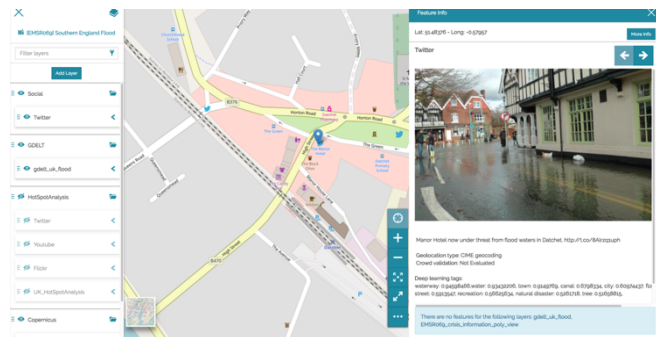


Figure 8: E2mC

IBM MobileFirst for iOS Incident Aware

IBM (United States) developed the Incident Aware application for its MobileFirst platform to provide law enforcement officers with location and incident information to help them understand the risks involved while on a call. The solution integrates data from local camera feeds, police records, incident histories, and other sources, and allows users to view information on augmented maps. Icons and pins on the map mark officers, vehicles, and incident locations. As the user moves, GPS tracks location for other officers and the command center. An additional feature allows users to silently request backup with one tap on the device. Further, included decision-making tools, such as the calculated risk rating, which is updated continuously, allow users to respond more safely and effectively.²⁵

The application is available for iPad, iPhone, and Apple Watch on the iOS app store. The Incident Aware app is offered as part of a service plan.²⁶ Information regarding specific deployment within the first responder community does not appear to be publicly available.



Figure 9: IBM MobileFirst for iOS Incident Aware

IncidentView

IncidentView from Alsea Geospatial, Inc. (United States) provides tactical information to first responders in augmented digital maps. Data sources include automatic vehicle location (AVL), dispatch information and notifications, local infrastructure, address records, preplan displays, and routing and navigation. An editor feature allows users to control and edit fire infrastructure data such as hydrants, standpipes, and access panels. IncidentView data can be accessed on Windows, iOS, and Android devices.²⁷

Pricing for IncidentView depends on the particular device used:²⁸

- Tablet or Smartphone
 - \$15 USD per device, per month
 - \$1,500 USD activation fee
- Computer or Toughbook
 - \$30 USD per device, per month
 - \$1,500 USD activation fee
- Internet Browser
 - \$1,200 USD per year
 - No activation fee



Figure 10: IncidentView

Information regarding specific deployment within the first responder community does not appear to be publicly available.

Intergraph InSight Explorer

Intergraph InSight Explorer from Hexagon AB (Sweden) is a self-serve, web-based crime mapping and analysis application for law enforcement agencies. The solution allows analysts to “search through and interpret large volumes of unstructured and structured data to make more informed decisions” and enhance investigative processes.²⁹ Additional capabilities of Intergraph InSight Explorer are listed below:³⁰

- Leverage data found in remarks, narratives, field interviews, and reports;
- Combine unstructured and structured data, tabular results, fuzzy logic, and geo-references and non-XY data;
- Utilize “elasticsearch” to process records and combine them into a single crime mapping and analysis application; and
- Integrate with Intergraph InPursuit WebRMS (records management system) and I/CAD (computer-aided dispatch system).

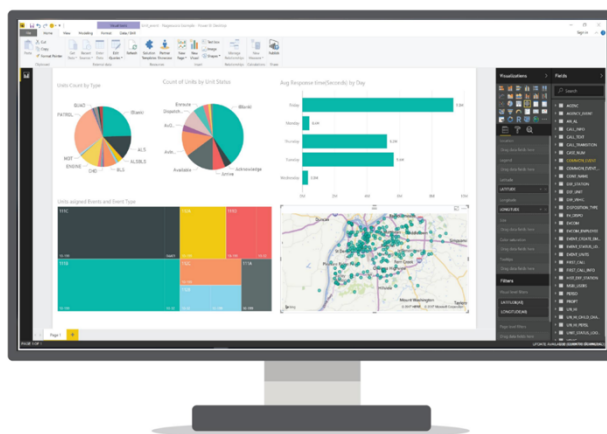


Figure 11: Intergraph InSight Explorer

Information regarding price and specific deployment within the first responder community does not appear to be publicly available.

