





The International Forum to Advance First Responder Innovation

Statement of Objectives (SOO) for Technologies Related to: "The ability to create actionable intelligence based on data and information from multiple sources"

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FIRST RESPONDER INNOVATION

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Statement of Objectives (SOO) for Technologies Related to: **"The ability to create actionable intelligence based on data and information from multiple sources"**

Background

The International Forum to Advance First Responder Innovation (IFAFRI) is an organization of international government leaders from 13 countries and the European Commission, focused on enhancing and expanding the development of new technology for first responders worldwide.[1] 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 global first responder markets to inform and guide industry and academia to develop and produce innovative technology solutions at affordable prices; and
4. Providing information about relevant and available first responder technologies to the first responder community.

To arrive at a set of *Common Global Capability Gaps*, IFAFRI members conducted analyses of first responder capability gaps in their respective countries. IFAFRI then assessed those gaps to identify those that were common across multiple member nations. The gaps with the highest commonality amongst member nations were presented to all IFAFRI members for consensus. IFAFRI has reached consensus on ten first responder capability gaps:

[1] For the purpose of this document, the term "first responder" refers to 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.

The ability to know the location of responders and their proximity to risks and hazards in real time
The ability to detect, monitor, and analyze passive and active threats and hazards at incident scenes in real time
The ability to rapidly identify hazardous agents and contaminants
The ability to incorporate information from multiple and nontraditional sources into incident command operations
The ability to maintain interoperable communications with responders in any environmental conditions
The ability to obtain critical information remotely about the extent, perimeter, or interior of the incident
The ability to conduct on-scene operations remotely without endangering responders
The ability to monitor the physiological signs of emergency responders
The ability to create actionable intelligence based on data and information from multiple sources
The ability to provide appropriate and advanced personal protective equipment (i.e., garments, gear, and breathing apparatus)

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IFAFRI is publishing this Statement of Objectives (SOO) to provide a technical overview of the global first responder need and direct researchers who may be interested in pursuing development of related solutions. IFAFRI will assist with facilitating interactions between first responders and organizations pursuing development toward this capability gap.

This particular SOO is focused on:

"The ability to create actionable intelligence based on data and information from multiple sources"

There is a significant amount of data generated during an incident, however, many sources produce raw data in a format that is not easy to understand or use. For example, hazard sensors report measurements, but without prior knowledge or additional contextual information a value or response may mean little to the user. Responders may not be able to easily identify critical information, implications of the information, or patterns embedded in the data. Raw data are often useless data; only after they are transformed into actionable information or intelligence do they have utility. Adding context, validation, and follow-on information provides value during on-scene response operations. A measurement from a chemical sensor may be insufficient to allow responders to act. However, when combined with information on the chemical type, prevailing

wind direction, and recommended protective actions, responders can act purposefully to increase their level of safety. Actionable intelligence allows responders to understand the information in the context of the incident and plan their actions accordingly.[2]

Data analytics is used in many fields to provide context, draw conclusions, and identify patterns, correlations, and insights from raw data. Data analytics can be applied to routine operations (e.g., identifying potential increases in emergency medical service calls based on weather patterns) or to support response to a specific incident (e.g., analysis of data from multiple records sources to identify likely suspects).

General Description of Operational Capability

Responders would like solutions that provide information that can be used to make more effective decisions across many responder tasks. Information should be viewable on existing platforms, including smartphones, mobile data terminals, and other computer systems. Analysis should be completed in real time and updated when additional data is available. When appropriate, information should be distilled and presented in charts, graphs, maps, etc. Potential solutions may include templates, checklists, or other aides that allow responders and command to make more informed decisions. Outputs from potential solutions may also be used for planning or risk assessment purposes.

This gap is related to the fourth gap, "the ability to incorporate information from multiple and nontraditional sources into incident command operations," which focuses on the integration of data. Data may need to be integrated from multiple sources to create actionable information, but this is not always the case. This SOO focuses on the analysis of individual and/or integrated data sources to create information that can be used for better planning, decision-making, and action.

