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Voices of First Responders—Nationwide Public Safety Communication Survey Methodology:

Development, Dissemination, and Demographics
Phase 2, Volume 1

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National Institute of Standards and Technology
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Voices of First Responders Series

This report is a part of a series of publications amplifying the voices of first responders (VoFR) in four public safety disciplines: Communication Center & 9-1-1 Services (COMMS); Emergency Medical Services (EMS); Fire Service (FF); and Law Enforcement (LE). The VoFR series reports on the experiences of first responders with communication technology, including their needs for, and problems with, communication technology. Publications in this series are primarily intended for designers, developers, vendors, and researchers of public safety communication technology, as well as for public safety administrators and decision-makers.

Published as a part of the VoFR series include NIST reports, conference papers, presentations, posters, articles and blog posts, a book chapter, and a web tool for disseminating the research results and data collected from the interviews with and survey of first responders. The reports from which all published materials are derived are listed below and can be accessed from the ***PSCR User Interface/ User Experience Publications*** webpage at: https://www.nist.gov/ctl/pscr/user-interface-user-experience-publications. The ***PSCR Usability Results Tool***, providing access to results of the large-scale survey and in-depth interviews with first responders across the U.S. about their communication technology use, can be accessed via https://publicsafety.nist.gov/. The datasets from this research project are available via https://doi.org/10.18434/mds2-2820.

Voices of First Responders

- How to Facilitate Adoption and Usage of Communication Technology: An Integrated Analysis of Qualitative and Quantitative Findings (NISTIR 8443) https://doi.org/10.6028/NIST.IR.8443
- COMMS (NIST SP 1286pt1) https://doi.org/10.6028/NIST.SP.1286pt1
- EMS (NIST SP 1286pt2) https://doi.org/10.6028/NIST.SP.1286pt2
- FF (NIST SP 1286pt3) https://doi.org/10.6028/NIST.SP.1286pt3
- LE (NIST SP 1286pt4) https://doi.org/10.6028/NIST.SP.1286pt4

Phase 1: Findings from User-Centered Interviews

- Volume 1 - *Identifying Public Safety Communication Problems* (NISTIR 8216) https://doi.org/10.6028/NIST.IR.8216
- Volume 2 - *Examining Public Safety Communication Problems and Requested Functionality* (NISTIR 8245) https://doi.org/10.6028/NIST.IR.8245
- Volume 3 - *Examining Public Safety Communication from the Rural Perspective* (NISTIR 8277) https://doi.org/10.6028/NIST.IR.8277
- Volume 4 - *Examining Public Safety Communication from the Perspective of 9-1-1 Call Takers and Dispatchers* (NISTIR 8295) https://doi.org/10.6028/NIST.IR.8295
- Volume 5 - *Applying Human Factors and Ergonomics Knowledge to Improve the Usability of Public Safety Communications Technology* (NISTIR 8340) https://doi.org/10.6028/NIST.IR.8340

Phase 2: Nationwide Survey

- Volume 1 - *Methodology: Development, Dissemination, and Demographics* (NISTIR 8288) https://doi.org/10.6028/NIST.IR.8288
- Volume 2 - *Mobile Devices, Applications, and Futuristic Technology* (NISTIR 8314) https://doi.org/10.6028/NIST.IR.8314
- Volume 3 - *Day-to-Day Technology* (NISTIR 8400) https://doi.org/10.6028/NIST.IR.8400
- Volume 4 - *Statistical Analysis Results* (NISTIR 8444) https://doi.org/10.6028/NIST.IR.8444

Abstract

With the newly created Nationwide Public Safety Broadband Network (NPSBN), the public safety community is in the process of supplementing the use of land mobile radios (LMR) to a technology ecosystem that will include a variety of new communication tools, including a range of broadband data sharing platforms. It is imperative to have a clear understanding of first responder needs, requirements, and contexts of use in order for successful deployment and adoption of new communication technology. This report is part of a multi-phase mixed methods project that is designed to provide an in-depth look at the population of first responders, along with their work environments, their tasks, and their communication needs, with particular focus on their technology problems. In the current project phase, a large-scale, online nationwide survey of first responders in 911/Dispatch, Emergency Medical Services (EMS), Fire Service, and Law Enforcement was conducted. This report details the survey methodology, including survey development and dissemination, and summarizes nationwide participant demographics.

A total of 7 182 completed survey responses were received, with responses from all 50 states and the District of Columbia (D.C.). The survey sampling priorities were mirrored in the data, with good representation from the four public safety disciplines surveyed (911/Dispatch, EMS, Fire Service, and Law Enforcement), and a good mixture of responses from urban, suburban, and rural areas. Other demographic variables of interest—such as jurisdictional level, years of service, and age—also showed good variability, mapping well to national numbers. Such a largescale survey, with over 7 000 completed responses across the United States, represents a dataset of great relevance for the public safety community. This multi-phase, mixed methods project provides direct input from first responders about the communication technology used and needed by first responders.

Key words

First responders; Communication technology; Public safety communication research; Survey research; Usability; User needs and requirements.

Audience

This report is primarily intended for designers, developers, vendors, researchers, and public safety administrators of public safety communication technology.

Disclaimer

Any mention of commercial products or reference to commercial organizations is for information only; it does not imply recommendation or endorsement by the National Institute of Standards and Technology, nor does it imply that the products mentioned are necessarily the best available for the purpose.

Executive Summary

With the newly created Nationwide Public Safety Broadband Network (NPSBN), the public safety community is in the process of supplementing the use of land mobile radios (LMR) to a technology ecosystem that will include a variety of new and improved communication tools, including a range of broadband data sharing platforms. It is imperative to have a clear understanding of first responder needs, requirements, and contexts of use in order for successful deployment and adoption of new communication technology. This report is part of a multi-phase, exploratory sequential mixed methods project that is designed to provide an in-depth look at the population of first responders, along with their work environments, their tasks, and their communication needs, with particular focus on their technology problems.

The first phase of the project, Phase 1, provided a qualitative examination of first responders' technology problems and requirements, focusing on interviews with approximately 200 first responders across the country from four public safety disciplines; 911/Dispatch, Emergency Medical Services (EMS), Fire Service, and Law Enforcement. The second phase of the project, Phase 2, utilized the results of the Phase 1 qualitative interviews to inform a large-scale, online, quantitative nationwide survey in order to provide a more comprehensive view of first responders and communication technology. This report details the Phase 2 survey methodology, including survey development and dissemination, and summarizes nationwide participant demographics.

In keeping with survey methods best practices, domain expert and survey expert reviews were conducted during the survey development process, as well as cognitive walkthroughs by first responders. This ensured that the survey language reflected terminology directly from those in the public safety field. A stratified, prioritized sample was employed. Sampling priorities focused primarily on first responder disciplines at the local jurisdictional level. Another high priority for sampling was outreach to urban, suburban, and rural areas. During survey dissemination, outreach via email occurred at the department/agency level.

A total of 7 182 completed survey responses were received, with responses from all 50 states and the District of Columbia (D.C.). The sampling priorities were mirrored in the data, with good representation from the four public safety disciplines surveyed (911/Dispatch, EMS, Fire Service, and Law Enforcement), and a good mixture of responses from urban, suburban, and rural areas. Other demographic variables of interest—such as jurisdictional level, years of service, and age—also showed good variability, mapping well to national numbers.

Such a largescale survey, with over 7 000 completed responses across the United States, represents a dataset of great relevance for the public safety community. The current report provides the methodological foundation and demographics overview necessary for more detailed future analyses, which will be presented in additional volumes. This multi-phase, mixed methods project provides direct input from first responders about the communication technology used and needed by first responders. Findings from across this multi-phase project can aid developers and researchers in the public safety communication technology domain.

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List of Acronyms and Abbreviations

AAST ..... American Association of State Troopers
AED ..... Automatic External Defibrillator
APCO ..... Association of Public Safety Communications Officials
Apps ..... Applications
AR ..... Augmented Reality
AVL ..... Automatic Vehicle Location
CAD ..... Computer-Aided Dispatch
COMMS ..... Communications, 911/Dispatch
D.C. ..... District of Columbia
EMS ..... Emergency Medical Services
EPCR ..... Electronic Patient Care Reporting
ERG ..... Emergency Response Guide
FAQ ..... Frequently Asked Questions
FEMA ..... Federal Emergency Management Agency
FF ..... Fire Service, Fire Fighting
HUDs ..... Heads-Up Displays
IACP ..... International Association of Chiefs of Police
IAFC ..... International Association of Fire Chiefs
LE ..... Law Enforcement
LMR ..... Land Mobile Radio
MCC ..... Mission Critical Communications
MCCA ..... Major Cities Chiefs Association
MDC ..... Mobile Data Computer
MDT ..... Mobile Data Terminal
Mic ..... Microphone
NACSA ..... National Association of Campus Safety Administrators
NCCPS ..... National Center for Campus Public Safety
NENA ..... National Emergency Number Association
NFPA ..... National Fire Protection Association
NG 911 ..... Next Generation 911
NHTSA ..... National Highway Traffic Safety Administration
NPSBN ..... Nationwide Public Safety Broadband Network
NSA ..... National Sheriffs' Association
NVFC ..... National Volunteer Fire Council
POCs ..... Points of Contact
PSAP ..... Public Safety Answering Point
PSCR ..... Public Safety Communications Research

RMS ..... Records Management System
TIC ..... Thermal Imaging Camera
UI/UX ..... User Interface/User Experience
URL ..... Uniform Resource Locator
VR ..... Virtual Reality

1. Introduction

The Nationwide Public Safety Broadband Network (NPSBN), a high-speed infrastructure for public safety, is being developed as a result of the United States Middle Class Tax Relief and Jobs Creation Act of 2012. The establishment of the NPSBN provides a unique opportunity to advance public safety communication. If advanced public safety communication technology is to be successful, first responders[1] must be able to achieve their goals and objectives with effectiveness, efficiency, and satisfaction in their specified contexts of use—in other words, the technology must be usable [12]. The Public Safety Communications Research (PSCR) community has identified user interfaces and user experience (UI/UX) as critical components for successful deployment and adoption of new communication technology [21]. The challenge for communication technology developers and designers is truly understanding first responder needs, requirements, and their contexts of use. This is no easy task given the variability within the first responder population. For example, there are differences across first responder disciplines—911/Dispatch Communications (COMMS), Emergency Medical Services (EMS), Fire Service (FF), and Law Enforcement (LE)—in the types of tools they use and for what purposes. There are also differences in communication technology needed and problems experienced based on geography and topography, as well as where first responders are located—rural, suburban, or urban areas. This is why it is so crucial to understand the different public safety user groups and the communication technology they currently use, problems experienced with current technology, and technology they envision for the future.

In order to understand the users, user experience, and user needs related to public safety communication technology, the PSCR Usability Team conducted a multi-phase, exploratory sequential mixed methods study. The goal was to understand the behavioral, procedural, and technical pieces that first responders believe are necessary to facilitate communication and best address their technology needs. The first phase of the project, Phase 1, provided a qualitative examination of first responders, focusing on interviews with approximately 200 first responders across the country, from COMMS, EMS, FF, and LE. As reported in Volumes 1, 2, 3, and 4 from Phase 1 [2][6][11][23], the current tools and technology first responders use often do not fully meet their needs, or do not always function as needed in their various contexts of use (for example, in the rural environment). Opportunities for improving problems experienced with current technology are often too costly or inappropriate for first responder contexts of use. In part to address these issues, communication technology (existing and emerging) is being researched and developed to enable data, video, and voice communication for the NPSBN. This multi-phase, mixed methods project provides direct input from first responders about the communication technology used and needed by first responders.