IntelliSURF™

IntelliSURF™ from NCS Pte. Ltd. (Singapore) is a next-generation smart city operating platform designed to help governments and enterprises to:³¹

- Ingest data from a variety of sources (e.g., video, sensor, geospatial, social media, corporate information systems, etc.);
- Synthesize information to detect evolving situations, and to visualize the information through a unified dashboard to provide real-time situational awareness;
- Support operational efficiency through automated responses with standard operating procedures, notification, and collaboration tools; and
- Provide mobility options to individuals on the ground.



Figure 12: IntelliSURF™

IntelliSURF™ includes a suite of smart city applications for urban infrastructure and various use cases, including indoor navigation, real-time parking lot availability, physical security management, water consumption, video analytics, light control management, etc. Notably, IntelliSURF™ is an “open, modular platform,” which supports the development of additional, custom applications.³²

Information regarding price and specific deployment within the first responder community does not appear to be publicly available.

CitizenGlobal

CitizenGlobal (United States) developed a cloud-based platform designed to collect, manage, and analyze digital evidence as part of case management. Users are able to sync, manage, and share media from body, in-vehicle, and surveillance cameras. In addition, responders are able to search and collect real-time location-based social media and capture content from web pages. Responders are also able to collect media from eye witnesses, local businesses, and journalists. The digital files allow easy evidence sharing with the criminal justice system and to support Freedom of Information Act (FOIA) requests.

CitizenGlobal offers its platform to the Large Emergency Event Digital Information Repository (LEEDIR) that can be used for free by law enforcement and relief agencies during major events eyewitness photos, videos and text.³³ When activated:



Figure 13: CommandCentral Aware

- Eyewitnesses can submit multimedia information via the LEEDIR mobile apps (iOS and Android) and the LEEDIR website; and
- Collaborating agencies can securely manage, analyze and share information rapidly.

LEEDIR is a public-private partnership between CitizenGlobal and the Los Angeles County Sheriff's Office.

MAX Systems Portfolio

The MAX Systems portfolio from Zetron (United States) provide digital command and control console solutions. The modules can be used independently or integrated for greater functionality. Selected modules include:³⁴

- MAX Call-Taking is a Next Generation 9-1-1 solution with features including automatic call distribution, selective display of information to optimize call taking, SMS text to call formatting, a map viewer that integrates with local ESRI GIS data, and enhanced location services through RapidSOS.
- MAX CAD is an integrated CAD, GIS mapping, and AVL product. It allows users to manage multiple incidents using a customizable graphical user interface. The system automatically populates information and integrates with RMS and other databases, standard operating procedures (SOPs) and third-party medical data.
- MAX GIS Mapping is an ESRI-based map viewer. It can be used as a stand-alone map viewer for an individual incident, or integrated with CAD and historical databases. When integrated, the system will automatically map the active incident. When integrated with an AVL module the system will display vehicle locations on the incident map.

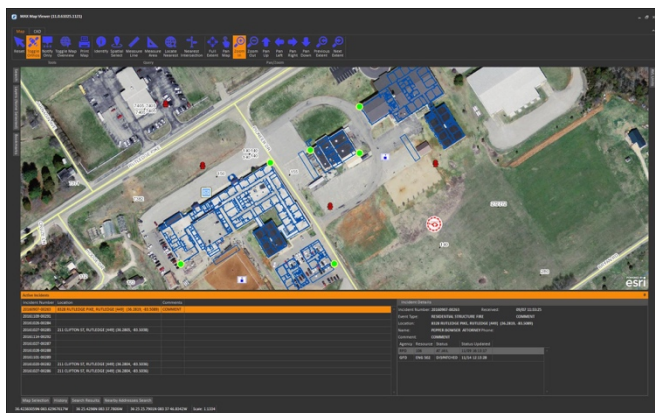


Figure 14: MAX GIS Mapping

Information regarding price and specific deployment within the first responder community does not appear to be publicly available.