Existing First Responder Capabilities

Current capabilities to create actionable intelligence based on data and information from multiple sources include:

- Joint task forces or joint intelligence cells;
- Agency intelligence analysts;
- Agency data analysts;
- Plume models;
- Commercially-available data integration and decision-support tools (limited availability due to cost);
- State and jurisdiction-level data integration and visualization platforms; and
- Computer-aided dispatch (CAD) systems.

[2] *Project Responder 5,* (Washington: Department of Homeland Security,) August 2017, 97. https://www.dhs.gov/sites/default/files/publications/Project-Responder-5-Report_170814-508.pdf

Operational Environment

The following list provides examples of operating conditions that *may* be encountered by first responders on a daily basis. It is not an all-inclusive list, but is intended to illustrate the diversity of conditions in which responders operate.

- Single and multi-level buildings;
- Structures of varied construction materials (e.g., steel, concrete, wood frame, masonry, synthetic materials);
- Collapsed or threatened buildings;
- Confined spaces;
- Subterranean and underground facilities;
- Wooded areas with dense vegetation;
- Rugged outdoor terrain;
- Areas with limited or no cellular and/or radio connectivity;
- Extreme high and low temperatures and humidity;
- Wet conditions (e.g., rain, flooding);
- Thermal radiation [3];
- Direct flame contact or exposure;
- Excessively noisy and smoky conditions in outdoor, indoor and/or subterranean areas;
- Vast expanse of incident scene (i.e., lack of line-of-sight between commanders and deployed personnel);
- Underwater and maritime environments;
- Chemical, biological, and radiological hazards (e.g., corrosives, infectious diseases); and
- Human threats (e.g., active shooter, knife attacker).

Target Objectives

1. Provide user with contextual information and potential effects or consequences;
2. Assess incident-specific data against legacy data and information;
3. Provide predictions, forecasts and models; and
4. Provide decision-support.

The following section provides responder-identified requirements for potential solutions. It is understood that not all requirements may be currently technically feasible. Responders would prefer incremental, continuous advancement of solutions instead of waiting for equipment that meets all of the requirements at the same time. As such, these requirements do not represent a minimum set of requirements that must be met before new tools, devices, platforms or systems can be released.

[3] Thermal radiation, one of three methods of heat transfer, causes increase in temperature from electromagnetic waves. Thermal radiation can cause flashover within a room, causing all contents to raise to their ignition temperature and engulf the room from floor to ceiling. Thermal radiation can also increase the temperature of firefighter garments, damaging the gear and causing potential harm to the responder.

Data Type Requirements

Information that is pertinent to emergency response operations comes from pre-existing and incident-specific data sources. Potential solutions should:

- Assess data from multiple sources and types:
  - Video feeds;
  - Still images;
  - Hazard sensor data (e.g., chemical, gas);
  - Map and terrain data;
  - Responder geolocation data;
  - Digital building blueprints (e.g., building information modeling (BIM));
  - Data from Internet of Things (IoT)-connected devices;
  - Public safety data sources (e.g., law enforcement record systems, license plate readers, CAD data);
  - Public and private health-related data sources (e.g., public health alerts, hospital patient care records, community social service data)
  - Public data feeds (e.g., traffic, school, municipal video feeds, property tax records, permits);
  - Available private data feeds (e.g., cell phone records and triangulation, bank records, personal and/or business camera systems);
  - Traditional and social media data;
  - Data from response-related repositories;[4]
  - Data from transportation repositories;[5]
  - Best practice documents or repositories;
  - Near real-time satellite imagery;
  - Virtual/augmented reality data sources;
  - Application-based data feeds;[6]
- Allow rapid integration of new data feeds into the system;
- Allow removal of data feeds from the system; and
- Include solutions for fire, law enforcement, emergency medical services, and emergency management.

Assessment Requirements

A key component of this capability gap is the need to analyze the raw data to create actionable information. Potential solutions should:

- Analyze incident-specific and historical data, using multiple sources when possible;
- Use appropriate analytical methodologies to develop actionable information (e.g., trend and pattern, link, sentiment);

[4] Example: The Emergency Response Guidebook (ERG) contains an indexed list of dangerous goods, the general hazards those dangerous goods pose, and recommended safety precautions.
[5] Example: AskRail provides information to emergency responders with data about the type of hazardous materials being transported by railcar.
[6] Example: 999Eye allows callers with compatible mobile devices to securely share live footage of incidents with public safety agencies.