The second phase of the project, Phase 2, used the results of the Phase 1 qualitative interviews to inform a large-scale, online, quantitative nationwide survey in order to provide a more comprehensive view of first responders and communication technology. This report details the Phase 2 survey methodology, including survey development and dissemination, and summarizes nationwide participant demographics.

[1] For the purposes of this report, the use of first responders refers to personnel who are actively involved in day-to-day incident response and operations or in supporting roles.

2. Methodological Overview

This report is part of a sequential, exploratory mixed methods study. In such designs, an initial exploratory qualitative phase is often followed by a larger quantitative phase. Exploratory sequential designs are particularly appropriate when exploring a phenomenon (such as public safety communication), when a measure or instrument is not currently available and when the variables are not initially known (the technology needs and problems of first responders, for example).

Phase 1 of the project focused on qualitative data from approximately 200 in-depth interviews with first responders across the country [2][6][11][23]. A series of reports present the results of the Phase 1 interviews. The Phase 1, Volume 1 report explores first responder contexts of use, as well as their beliefs and behaviors related to communication technology [2]. Phase 1, Volume 2 reports specifically on the problems and requested functionality that first responders experience related to communication technology identified in the qualitative data [6]. Phase 1, Volume 3 presents findings from first responders in rural areas [11]; and Phase 1, Volume 4 presents findings from the COMMS data [23]. The data detailed in these four reports from the Phase 1 interviews provided input for Phase 2—the construction of an online quantitative survey that was sent to first responder agencies across the country. The goal was to provide broader representation of the first responder population in order to augment understanding of the types of communication technology first responders have, use, and want, and the problems they currently experience with their technology. A nationwide online survey allowed representation from larger numbers of first responders across the country about communication technology, and to confirm, clarify, and/or expand on the needs and problems related to communication and technology identified in Volumes 1, 2, 3, and 4 from Phase 1 of the study [2][6][11][23].

The National Institute of Standards and Technology Research Protections Office reviewed the protocol for this project and determined it meets the criteria for “exempt human subjects research” as defined in 15 CFR 27, the Common Rule for the Protection of Human Subjects.

3. Survey Population and Sampling Plan

In survey research, the target population represents the entire population of interest. The sampling frame is a subset of the target population who are contacted to participate in the survey. The sample is those individuals who ultimately participate in the survey (as not everyone who is contacted will actually choose to participate). The target population for this survey was first responders in the United States, including COMMS (911 call takers, dispatchers, and other communication specialists); Emergency Medical Services (EMS); Fire Service (FF); and Law Enforcement (LE). In order to reach first responders, outreach occurred at the department/agency level. In the United States, there are approximately 6 000 911 public safety answering points (PSAPs) [16], approximately 18 000 federal, state, county, and local law enforcement agencies [1], approximately 30 000 fire departments [8]; and approximately 20 000 EMS agencies [17].

The sampling frame consisted of an online database that was purchased from a national public safety directory and data firm. The online database consisted of contacts for a variety of first responder departments/agencies, including: Municipal Law Enforcement, County Sheriffs, State Police and Highway Patrol, Fire Agencies, EMS Agencies, and PSAP Centers. The database included contacts in all 10 FEMA Regions [9]. Contact information in the database was for chiefs of departments/agencies or

communication officers in the four first responder disciplines identified for this project (COMMS, EMS, FF, and LE). Invitation emails were sent to first responder departments/agencies in all 50 states and D.C. The goal was to reach as many departments and agencies as possible, and through them to reach first responders, in order to have broad representation.

A secondary means of outreach was via first responder points of contact (POCs) from Phase 1 of the project, who were contacted by NIST team members and asked to distribute the link to their first responder communities and colleagues. A third form of outreach was through public safety organizations. A variety of different first responder organizations were contacted about distributing the survey to their memberships.

A stratified sample was employed, where the population was divided into subgroups who were all first responders. Strata were then prioritized. Below is the list of strata used in order to include representation from different types of first responders.

- Four disciplines of first responders (LE, FF, EMS, COMMS)—high priority
- Urban, suburban, rural—high priority
- Different jurisdictional levels
    - Local—high priority
    - County
    - State
    - Federal

Local was the highest jurisdictional priority, as incident response typically is considered to start at the local level. Other variables considered in the sampling plan were career and volunteer FF, public and private EMS, and civilian and deputized COMMS.

4. Survey Instrument Development

The survey team began to meet in January of 2018 in order to begin work on the development of an online survey. The survey team included expertise in multiple domains: cognitive science, engineering psychology, human factors, usability, computer science, information systems, sociology, qualitative research, and survey research methodology. Each team member brought unique disciplinary and methodological perspectives to the project. The benefits of a multidisciplinary team like this cannot be overemphasized when constructing and implementing a complex, nationwide research project such as this one.

The following sections describe the process for design and development of the online survey from the initial, conceptual design through the finalized online instrument. This iterative research process flowed between defining survey process and content, and while it is presented here in a linear way, it actually occurred in a recursive fashion. This process is depicted in Fig. 1, and discussed throughout the remainder of this section.

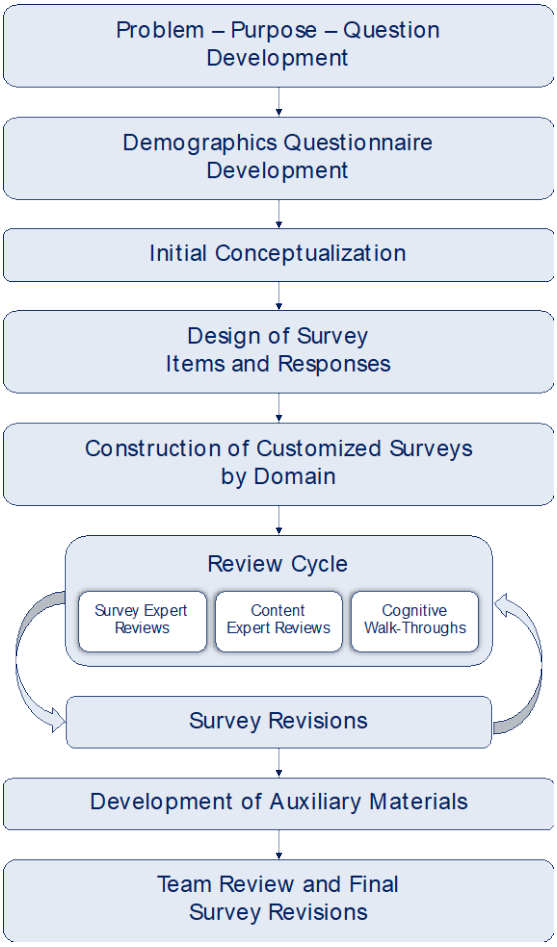

Fig. 1. Survey development process

4.1. Problem, Purpose, and Question

Work began by refining the problem, purpose, and research questions to more clearly represent the goals of the survey. The research goals for this phase of the project included identifying the various communication technology that first responders have and use in their day-to-day operations as well as in out-of-the-ordinary situations, such as major disasters or large planned events. Another goal was to identify the problems first responders experience with the devices and apps/software they have and use, and to identify additional communication technology that they believe would be helpful in their work. The following research questions served as guides for the development of the survey.

1. What are first responder needs related to communication and technology as they engage in their user-identified primary tasks?
    a. What communication tools and technology do first responders believe currently work, or do not work, for them?
2. What are the problems that first responders experience as they use communication technology?

These questions helped to provide a focus for the project and created a foundation for the development of the survey.

4.2. Guiding Principles for Survey Development

As survey development progressed, a series of decisions had to be made, from how best to structure the survey to what language to use on the landing page. In order to address these questions, the team identified a set of guiding principles.

The survey should be:

- Grounded in research from the previously collected empirical data from Phase 1 [2];
- Tailored appropriately for each discipline;
- Focused specifically on technology, especially on problems and requested functionality identified in the Phase 1, Volume 2 report [6], and on PSCR research priorities [20];
- Focused more on day-to-day technology (since the majority of first responder work takes place in daily incident response) but with some attention to larger events;
- Written using the language of first responders;
- Kept short, in order to respect first responders' time (with a goal of approximately 15 minutes for completion);
- Be online and mobile friendly, given the nature of first responder work;
- Based on best practices in survey research.

Perhaps the most important guiding principle during survey development was to keep the survey short—in order to respect first responders and their time, and thus help ensure completion rates.

4.3. Demographics Questionnaire Development

The decision was made early in the development process to use a demographics questionnaire that was derived from the questionnaire employed in Phase 1 of the project. A few modifications were made, but the core of the demographics collected remained the same (see Appendix B). Modifications were made in an effort to keep completion time short (for example, leaving out demographics questions about experience with technology).

Another decision point related to the demographics questionnaire was where to place it—at the beginning or at the end of the survey. The decision was made to place the demographics at the beginning of the survey for several reasons. First and foremost, it was necessary to know what discipline the respondent was from in order to branch to the appropriate survey. Since this question was asked in the demographics, it made sense to have it up front. In addition, the goal was to have as many first responders as possible complete the demographics section, as demographic responses would be necessary for particular analyses (for example, comparing responses from urban, suburban, and rural areas). Since participation in the survey was voluntary, it was decided that none of the demographics questions, nor any of the questions on the survey, would require a response. However, a response to the discipline question was necessary in order to branch to the appropriate discipline-specific survey. If participants did not answer that question the survey would not allow them to move forward. They could choose to quit the survey at that, or any, point.

4.4. Survey Organization and Question Framing

Several approaches to the structure of the survey were developed and reviewed in order to find the best mechanism for addressing the research questions, which sought to identify the communication technology that first responders currently have and use, as well as what they believe would be useful in the future. Ultimately, two major categories of questions were used: the first section focused on day-to-day incident response and the second section focused on large events (major disasters or large planned events). Empirical evidence from Phase 1 showed that day-to-day operations were more prevalent for first responders [2][6][11][23]; therefore, greater emphasis was placed on these questions in the survey. However, it was also important to capture information from first responders who had worked in major disasters or other situations that were different than the scope of their day-to-day operations (for example, large parades, concerts, or football games). For both sections, questions about technology, including per-discipline customizations, were developed with careful and thorough review of the technology problems and requested functionality identified in Phase 1 interviews with first responders [6].

In addition, a great deal of attention was paid to the text that framed survey items in order to be clear about the type of technology being asked about. In both sections on technology, explanatory text preceded all questions. Where additional emphasis was needed, text was bolded and capitalized. For example, in the section on technology for day-to-day incident response, the section began with the following text:

> We know there is no such thing as a typical day in public safety. However, for this set of questions, focus on the kinds of things you use in your day-to-day work.