NICE Investigate

NICE Public Safety (Israel) developed NICE Investigate to automate and expedite the collection, analysis and sharing of digital evidence. The solution provides detectives, investigators, prosecutors and law enforcement professionals with a secure online case management software. The platform integrates data from existing sources including CAD, RMS, automated license plate recognition systems, the automated fingerprint identification system (AFIS), etc. The system can also integrate with audio, video, and digital content from nontraditional sources such as crowdsourced content from citizens and closed-circuit television (CCTV) from local businesses.

Users are able to use a ‘Google-like’ feature to search across all connected information sources. Additional content analytics makes content within media (e.g., audio, video files) searchable as well. Decision-support tools suggest relevant content from connected sources to ensure that all relevant sources are considered. Information can be displayed in maps and timelines allowing users to better visualize data.³⁵

Information regarding price and specific deployment within the first responder community does not appear to be publicly available.

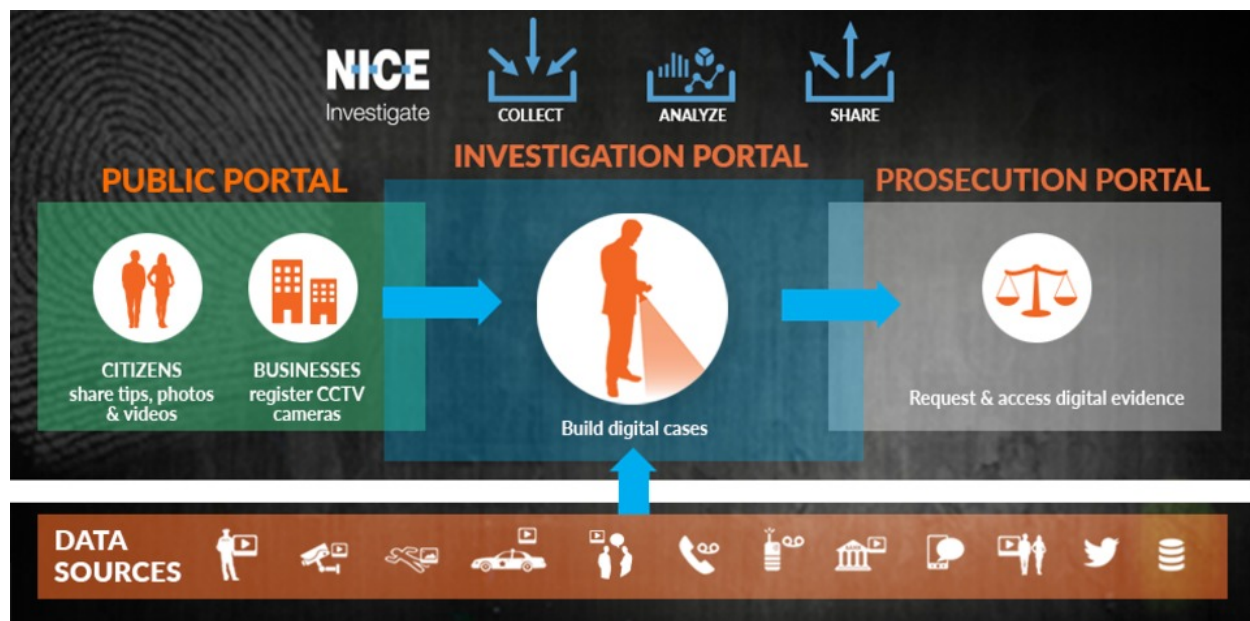


Figure 15: NICE Investigate Platform

Rave 911 Suite™

The Rave 911 Suite™ from Rave Mobile Safety (United States) integrates data sources and communications tools, allowing dispatchers and responders to handle, dispatch, and respond to emergency calls more effectively. The Rave 911 Suite™ combines:³⁶

- Call taker initiated two-way messaging with mobile-phone callers;
- e911 location tracking information;
- Secure, critical facility information through RaveFacility profiles (when available) that contain building information (e.g., floor plans, alarm information, utility shut-offs, automated external defibrillator [AED] locations); and
- Smart911 Safety Profiles (when available) which contain personal and medical information.