- Perform analysis in real time;
- Provide predictive analysis on the potential occurrence or evolution of an event;
- Provide predictive analysis on the potential consequences of decisions and/or actions;
- Provide outputs to support decision-making through templates, checklists, or recommended courses of action;
- Provide operational prompts based on results of analysis;
- Perform data quality analysis (e.g., validation/credibility of data sources);
- Alert user to anomalies or results that need further attention;
- Alert user to critical information;
- Identify when and which data is missing or incomplete;
- Alert user to similarities and differences from past incidents;
- Provide outputs in a usable format;
    - Allow user to filter data and customize filter criteria;
    - Allow user to customize triggers and thresholds;
- Generate analysis products (written or graphical) in real time;
- Update assessments when new data is available;
- Provide confidence measurement to indicate accuracy and reliability of analysis;
    - Utilize prioritized parameters to assess confidence in analysis (i.e., data from trusted sources increases confidence);
    - Provide a visual indication of confidence level;
- Perform analysis autonomously and/or requires a low cognitive load for users; and
- Provide option allowing user to confirm receipt or describe resulting actions; and
- Be scalable to incident size, to include cross-border incidents.

Visualization Requirements

Potential solutions should provide a visual display of information as appropriate. Potential solutions should:

- Allow display on common communications and computing devices (e.g., smartphones, tablets, laptops);
- Create and update visualization products in real time;
    - Incident-specific outputs;
    - Incident-specific predictive outputs;
    - Future predictive outputs;
- Allow user to view data as it changes over time (i.e., historical and within the incident);
- Provide an intuitive graphical user interface (GUI);
- Display data in multiple formats (e.g., text, images, tables, graphs);
- Allow user to customize display settings (e.g., font, icons); and
- Allow for the development of customized user profiles (e.g., tags, triggers, searches).

Transmission Requirements

Potential solutions should provide real-time transmission of actionable information to responders, command, and other intended destinations. Potential solutions should:

- Encrypt data prior to transmission;
- Transmit data:
  - To intended destination;
  - In real time;
- Automate data routing, storage, and processing;
- Function in a communications-degraded environment:
  - Securely cache data intended for recipients when connection to a communication network cannot be made;
  - Securely transmit cached data to recipients when connection to a communications network is restored without affecting live data streaming; and
- Store for post-incident analysis.

Compatibility Requirements

Potential solutions should integrate data and outputs with other response systems. Potential solutions should:

- Comply with exchange standards for data transmission;[7]
- Be compatible with multiple operating systems (e.g., Windows, macOS);
- Bi-directionally (where appropriate) integrate with:
  - Existing communications devices;
  - Electronic situational awareness tools;
  - Electronic incident command systems;
  - Dispatch systems; and
  - Model prediction and forecast systems.

Maintenance Requirements

Potential solutions should be easy to operate and maintain throughout the service life. Potential solutions should:

- Maintain backwards compatibility after upgrade;
- Perform automated periodic malware detection and cybersecurity screening of software and firmware components;
- Provide secure portal access standards to allow authorized users access to the system;[8]
- Allow for remote maintenance;
- Allow for remote upgrades;
- Provide live notification of a fault;
- Maintain a fault log; and
- Maintain an access log.

[7] Examples: National Information Exchange Model (NIEM) and OASIS Standards
[8] Example: National Institute of Standards and Technology Special Publication 800-95

Cost Requirements

Potential solutions should be designed to minimize price of system, consumables, training, and maintenance. Potential solutions should be priced to be affordable to all response agencies and should be designed for daily use.

Additional Considerations

As in other research and development endeavors, additional considerations should be evaluated by organizations wishing to pursue innovation toward this gap:

- Detailed test and evaluation strategy for the viability of system(s);
- Transition strategy to guide the prototype(s) into commercialization;
- Specifications to guide the development of viable commercial system(s);
- Standards, guidelines, other legal requirements; and
- Stakeholder oversight/interaction, to ensure that the developed system meets the requirements identified by the first responder community.