Subsequently, each question in the section included the words **DAY-TO-DAY** in it, bolded and in all caps in order to remind respondents of the question focus:

> Think about your **DAY-TO-DAY** work and your use of the following **devices**.

Since there were similar sections on devices and apps/software, the decision was also made to bold these words where they appeared in questions. The same held true in the sections for **MAJOR DISASTERS** and **LARGE PLANNED EVENTS**.

Discipline-specific question framing was also used where appropriate. For instance, the examples given for major disasters were tailored for each discipline (e.g., active shooter situation for LE, but MCI, or mass casualty incident, for EMS).

Given the myriad of different types of communication technology used by first responders, decisions had to be made about which ones to include. Phase 1 qualitative interview data were key here to identifying what to include, with problems and requested functionality listed in the survey coming directly from the data in Volumes 1 and 2 [2][6]. In particular, the types of devices and apps/software utilized and needed were somewhat different for each discipline, along with the problems experienced. It became clear there would need to be four different surveys, tailored for each discipline. The goal was to not have first responders go through a list of technology that did not pertain to their work. This was part of the effort to keep the survey short out of respect for first responders and their time. The lists of technology and response options for those lists are discussed in Sec. 6.

While every effort was made to keep the four discipline-specific versions of the survey as parallel as possible, it was clear that the COMMS survey needed a slightly different structure in order to elicit information about the call centers where respondents worked. This meant that the EMS, FF, and LE surveys were the most structurally parallel, while the COMMS survey differed in some areas (see Sec. 5).

Additionally, the COMMS survey included questions related to the use of Next Generation 911 (NG 911). NG 911 is a digital or Internet Protocol (IP)-based 911 system that has several key capabilities, including: the ability for voice, photos, videos and text messages to be sent from the public to the 911 network; the transfer of emergency calls, location information, and multimedia to another PSAP; and the exchange of voice and data with other state or federal entities involved in the response via internetworking technologies based on open standards [13][15]. As the survey was designed to gauge the use of technology for day-to-day operations, the NG 911 explanatory text focused on the front-end user interaction rather than the back-end technology implementation. In the survey, NG 911 was described in this simplified way:

> Next Generation 9-1-1 is a system that will allow the public to send texts, pictures, and video to 9-1-1 call centers.

Finally, the use of open-ended text boxes in the survey was discussed. The use of open-ended text boxes had the potential to increase the completion time for respondents, which could violate the guiding principle of keeping the survey short. Realizing that it is impossible to capture all possible response items in a survey, it is important to allow respondents the option to write in additional information if they choose to do so. Therefore, open-ended text boxes were included where appropriate, but responses to these (or any) questions were not required.

4.5. Development of Auxiliary Materials

Auxiliary materials included initial email invitations, reminder emails, survey landing page text, survey closing page text, and Frequently Asked Questions (FAQs) for the survey Help Desk. Much of this is detailed in the Sec. 7, while here the focus is only on major decisions related to these materials in the development stage.

The decision was made to construct a simplified landing page that provided a brief overview of the survey, what it was about, approximate expected completion time (15 minutes), and other important details related to human subjects protections[2] (such as the voluntary nature of the survey, that responses would be anonymous, no attempt would be made to identify respondents, etc.). In order to make the landing page simpler, additional details were available through a toggle button which, when clicked, displayed or hid the details if the participant chose to do so. Help Desk contact information was also included on the survey landing page.

Several decisions were also made regarding the links to be used for accessing the survey. First and foremost was the decision to have the survey URL link directly to NIST in order to have a nist.gov domain for the landing page in an effort to facilitate trust with a .gov domain rather than a .com; this

[2] The National Institute of Standards and Technology Research Protections Office reviewed the protocol for this project and determined it meets the criteria for "exempt human subjects research" as defined in 15 CFR 27, the Common Rule for the Protection of Human Subjects.

would make it clear that the survey was for research purposes and not a marketing attempt. In keeping with industry best practices and NIST policy, a site certificate was purchased; the final URL was: https://publicsafety.nist.gov/. The NIST logo and identifier were included at the top of every survey page. Additionally, there were back and continue buttons at the bottom of each survey page (except for the first page, which only had a continue button); the final survey page had a back and a finish button.

Another important decision point involved device and browser support. Recognizing the wide variability in technology usage in public safety [2][6][11][23], the decision was made to support the ability to take the survey on a variety of devices, from desktop to mobile devices, and a variety of common and legacy browsers as well.

4.6. Content and Survey Expert Reviews

Once the survey structure was finalized and a comprehensive set of survey items and responses had been developed, the survey was sent to several content and survey experts for review. In addition, cognitive walk-throughs were conducted with several content experts and stakeholders. Cognitive walk-throughs provide information on item and response interpretation and relevance. Survey experts were research methodologists and/or measurement specialists who provided input about how well the survey addressed the research problem, purpose and questions, as well as on the construction of survey items and response options. Content experts from all four first responder disciplines were asked to review the survey and provide feedback as well, including language congruence with each public safety discipline, survey item and response option appropriateness and comprehension, and overall thoughts about the survey. In addition, cognitive walk-throughs [14] were conducted with first responders to identify their ability to: 1) interpret items; 2) recall memories/experiences that are relevant to items; and 3) choose a response choice that aligns with their memories/experiences. Cognitive walk-throughs included asking each participant to read each question and then answer three questions: 1) what is this question asking; 2) what answer would you choose; and 3) why did you choose that answer. Cognitive walk-throughs aided the survey team in determining item and response appropriateness.

Data from all three of these review types provided feedback on how to improve the survey. These included things such as: changing response options in some questions to more accurately capture the type of information sought; considering the ordering of questions in some instances; or changing language in some questions to more accurately represent the language of first responders.

Generally, changes were made based on recommendations from these reviews. However, occasionally the decision was made to not make a change (e.g., not to ask respondents about problems experienced with all technology they use), usually because it would have increased the time it would take for respondents to complete the survey. Once revisions were made, another round of reviews was conducted by survey and content experts. This review also included the auxiliary documents. Final revisions were made to survey documents based on comments received.

4.7. Final Reviews and Revisions

After survey and content expert reviews, the online survey was pilot tested with several first responders in order to provide additional information on time for completion, as well as the logic and

flow of the instrument. Pilot testing consisted of asking a variety of first responders to actually take the survey and provide qualitative comments at the end about their experience taking it.

Once all sections were complete, the online survey instrument was tested on both desktop and mobile devices. All team members reviewed all four discipline-based surveys and auxiliary documents on a variety of devices. Several rounds of these reviews took place, with corrections made to the online tool as appropriate.

5. Survey Logic and Structure

This section describes the survey implementation logic, such as survey branching and skip logic decisions. As previously noted, there were four slightly different versions of the survey, customized for each of the four public safety disciplines: COMMS, EMS, FF, and LE. The overall survey structure and flow were largely similar across the four survey versions: all began with a section on demographics, followed by a section on use of technology for day-to-day incident response, and concluded with a section on use of technology in large events (see Fig. 2). The content of each survey section is described in the following sections. Discipline-specific customizations are also described, and detailed survey questions are shown in Appendix D.

Fig. 2. Major survey components and flow

Surveys were nearly identical for EMS, FF, and LE, while differing somewhat more for COMMS, due to the different nature of their working environment [23]. For ease of exposition, the EMS, FF, and LE survey versions will be described together, with relevant customizations noted, followed by a description of the COMMS survey.

5.1. Survey Branching for EMS, Fire, and Law Enforcement

The EMS, FF, and LE surveys all followed the same structure and flow (see Fig. 3), beginning with demographics questions (see Appendix B). In addition to the core set of demographics collected for each of the disciplines, EMS participants were asked if their agency was public or private and FF participants were asked if they were mainly career or volunteer.

5.1.1. *Day-to-Day Technology Usage*

Following the demographics were questions about responders' use of communication technology in their day-to-day work. This day-to-day technology section asked participants a series of questions structured in various formats (see Table 1). Participants were asked, separately, about their use of certain devices and apps/software in their day-to-day work; for each technology listed, they chose whether they used it a lot, used it occasionally, had it but did not use it, or did not have it. The technology on these lists were derived from the results of the first phase of this project, the in-depth interviews (see Sec. 6). Following the respective device and apps/software questions, participants were asked to rank the top 5 devices they previously indicated they had, with 1 being the most useful to them in their day-to-day work.

After the top apps/software ranking, the next question was related to their perceived usefulness of futuristic technology for their day-to-day incident response activities (see Table 1). Participants were asked to select which technology would also be useful in their day-to-day work. This list of technology was populated from two sources. The first source was a preset list of futuristic technology based on PSCR research priorities and derived from the results of the in-depth interviews (see Sec. 6). The second source was based on a participant's previous survey responses about their day-to-day technology use; all technology where either no selection was made or "do not have" was selected was piped forward to the futuristic technology list (i.e., any technology a participant indicated that they did not currently have; see Fig. 4).