Figure 16: RAVE 911 Suite™ - Smart911 Safety Profile

First responders view and interact with the Rave 911 Suite™ using a web-browser on any Internet-enabled device. The solution is optimized for devices with small screens, such as smartphones or tablets.³⁷

Sentinel Visualizer

Information regarding price and specific deployment within the first responder community does not appear to be publicly available.

WebEOC

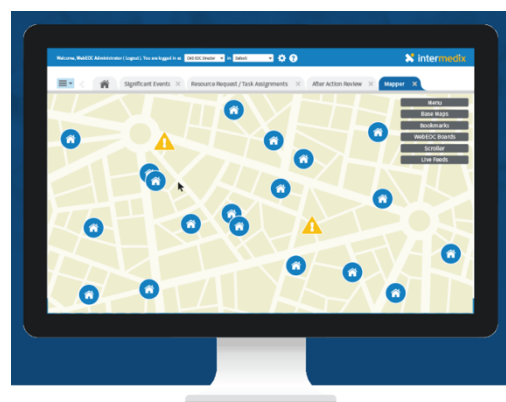


Figure 18: WebEOC

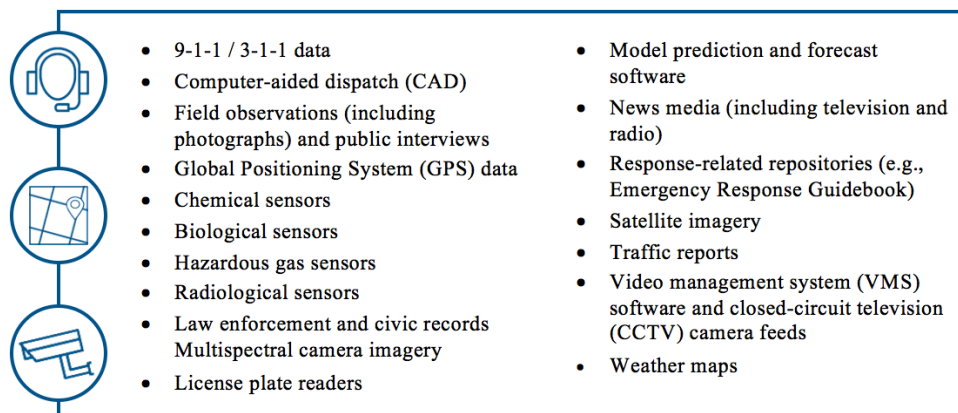
Appendix A

Capability Gap 4 refers to the need to collect, integrate, and validate data from multiple and nontraditional sources. To provide better context on what these sources are, the following section presents definitions and examples of both traditional and nontraditional information sources.

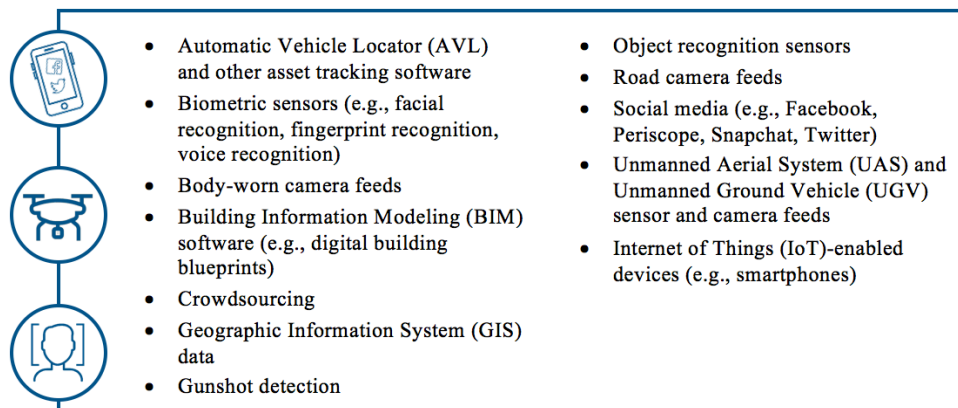
During emergency response operations, it is critical for incident command to obtain information about the incident scene from all available (and credible) information sources in order to enhance situational awareness and improve first responder safety, efficiency, and effectiveness.