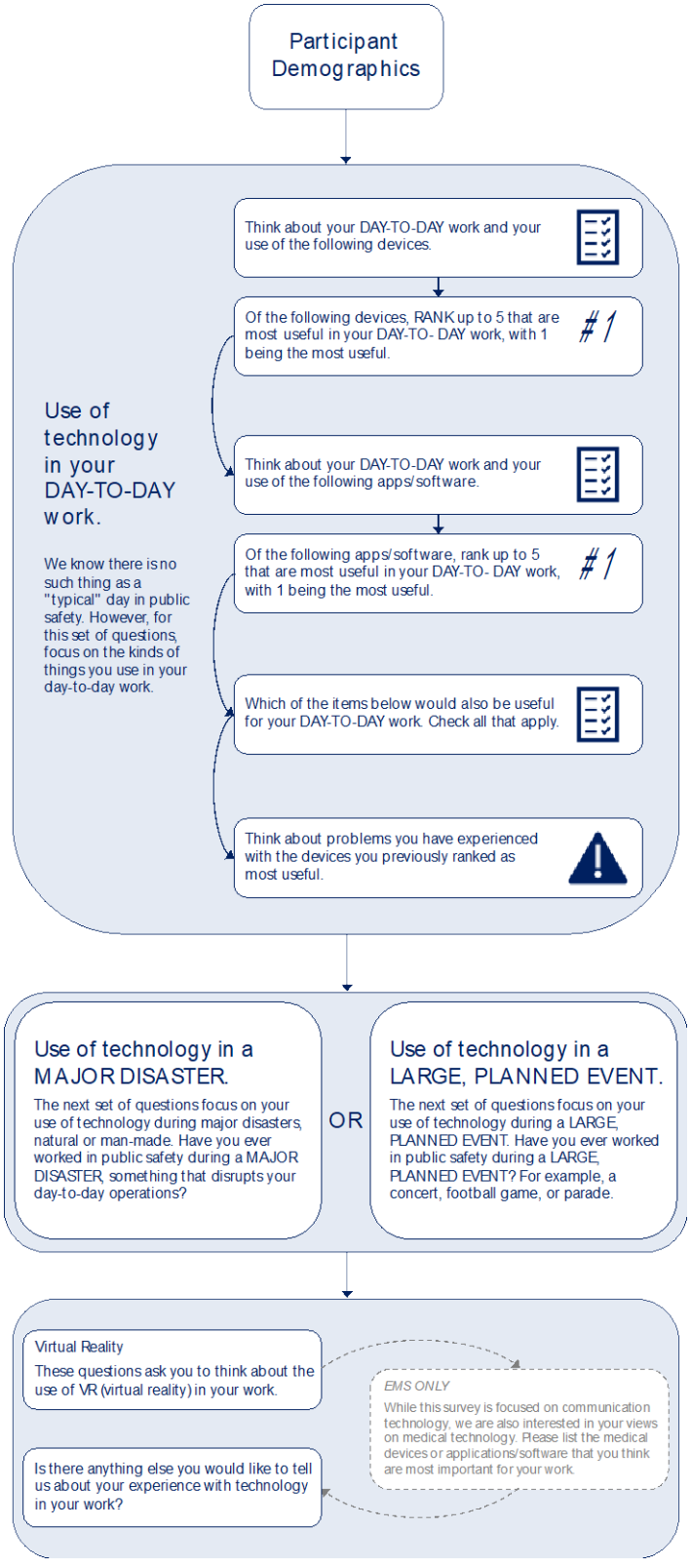

Fig. 3. Survey flow for EMS, FF, and LE

Table 1. Day-to-day questions and response options

Question	Responses
Their frequency of use for various devices	*For each device, choose one of:* • Use it a lot • Use occasionally • Have, but do not use • Do not have
To rank their top 5 devices	*Rank* 1st through 5th
Their frequency of use for various apps/software	*For each app/software, choose one of:* • Use it a lot • Use occasionally • Have, but do not use • Do not have
To rank their top 5 apps/software	*Rank* 1st through 5th
To select any futuristic technology they thought would be useful	*Check all that apply* from list of technology (see Sec. 6)
Problems they experienced with top 3 ranked devices	*For each problem, choose one of:* • Always • Most of the time • Sometimes • Rarely • Never • Does not apply

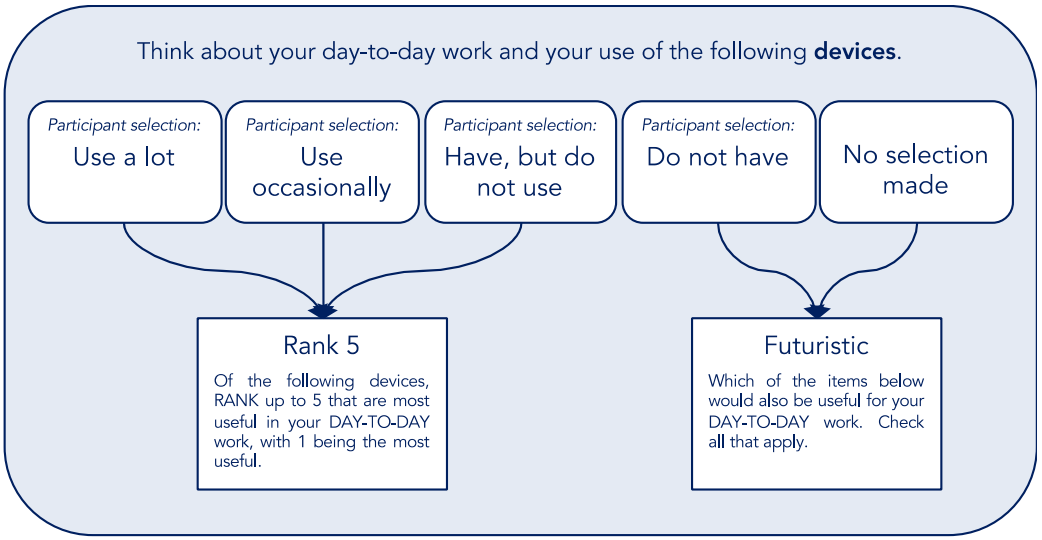

Fig. 4. Survey logic for day-to-day devices

The final questions in the day-to-day section were centered around problems first responders face with technology. Each of the devices included in the survey had a pre-determined list of common problems associated with the device (based on Phase 1 interview data; see Sec. 6). The list of common problems was presented with each device separately, and participants were asked how often they experienced the problem; there were five response choices ranging from always to never, as well as "does not apply" (see Table 1). To align with the guiding principle of keeping the survey short (see Sec. 4.2), participants were only asked about the problems they experienced with each of their top three previously ranked devices. Although multiple variations of some devices were listed separately, the problems experienced by those variations were not unique. Therefore, if a participant selected multiple variations of the same device, only one set of problems for the device was presented. For example, only one list of smartphone problems was presented to participants who ranked "smartphone: personal" and "smartphone: work issued" in their top three most used devices. In these cases, problems were also presented for the participant's 4th ranked device (see Appendix C).

5.1.2. Large Event Technology Usage

The survey section about large events asked participants questions based on *either* incident response during a major disaster, whether natural or manmade (such as an earthquake, hurricane, wildfire, MCI, active shooter incident, or riot) *or* working a large planned event (such as a concert, football game, or parade). As described in Sec. 4.4, the examples were tailored per discipline, so not all participants saw all examples. If participants indicated that they had worked in public safety in a major disaster, they got questions on their experiences working a major disaster. If they had NOT worked during a major disaster, they got questions on their experiences working large planned events (see Fig. 5). For either branch (major disaster or large planned events), the questions were similar (see Table 2). The final question in the large event section presented participants with a preset list of 4 to 6 technologies (based on Phase 1 interview data; see Sec. 6), and asked them to select the technology they thought would be helpful for this type of incident/event (see Table 2). If participants had worked neither a major disaster nor a large planned event, they were moved to the final survey questions.

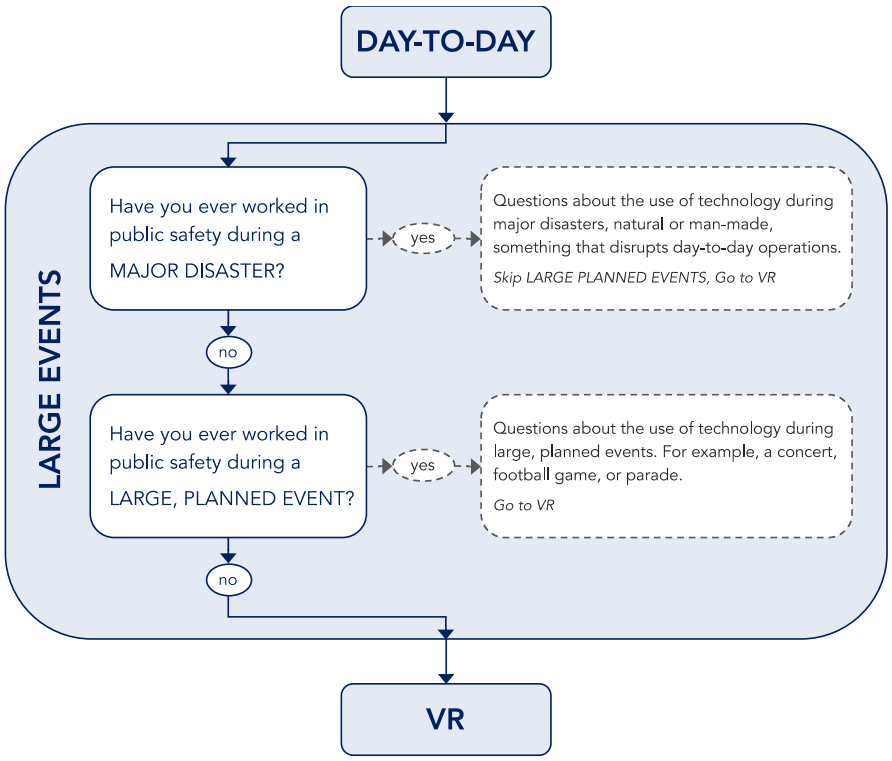

Fig. 5. Survey flow for large events

Table 2. Large event questions and response options

Question	Responses
Is the technology mostly the same or very different from the technology used in their day-to-day work (or a mix of both)?	*Choose one of:* • I use mostly the same technology. • I use some of the same technology, with some specialized technology. • I use very different technology.
List any specialized technology used	*Open-ended text box*
List the most important technology used	*Open-ended text box*
In addition to the technology they use day-to-day, which technology would be helpful for a <large event>? *<large event> would display either major disaster or large planned event.*	*Check all that apply* from list of technology (see Sec. 6)

Throughout the survey, whenever a technology list was presented as part of a question (in both the day-to-day and large event sections), participants were given an opportunity to add any technology not listed in the format of an open-ended text box.

5.1.3. *Final Survey Questions*

To close the survey, participants were asked to weigh in on the use of virtual reality (VR) in their work. They were asked if they thought it would be useful for training, or if it would be useful in other ways (and asked to explain in what ways they thought it would be useful).

At this point, EMS respondents, exclusively, were asked a question regarding their medical technology usage. They were asked to list the medical devices or apps/software that they thought were most important for their work (see Appendix D).

A final open-ended text box was the last question on the survey, inviting participants to provide any additional information they wished to share about their experiences with technology in their work (see Appendix D).

5.2. Survey Branching for COMMS

As previously noted, EMS, FF, and LE were very similar in terms of overall survey structure, but COMMS differed (see Sec. 4.4); those differences are presented in this section (see Fig. 6). Each of the major sections for the EMS, FF, and LE surveys were also in the COMMS survey, with the addition of a section designed to gather information about the participant's call center (see Fig. 6).

To start, the demographics questions that were asked to each of the other three disciplines were also asked to COMMS participants. Like EMS and FF, COMMS participants were asked an additional discipline-specific question: whether they were civilian or deputized. Following the demographics questions was the section on call centers.