Information needs differ depending on the type of incident and today, the majority of first responders are in need of real-time access to data from traditional and nontraditional information sources—that if seamlessly integrated into a common operating platform, could drastically transform emergency response operations.

Traditional information sources are defined as those that are generally accepted by the emergency response community, and those that first responders are more accustomed to using during an incident to inform and guide decision-making. Examples of traditional information sources include:



Nontraditional information sources are defined as those that are relatively new, and the use of which in response activities (to provide added situational awareness) is a recent addition to responder capability or is in development. Validation of these sources, particularly social media and other public data repositories, is a priority for first responders and must be addressed before these sources are more commonly accepted into emergency management and decision-making processes. Examples of nontraditional information sources include:



Appendix B

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
Active911	Active911 Inc.	United States
Aftermath Disaster & Emergency	Aftermath Data LLC	United States
Android Team Awareness Kit	Department of Homeland Security (DHS) Science and Technology Directorate (S&T)	United States
Anywhere Public Safety Software System	CODY Systems	United States
ArcGIS	Environmental Science Research Institute Inc. (Esri)	United States
Artificial Intelligence for Digital Response (AIDR)	Qatar Computing Research Institute (QCRI)	Qatar
Burgh's Eye View	City of Pittsburgh Department of Innovation and Performance	United States
C-Insight	CityShob Software Ltd.	United States
Call Taking and Computer-Aided Dispatch (CAD)	RapidDeploy	South Africa
Carbyne Control Suite	Carbyne Ltd.	Israel
Chorus Analyser	Chorus Intelligence Limited	United Kingdom
Citizen	Axon Enterprise Inc. (formerly TASER International)	United States
CityCop	CityCop Inc.	United States
Command Center Software	Motorola Solutions Inc.	United States
Computer-Aided Dispatch	NowForce Ltd.	Israel
Computer-Aided Dispatch	Souther Software Inc.	United States
Constellation	Haystax Technology Inc.	United States
CrimeCenter™ Case Management System	CrimeCenter Software	United States
Crisis360™	Smartbridge LLC	United States
CrisisWorks	CrisisWorks	Australia
DigitalGlobe Crowdsourcing	DigitalGlobe Inc.	United States

DigitalStakeout	DigitalStakeout Inc.	United States
Echo Responder™ Mobile App	Echo Response Technologies LLC	United States
Echosec™	Echosec Systems Ltd.	Canada
ELERTS Mobile App	ELERTS Corporation	United States
Emergency AUS Mobile App	Gridstone, a Motorola Solutions Inc. Company	Australia
EMS Computer-Aided Dispatch	Traumasoft LLC	United States
Europe Media Monitor (EMM) - NewsBrief	European Commission Joint Research Center (JRC)	Belgium
FDM Computer-Aided Dispatch (CAD)	FDM Software	Canada
First Response Software	Adashi Systems LLC	United States
Flex	Motorola Solutions Inc.	United States
Geoaware™ Services Platform	Vizsafe Inc.	United States
GovPilot®	GovPilot	United States
Hitachi Content Platform	Hitachi Vantara Corporation	United States
i2 Enterprise Insight Analysis	International Business Machines Corporation (IBM)	United States
IamResponding.com	Emergency Services Marketing Corporation Inc.	United States
IBM MobileFirst for iOS Incident Aware	International Business Machines Corporation (IBM)	United States
Incident Command Software (ICS)	Command Solutions Limited	United Kingdom
Incident Management (WebEOC)	EMS Systems LLC	United States
IncidentView	Alsea Geospatial Inc.	United States
Incode Public Safety Computer-Aided Dispatch	Tyler Technologies Inc.	United States
Inform CAD+911	TriTech Software Systems	United States
IntelliSURF™ Platform	NCS Pte. Ltd.	Singapore
InterAct Computer-Aided Dispatch (CAD)	Caliber Public Safety	United States
Intergraph InSight Explorer	Hexagon AB	Sweden
Large Emergency Event Digital Information Repository (LEEDIR)	CitizenGlobal Inc.	United States
Law Enforcement Message Switch/Justice Exchange (LEMS/JX™)	Unisys Corporation	United States
LEAP Network	Forensic Logic Inc.	United States