5.2.1. *Call Center Questions*

COMMS participants were asked several questions about the variety of technology in the call center where they work (see Table 3). These questions began by asking what their call center dispatched for (EMS, FF, and/or LE). Participants

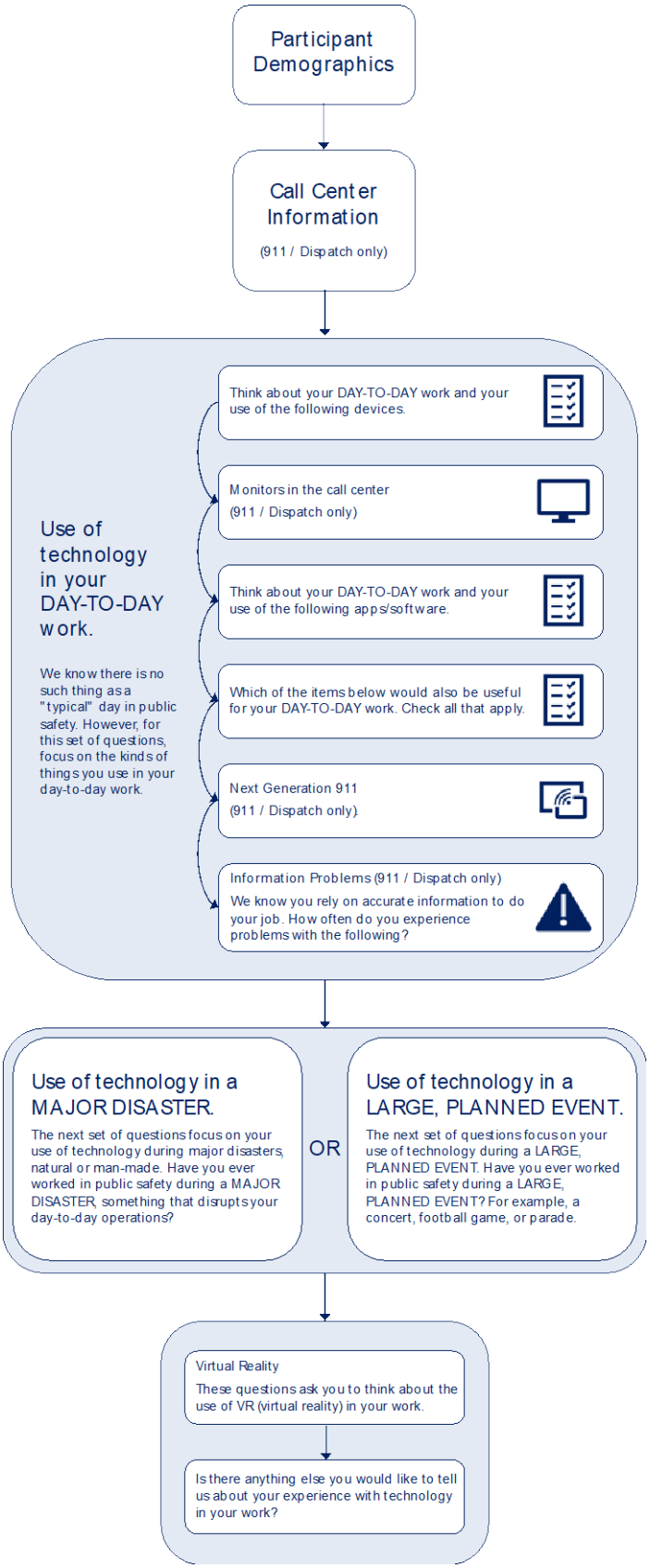

Fig. 6. Survey flow for COMMS

were then asked to list the pros and cons of using text-to-911, pictures, and videos (via an open-ended text box). This was followed by questions about audio-recorded calls, and whether their call center had any issues with data storage or data retrieval. This section closed with questions on the reliability of 911 and what call centers did if 911 was down.

Table 3. Call center questions

What does their call center dispatch for?	EMS / Fire / Police
Can their call center receive 911 text messages from the public?	Would this be beneficial for their job? List pros and cons
Can their call center receive pictures and/or videos from the public?	Would this be beneficial for their job? List pros and cons
Does their call center audio record calls?	If so, does call center have problems with data storage? If so, does call center have problems with data retrieval?
Has 911 ever gone down in their call center?	If so, what caused it to go down? If so, what did their call center do?

5.2.2. Day-to-Day Technology Usage

Like the other three disciplines (EMS, FF, and LE), COMMS participants were asked about their frequency of use of various technology devices in their day-to-day work (see Sec. 5.1.1). The difference here is, rather than a follow-up question ranking their top devices, COMMS participants were asked additional questions about their monitor use:

- Number of monitors at personal workstation
- Number of monitors for shared viewing

COMMS participants were then asked, like the other three disciplines, about their use of apps/software in their day-to-day work (see Sec. 5.1.1). Likewise, the next question was related to futuristic technology; it was about what communication technology would also be useful in participants' day-to-day work (see Sec. 5.1.1). Specifically for COMMS, additional technology questions were asked about NG 911. Participants were asked if they had ever heard of NG 911, and after reading a brief description of NG 911 were asked if they thought it would it be helpful in their jobs (see Appendix D).

The final questions in the COMMS day-to-day section were centered around problems COMMS participants faced with information. For several common problems with information, participants were asked to rate their frequency of experiencing each problem; 5 response options ranged from "always" to "never," as well as "does not apply". The information problems listed were commonly experienced by participants in the in-depth interviews (see Sec. 6).

5.2.3. Large Event Technology Usage

The COMMS large events survey questions were almost identical to those of EMS, FF, and LE, with the exception of the final question in this section about which technology they thought would be helpful for this type of incident/event (see Appendix D). The question was the same, but participants were presented a different list of technology (based on Phase 1 interview data; see Sec. 6).

5.2.4. Final Survey Questions

The close of the COMMS survey asked about the use of VR and gave COMMS participants the opportunity to provide any additional relevant information, as in the other three disciplines (see Appendix D).

6. Technology Lists

Questions throughout the survey gauged the opinions of first responders about various technology (see Sec. 4.4 and Sec. 5). For all four disciplines, lists of technologies were used for questions about responders' day-to-day device use, day-to-day application/software use, future use of day-to-day devices, and technology use during major disasters/large planned events. For EMS, FF, and LE, lists of common problems were used for each device presented; a list of common problems with information was used for COMMS. All lists used in the survey were the result of a thorough review of the problems and requested functionality identified in the Phase 1 interviews with first responders [2][6]. This section presents the common technologies listed across disciplines for both the day-to-day and large events survey sections. The full list of technologies for each discipline for each question can be found in Appendix C.

Each list-style question included technologies that were presented across all four disciplines (see Table 4). As stated in Sec. 5, the list of devices for the futuristic technology question was composed from two sources. Some technologies on this list were dependent on a participant's previous responses. The preset list of futuristic technology for each discipline included seven across all four disciplines. The technologies listed for the question on technology use for major disasters was identical to those listed for the technology use question for large planned events (see Sec. 5 for survey questions).

Table 4. Common technology listed across all four disciplines

Day-to-Day Device use	Day-to-Day Apps/Software	Day-to-Day Futuristic	Major Disasters and Large Planned Events
Desktop computer	CAD (computer-aided dispatch)	AR (augmented reality)	Deployable communication technology (such as cell towers on wheels)
Microphone	Email	Indoor mapping	Drones
Pager	Mapping/driving directions	One login (instead of many different usernames and passwords)	Mobile command centers
Radio	RMS (records management system)	Real-time on-scene video	
Smartphone	Traffic	Smart watch	
	Weather	Voice controls for hands-free input	
		VR (virtual reality)	

Because of the unique environment of COMMS centers, several devices were only presented for the EMS, FF, and LE disciplines (see Table 5).

Table 5. Common technology listed for EMS, FF, and LE

Day-to-Day Device use	Day-to-Day Apps/Software	Day-to-Day Futuristic	Major Disasters and Large Planned Events
Earpiece Laptop Work-issued flip phone MDT/MDC Tablet	Report writing software	Drones Health/vitals monitoring of first responders HUDs (heads-up displays) Robots Self-driving vehicles Smart buildings Smart glasses Voice recognition for identification	Helicopters Remote sensing (by aircraft or satellite) Robots

As discussed in Sec. 5, EMS, FF, and LE participants were asked about the problems they experienced with each of their top three previously ranked devices. Since each device had its own set of problems, there were no two problems lists that were exactly the same. However, there were several common problems that were applicable across devices, such as outdated/old, price: too expensive, battery life, durability, interoperability, and size/bulkiness.

As a guiding principle was to keep the survey short, rather than ask all potentially relevant problems for all devices, the problems lists were tailored and trimmed based on the most commonly experienced technology problems identified in the nationwide interviews [2][6] (for example, flip phone problems were not included in the survey). For all devices, outdated technology and cost of the technology were included in the list of problems. The full list of problems for each device as presented in the survey can be found in Appendix C.

Rather than technology problems, COMMS participants were asked about information problems they encountered:

- Callers: inaccurate or missing information
- Cell phones: inability to accurately track caller location
- Information overload: too many calls at once
- Information overload: too much information to monitor at once
- Maps/databases: missing or inaccurate information

The full list of technology for each discipline for each question, and the list of problems for each device, can be found in Appendix C. Once the development of the survey was complete, the survey design was implemented for dissemination.

7. Survey Dissemination

As previously noted, three different types of outreach occurred: 1) emails sent to a general sample (see Appendix A); 2) emails sent to previous POCs; and 3) links posted on public safety organization websites or sent to their memberships. Different links were used for each of these three contact types so that the number of responses elicited from them could be monitored for further outreach and grouped for later analysis. Regardless of the link within each invitation, all participants were directed to the same survey. Dissemination through each of the outreach types is discussed below.

7.1. Outreach to the General Sample

The contact list for this project was purchased from a national public safety directory and data firm. The online database included access to a variety of first responder departments/agencies, including: Municipal Law Enforcement, County Sheriffs, State Police and Highway Patrol, Fire Agencies, EMS Agencies, and PSAP Centers. The database included contacts in all 10 FEMA Regions [9]. Contact information in the database was for chiefs of departments/agencies or communication officers. Fig. 7 below shows the process for dissemination to the general sample.

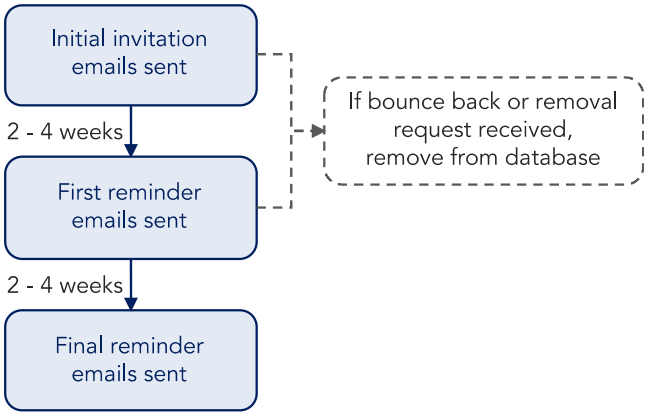

Fig. 7. Survey dissemination process

Initial survey invitation emails went directly to all database contacts where an email address was provided (see Table 6 for survey invitation timeline). Departments and agencies that were listed in the database received an initial email invitation with the link to the survey. Contacts were asked to forward the request to as many of their personnel as possible, as well as to colleagues from other departments/agencies. Link sharing was encouraged since the goal was to reach as many first responders as possible. This helped increase the number of responses but made it difficult to know exactly how many people actually received the link to participate.

Table 6. Survey dissemination timeline

Month 1	Month 2	Month 3	Month 4	Month 5	Month 6
Initial invitation emails					
	First reminder emails				
		Final reminder emails			

Outreach to the general sample began with one state from each of the 10 FEMA Regions (Massachusetts, New York State, Pennsylvania, Florida, Ohio, New Mexico, Kansas, Utah, Arizona, and Oregon). Once all of these states had received initial email invitations, outreach began to the remaining states in each of the FEMA Regions. Table 7 shows the number of initial invitations sent to each FEMA Region in each of the four first responder disciplines focused on in this study.