MAX CAD	Zetron Inc.	United States
Media Sonar	Media Sonar Technologies Inc.	Canada
NICE Investigate	NICE Ltd.	United States
ONESolution Public Safety Software	Superion LLC	United States
OpenStreetMap	OpenStreetMap Foundation (OSMF)	United Kingdom
Palantir Gotham	Palantir Technologies	United States
Pentaho Data Integration and Analytics	Hitachi Vantara Corporation	United States
Project Agos	Rappler Inc.	Philippines
Rave 911 Suite™	Rave Mobile Safety	United States
Raven Emergency Management Platform	Worldwide Incident Command Services Corporation (WICS)	United States
SAS® Intelligence and Investigation Management Software	SAS Institute Inc.	United States
SayVU	SayVU Technologies	Israel
Sentinel Visualizer	FMS Inc.	United States
Sintelix	Sintelix Pty Ltd	Australia
Smart City/Intelligent Traffic/Transportation Systems (ITS)	IntelliVision Technologies Corporation	United States
UN-ASIGN Crowdsourcing App	AnsuR Technologies AS	Norway
Ushahidi	Ushahidi Inc.	Kenya
Versaterm Records Management System (vRMS)	Versaterm Inc.	Canada
Visallo	Visallo LLC	United States
WebFOCUS	Information Builders	United States

In-Development Solutions		
Solution	Solution Developer(s)	Country
AUDREY	Department of Homeland Security (DHS) Science and Technology Directorate (S&T)	United States
beAWARE	Center for Research and Technology-Hellas (CERTH)	United States
E2mC	E-GEOS Spa	Greece
PetaJakarta.org	University of Wollongong Australia	Italy

Real-Time Video Analytics for Situational Awareness	Carnegie Mellon University	Australia
RED-ALERT	Siveco Romania SA	United States
RiskMap.us	Urban Risk Lab at the Massachusetts Institute of Technology (MIT)	Romania
Slándáil	College of the Holy & Undivided Trinity of Queen Elizabeth	United States
Social Media Analytics and Reporting Toolkit (SMART)	Purdue University	Ireland
TENSOR	Police Service of Northern Ireland	United States
TweetTracker	Arizona State University	United Kingdom
VICTORIA	Idemia Identify & Security France	United States

Appendix C

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 Cognitive and Artificial Intelligence (AI) Systems Market**
A market figure was available for 2021. A CAGR of 46.2% was used to estimate the revenue values for 2022. Market figures were rounded to the nearest hundred million.
- **Global Command and Control Room and Public Safety Answering Point (PSAP) Market**
Market figures were available for 2015 and 2020. A CAGR of 7.1% was used to estimate the revenue values for 2021 to 2022. Market figures were rounded to the nearest hundred million.

Glossary

All-Source Collection and Integration of Data

A component of Capability Gap 4 that describes the need of first responders to collect and integrate data from both traditional and nontraditional information sources in a user-configurable, common operating platform.

All-Source Information Validation

A component of Capability Gap 4 that describes the need of first responders to validate data from both traditional and nontraditional information sources. This need is a particular concern when information is collected from public repositories, such as social media feeds, from which source credibility is more difficult to determine.

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.

Nontraditional Information Sources

Source that are relatively new, and the use of which in response activities (to provide added situational awareness) is in development (e.g., social media, biometric sensors, body-worn camera feeds, etc.).

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.

Response Technology Objective (RTO)

A term used within *Project Responder 4* to translate a capability statement or need into an actionable, technology-centric objective. Each RTO identifies a high-level technology solution (or part of a solution) designed to improve the capabilities of the emergency response community.

Traditional Information Sources

Sources that are generally accepted by the emergency response community, and those that first responders are more accustomed to using during an incident to inform and guide decision-making (e.g., 311 data, weather maps, field observations, etc.).

References

- ² “Project Responder 4: 2014 National Technology Plan for Emergency Response to Catastrophic Incidents,” (Washington: Department of Homeland Security, Science and Technology Directorate,) July 2014, 24. https://www.dhs.gov/sites/default/files/publications/Project%20Responder%204_1.pdf
- ³ Ibid, p. 50
- ⁴ Ibid, p. 53
- ⁵ “Exploiting the Product Life Cycle,” *Harvard Business Review*, Nov. 1965, <https://hbr.org/1965/11/exploit-the-product-life-cycle>
- ⁶ “Global Physical Security Information Management (PSIM) Market: Efficacy to Counter Cybercrime Boosts Adoption,” *Transparency Market Research*, June 2018, <https://www.transparencymarketresearch.com/pressrelease/physical-security-information-management.htm>
- ⁷ “Public Safety Analytics Market by Component (Solution and Service), Analytics Type (Predictive, Prescriptive, and Descriptive), Application, Deployment Mode (On-Premises and Hosted), Industry Vertical, and Region - Global Forecast to 2022,” *Research and Markets*, March 2018, <https://www.researchandmarkets.com/reports/4473997/public-safety-analytics-market-by-component>
- ⁸ “Big Data and Data Analytics in Homeland Security and Public Safety is Forecast to Reach \$11B in 2022, Says a New Research Report from Homeland Security Research Corp.,” *Homeland Security Research Corporation*, 12 Dec. 2016, <https://homelandsecurityresearch.com/press-release-big-data-and-data-analytics-in-homeland-security-and-public-safety-is-forecast-to-reach-11b-in-2022-says-a-new-research-report-from-homeland-security-research-corp/>
- ⁹ “Computer-Aided Dispatch Market by Component (Solutions and Services), Application Area (Call Management, Dispatch Unit Management, Reporting, and Analysis), Deployment Type, Organization Size, Vertical, and Region - Global Forecast to 2022,” *MarketsandMarkets*, Aug. 2017, <https://www.marketsandmarkets.com/Market-Reports/computer-aided-dispatch-market-4669389.html>
- ¹⁰ “Command and Control Systems Market by Platform (Airborne C2, Land C2, Maritime C2, Space C2), Solution (C2 Hardware, C2 Software, C2 Services), Application (Defense, Commercial), and Region (NA, EU, APAC, ME, Row) – Global Forecast to 2022,” *MarketsandMarkets*, April 2018, <https://www.marketsandmarkets.com/Market-Reports/command-control-system-market-144844194.html>
- ¹¹ “Control Room Technologies and Services Market to Reach \$7.6 Billion by 2020, IHS Markit Says,” *IHS Markit*, 19 July 2016, <http://news.ihsmarkit.com/press-release/technology/control-room-technologies-and-services-market-reach-76-billion-2020-ihs-mar>
- ¹² “IoT for Public Safety Market by Component (Platform, Solution, and Services), Application (Emergency Communication & Incident Management, Surveillance & Security, and Disaster Management), Vertical Market, and Region - Global Forecast to 2023,” *MarketsandMarkets*, June 2018, <https://www.marketsandmarkets.com/Market-Reports/iot-public-safety-market-75184168.html>
- ¹³ “New Report Predicts \$346M NG 9-1-1 Market by 2022,” *Pandata Corp.*, 4 Aug. 2017, <https://www.rmediagroup.com/News/NewsDetails/NewsID/15814>
- ¹⁴ “Incident and Emergency Management Market by System (Web-Based Emergency Management, Mass Notification, Surveillance System, Safety Management), Solution, Service, Simulation, Communication Tool and Device, Industry Vertical, and Region – Global Forecast to 2023,” *MarketsandMarkets*, March 2018, <https://www.marketsandmarkets.com/Market-Reports/incident-emergency-management-market-1280.html>
- ¹⁵ “Worldwide Spending on Cognitive and Artificial Intelligence Systems Will Grow to \$19.1 Billion in 2018, According to New IDC Spending Guide,” *International Data Corporation*, 22 March 2018, <https://www.idc.com/getdoc.jsp?containerId=prUS43662418>
- ¹⁶ “Home Page,” *beAWARE*, n.d., <https://beaware-project.eu>
- ¹⁷ “Chorus Analyzer,” Chorus Intelligence Ltd., n.d., <https://chorusintel.com/analyser/>
- ¹⁸ *Chorus Analyzer*, Chorus Intelligence Ltd., n.d., <https://chorusintel.com/wp-content/uploads/2018/03/Chorus-Analyser-Brochure-02.18-web.pdf>
- ¹⁹ “CommandCentral Analytics – Crime Data Analysis,” Motorola Solutions, Inc. Accessed 29 July 2018. https://www.motorolasolutions.com/en_xu/products/smart-public-safety-solutions/intelligence/commandcentral-analytics.html#taboverview
- ²⁰ Ibid.
- ²¹ Ibid.