Table 7. Number of initial invitations sent by FEMA Region and discipline

	COMMS	EMS	FF	LE	*Total*
FEMA Region I	340	175	969	829	*2 313*
FEMA Region II	277	465	1 341	732	*2 815*
FEMA Region III	254	306	1 456	1 239	*3 255*
FEMA Region IV	836	440	3 379	2 388	*7 043*
FEMA Region V	807	395	2 730	2 961	*6 893*
FEMA Region VI	734	253	2 506	1 702	*5 195*
FEMA Region VII	429	340	1 170	1 189	*3 128*
FEMA Region VIII	234	141	684	713	*1 772*
FEMA Region IX	417	102	768	541	*1 828*
FEMA Region X	121	83	524	500	*1 228*
Total	*4 449*	*2 700*	*15 527*	*12 794*	*35 470*

A reminder email typically went out between two and four weeks after the initial invitation (see Appendix A). Reminder emails reiterated the request to forward the link to all personnel as well as to other departments and agencies. A second reminder email was sent between two and four weeks after the first reminder. The impact of reminder emails on response rate was clear: survey completions increased after each set of reminder emails were sent. A total of 5 620 completed survey responses were received from the general sample.

7.1.1. Undeliverable Emails

Reminder emails noted that respondents could contact the researchers if they did not wish to participate, wanted their name to be removed, or had other requests for information (see Table 8). There were very few requests for contacts to be removed; whenever requests were made, they were immediately removed from the master contact list. More common were email responses noting that the recipient was no longer in the position. If an alternate contact was found or suggested by the initial recipient, the survey invitation was emailed to the new contact. If an alternate contact was not available, the contact was removed from the contacts list. If an email was returned as spam and contained a link for sender approval, the link was clicked and the email resent. If the contact did not contain a sender approval link, the contact was removed from the master contact list. The majority of email errors were due to correspondence being marked as spam by the receiving agency. Overall, 10.90 % of the email addresses in the database resulted in permanent errors and were not delivered.

Table 8. Dissemination email issues

Issue	Resolution
Removal request	Contact removed from master contact list.
Participant no longer held position listed	Attempt to find alternate contact; if none found, remove from master contact list.
Email bounced back or "undeliverable"	Check for email typos and resend. If no typos, attempt to find alternate contact; if none found, remove from master contact list.
Email returned as spam *with* sender approval link	Follow link and resend email.
Email returned as spam *without* sender approval link	Contact removed from master contact list.

7.2. Outreach to Previous Points of Contact

A second prong of the outreach included reaching back to 112 POCs from previous interactions; PSCR stakeholder meetings, other conferences or workshops, or POCs from Phase 1 of this project. A separate link was made for this outreach so that the number of responses from this prong could be counted. As with the general sample, the email invitation they received asked them to take the survey and to distribute it to their personnel, as well as to share the link with other departments and agencies. As with the general sample, link sharing was encouraged in order to reach as many first responders as possible. This helped increase the number of responses, but also made it difficult to accurately identify the number of people who actually received the link to participate. The email invitation also thanked them for previous interest/involvement and included an infographic [18] depicting the results from Phase I of the project. A total of 195 responses were received from links sent to POCs.

7.3. Outreach to Public Safety Organizations

The final prong of the outreach effort included identifying and contacting a variety of national organizations that represent and/or work with public safety personnel about their interest in promoting the survey to their memberships. A total of 21 public safety organizations were contacted about participating (see Appendix E).

Organizations used a variety of different mechanisms to reach their memberships. Some organizations posted an article about the survey on their website, others sent an email blast to their list serve, while others posted the link to social media. This outreach spanned four months; a total of 1 367 responses were received from links sent to organizations.

8. Participant Demographics

A total of 7 182 first responders nationwide, across all disciplines, completed the survey: 5 620 from the general sample; 195 from previous POCs; and 1 367 from public safety organization members, as described in the preceding Outreach sections. The overall median completion time was 10:31 minutes,

and the average completion time was 15:55 minutes, in keeping with the overarching guiding principle of keeping the survey short.

Of the 7 182 completed responses, 21.78 % were COMMS, 12.56 % were EMS, 36.44 % were FF, and 29.23 % were LE (see Fig. 8). However, survey completion was not required, and an additional 1 175 responders began, but did not finish the survey (see Fig. 8). This could be due to a variety of different factors. For example, some participants may have recognized that the survey was outside the scope of their work, others may have lost interest as they progressed in the survey, or others may have been called away to respond to an incident.

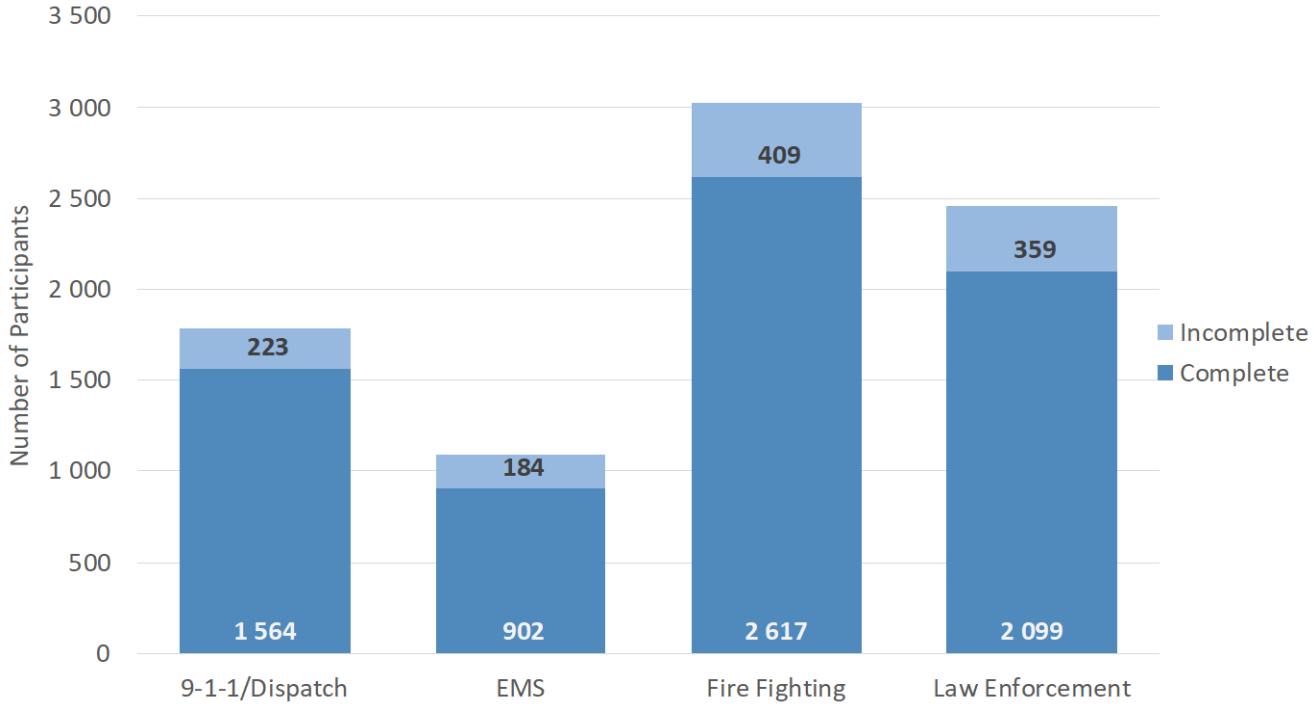

Fig. 8. Number of participants who fully and partially completed the survey, by discipline (n=8 357)

The demographics presented throughout this section represent the data from the 7 182 participants who completed the entire survey. However, since all survey questions were optional, the number of participant responses (n) per question varied; the n for each response is given with the associated figure. The vast majority of respondents completed the survey on a desktop device, while the remaining respondents used mobile devices (see Fig. 9).

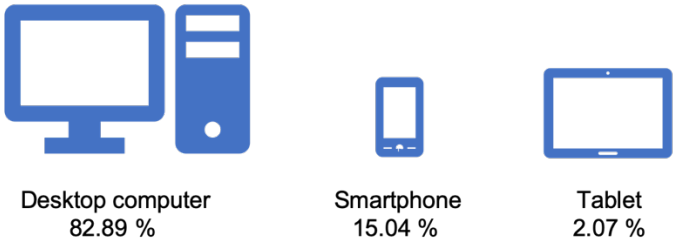

Fig. 9. Device types used by participants to complete the survey (n=7 182)

While a variety of internet browsers were used to complete the survey, Chrome and Internet Explorer were by far the most common. Table 9 shows the distribution of internet browsers used by participants to complete the survey.

Table 9. Respondent browsers used to complete survey (n=7 182)

Browser	Count	Percent
Chrome	2906	40.46 %
Microsoft Internet Explorer 11	2212	30.80 %
Safari	862	12.00 %
Microsoft Edge	695	9.68 %
Firefox	420	5.85 %
Other	72	1.00 %
Microsoft Internet Explorer 10	10	0.14 %
Microsoft Internet Explorer 9	5	0.07 %

Overall, 80.86 % of the participants were male; 19.14 % were female (see Fig. 10). These percentages of male and female first responders are comparable to nationwide population of first responders [4][5][8][19].

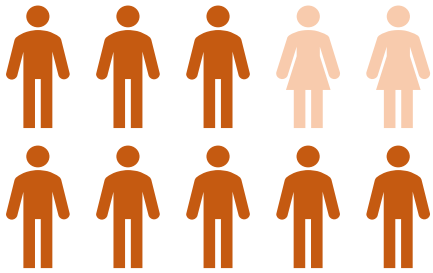

Fig. 10. Proportion of participants who completed the survey, by sex (n=7 101)

The majority of participants were between 46 and 55 years of age (35.69 %), followed by 36-45 years (24.16 %), 56-65 years (20.37 %), and 26-35 years (12.61 %) (see Fig. 11). Less than eight percent of participants were 25 or younger, 66 or older, or chose not to respond to the question about their age. Similarly, most participants had between 16 and 30 years of experience working in public safety, with the largest group of participants, 16.99 %, having 21-25 years of service (see Fig. 12).