-
- ²² “E2mC,” *Community Research and Development Information Service*, 4 Aug. 2018, https://cordis.europa.eu/project/rcn/206332_en.html
- ²³ “Copernicus Emergency Management Service,” *Copernicus*, n.d., <http://copernicus.eu/main/emergency-management>
- ²⁴ “E2mC,” *Community Research and Development Information Service*, 4 Aug. 2018, https://cordis.europa.eu/project/rcn/206332_en.html
- ²⁵ “IBM MobileFirst for iOS Incident Aware,” *IBM*, n.d., <https://www.ibm.com/us-en/marketplace/incident-aware-government-ios-app>
- ²⁶ Ibid.
- ²⁷ “IncidentView Digital Maps for First Responders,” *Alsea Geospatial, Inc.*, n.d., <http://www.incidentview.com/#Overview>
- ²⁸ Ibid.
- ²⁹ “Intergraph InSight Explorer,” *Hexagon AB*, n.d., <https://www.hexagonsafetyinfrastructure.com/products/public-safety-analytics/intergraph-insight>
- ³⁰ Ibid.
- ³¹ “Igniting the Pulse of the City,” *NCS Ptd. Ltd.*, n.d., <https://www.ncs.com.sg/solutions-for-urbanised-future>
- ³² Ibid.
- ³³ “LEEDIR,” *LEEDIR*, n.d., <https://www.leedir.com/about>
- ³⁴ “MAX CAD,” *Zetron*, n.d., <https://www.zetron.com/mission-critical-solutions/max/cad/>
- ³⁵ “NICE Investigate.” *NICE Systems, Inc.*, n.d., https://www.nice.com/Protecting-People-And-Assets/Lists/Brochures/NICE_Investigate_Solution_Overview.pdf
- ³⁶ “Rave 911 Suite™,” *Rave Mobile Safety*, n.d., <https://www.ravemobilesafety.com/rave-911-suite>
- ³⁷ Ibid.
- ³⁸ “The Next Generation of Big Data Visualization,” *FMS, Inc.*, n.d., <http://www.fmsag.com/Products/SentinelVisualizer/>
- ³⁹ Ibid.
- ⁴⁰ “The New WebEOC,” *EMSystems LLC*, n.d., <https://www.juware.com/solutions/webeoc>