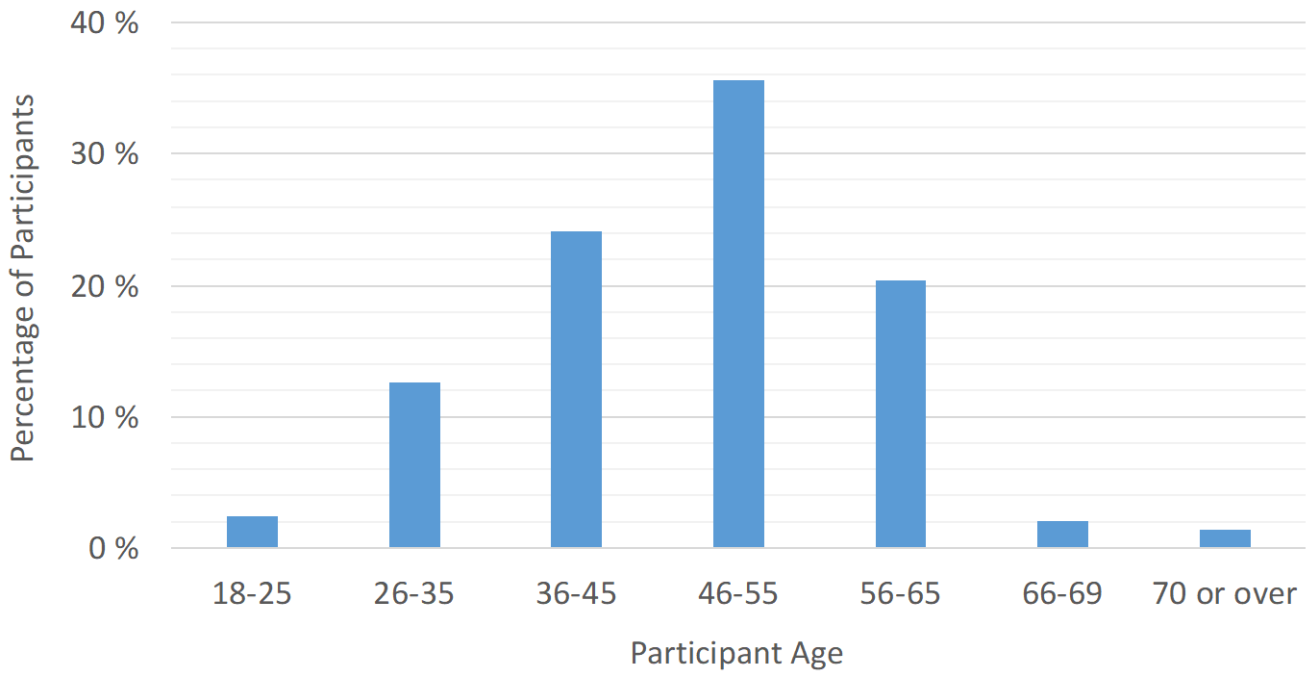

Fig. 11. Number of participants who completed the survey, by age (n=7 092)

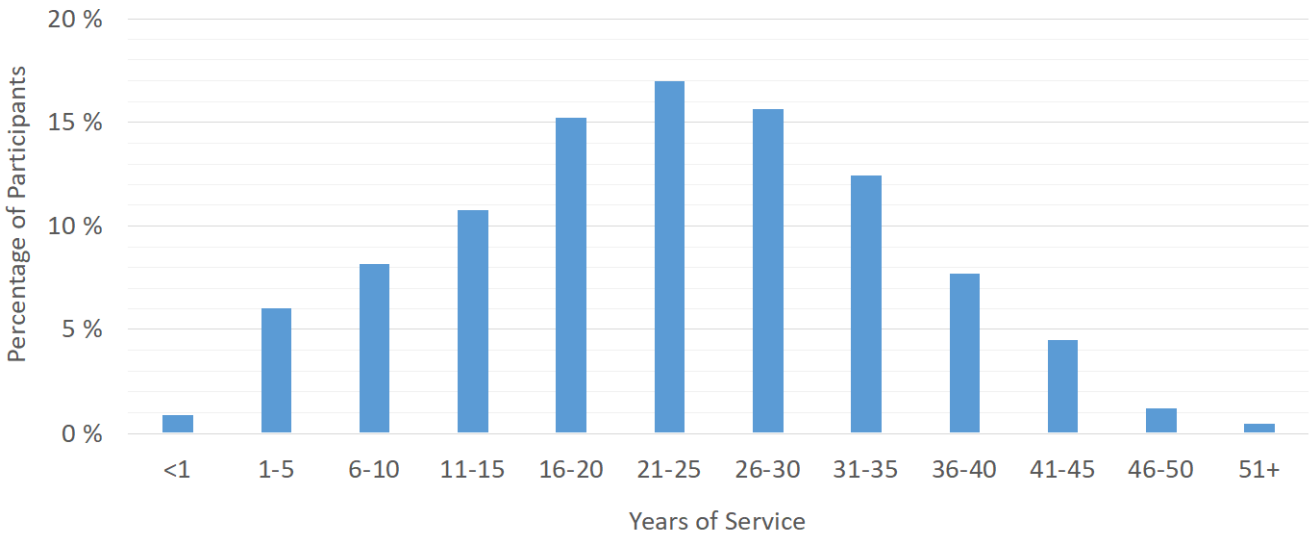

Fig. 12. Number of participants who completed the survey, by total years of service (n=7 167)

As evidenced by the data, the older the first responder, the more experience they had (see Fig. 13). However, after participants reached 56 year of age, their experience plateaued between 30-40 years of service.

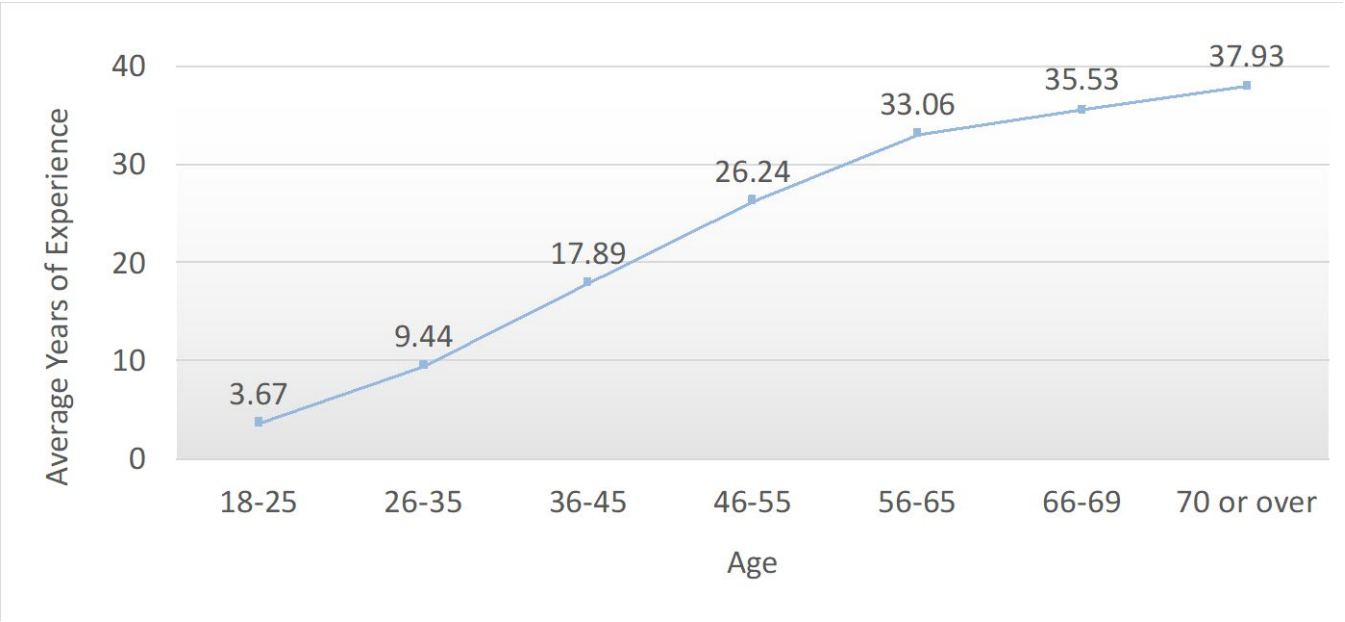

Fig. 13. Average years of service by age (n=7 085)

Participants also self-identified their jurisdictional level. The response options were local, county, state, federal, and tribal. The large majority, 63.20 % of the participants, worked in public safety at the local level, while 31.87 % of responders worked at the county level (see Fig. 14).

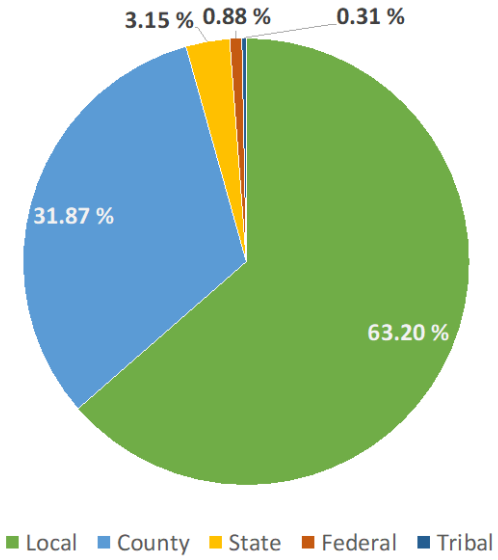

Fig. 14. Participants who completed the survey by jurisdiction (n=7 139)

The demographics questionnaire also asked participants about the area where they worked: which state, and whether they covered mainly rural, suburban, tribal, or urban areas. Each state had representation in the data; the minimum number of participants from a state was 7, the maximum was 482 (see Fig. 15). The median number of participants per state was 92, and the mean per state was 139.67.

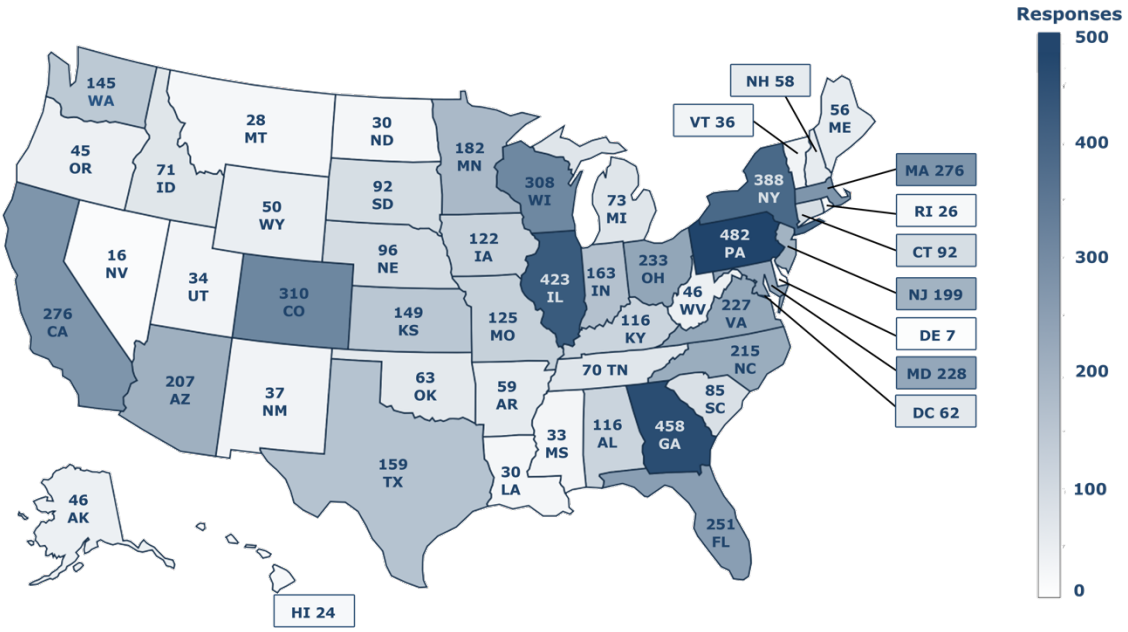

Fig. 15. Heatmap of number of participants who completed the survey, by state

The number of responses per FEMA Region is presented in Fig. 16 [9], overall and per-discipline responses. FEMA Region V had the most responses, 1 382, while FEMA Region X had the fewest, 307. The mean number of responses per FEMA Region was 712.30; the median was 544.00. The largest COMMS response was in FEMA Region IV (341); EMS in Region II (191); FF in Region V (575); and LE in Region V (433).

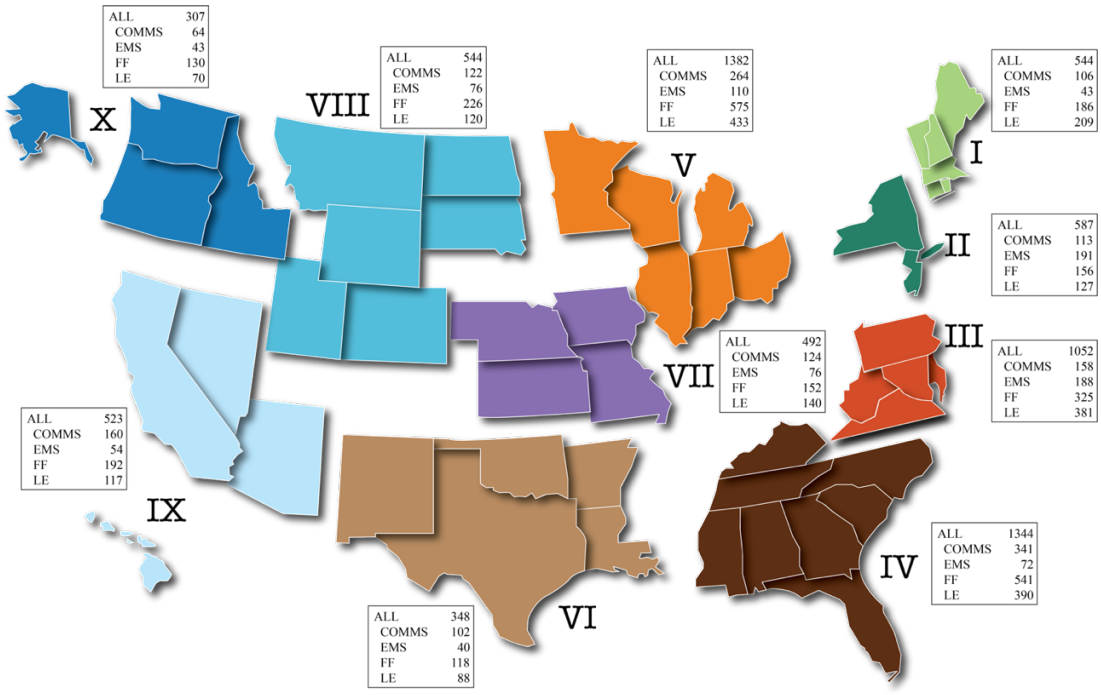

Fig. 16. Survey responses by discipline and FEMA Region

Overall, most of the participants indicated that they mainly work in suburban or rural areas, 38.68 % and 37.68 %, respectively (see Fig. 17), while 23.25 % of participants indicated that their work was primarily in urban areas.

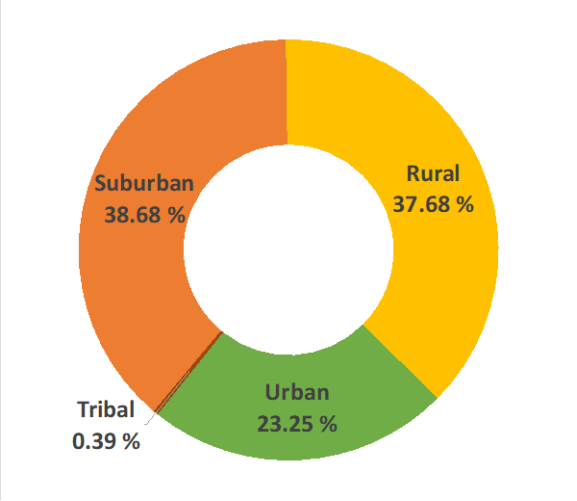

Fig. 17. Participants who completed the survey by area type (n=7 161)

Fig. 18 shows the number of participants by type of geographical area and FEMA Region. A large number of participants were from FEMA Regions III, IV, and V, with 1 052 (14.77 %), 1 344 (18.87 %), and 1 382 (19.40 %) of participants, respectively. The remaining FEMA Regions had fewer participants, ranging from approximately 4 to 8 %: Region I had 544 participants (7.64 %); Region II, 587 (8.24 %); Region VI, 348 (4.89 %); Region VII, 492 (6.91 %); Region VIII also had 544 participants (7.64 %); Region IX, 523 (7.34 %); and Region X, 307 (4.31 %).

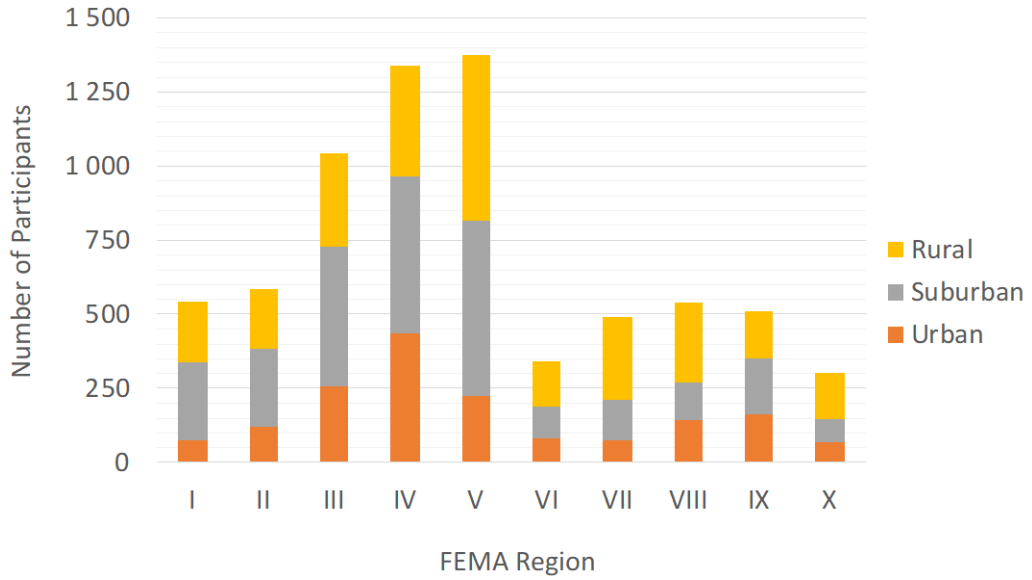

Fig. 18. Number of Participants who completed the survey, by FEMA Region and area type (n=7 109)

Lastly, a discipline-specific demographics question was asked for three of the disciplines (see Fig. 19). COMMS were asked if they were civilian or deputized; 92.11 % of participants were civilian and 7.89 % were deputized. EMS participants were asked if they worked in the public or private sector; 67.04 % worked in the public sector and 32.96 in the private sector. FF were asked if they were career or volunteer; 67.96 % were career and 32.04 % were volunteer.

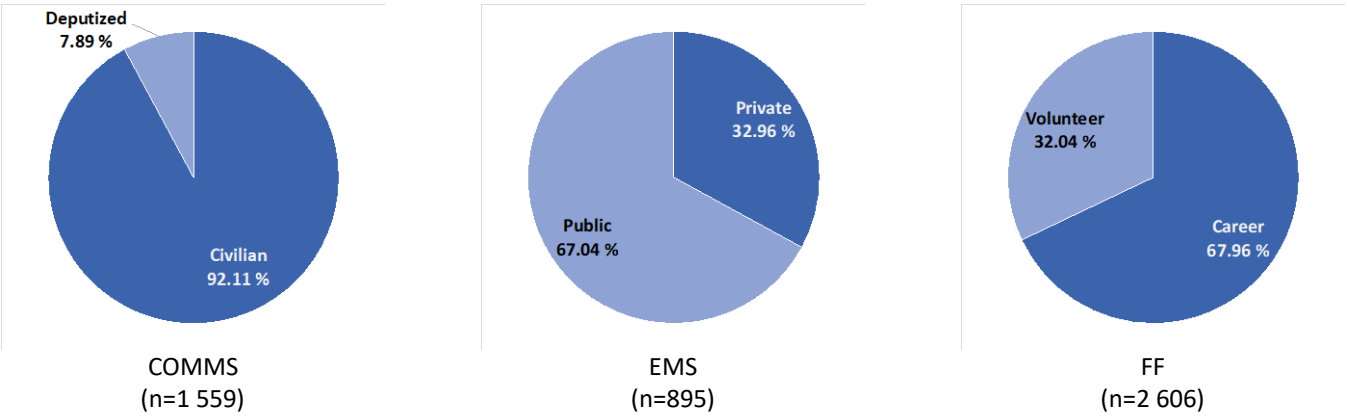

Fig. 19. Discipline-specific demographics

9. Discussion and Future Directions

Phase 2 of this sequential, exploratory mixed methods study was designed to reach a broad sample of first responders to gain a deeper understanding of their technology use. A nationwide survey allowed representation from larger numbers of first responders across the country about communication technology, and to confirm, clarify, and/or expand on the needs and problems related to communication and technology identified in Volumes 1, 2, 3, and 4 from Phase 1 of the study [2][6][11][23]. This survey offers an extensive view of the public safety technology landscape, with topics ranging from current to future technology, and from day-to-day usage to major events.

Overall, the sample surveyed in this phase mapped to the stratified sample priorities (see Sec. 3). With 7 182 completed responses, this survey sample has representation from every FEMA Region (including all states and the District of Columbia. Most importantly, the first responders in the sample represented each of the four disciplines, were from each of the three types of geographic areas (rural, suburban, and urban), and came from primarily local jurisdictions (Sec. 8). Other priorities were civilian and deputized COMMS, public and private EMS, and career and volunteer FF.

The participants within the sampling subgroups largely reflected the broader population (for example, for county and state jurisdictions), except for career and volunteer FF. Every effort was made to ensure responses would mirror the general first responder population as well as the stratified sample previously identified in this document (see Sec. 3). However, due to the nature of volunteerism for FF, there were difficulties in survey dissemination to that population. As noted in the Phase 1, Volume 3 report, volunteer FF work largely in rural areas, and as such, there are often challenges associated with gaining access to them [11]. Often without department phones, email addresses, or websites, contacting rural volunteer firefighters can be dependent on referrals from others. With the sampling

approach used here, access to the 65 % of volunteer FF nationwide [8] was limited. The result is that 32.04 % of the FF surveyed were volunteer.

The final design of the survey closely followed the guiding principles previously identified for the development of the survey (see Sec. 4.2). Each discipline had a different version of the survey catered to their environments and needs, and the survey focused on the technology used in both their day-to-day work and larger events (major disasters or large planned events). It was mobile friendly for responders on-the-go, and overall completion times were short. The resulting data from this nationwide survey in its four variations will be presented in a series of volumes related to Phase 2. This first volume presents an overview of the survey dataset in terms of demographics, along with a detailed discussion of the methods for designing, developing, and disseminating the survey. This serves as a foundation for forthcoming analyses that will present more specifics about and from the data, at different levels of analysis, including at the national level and per discipline.

This report, and the survey it details, is part of a multi-year, multi-phase project that provides a variety of timely and indispensable resources for those interested in public safety communication research, including industry developers, researchers, and first responder organizations. These resources consist of documents such as a usability handbook for public safety communication [24] and a compilation of scenarios for incident response [3]. As previously mentioned, results from the Phase 1 in-depth interviews were presented in a series of volumes [2][6][11][23] and published articles [7][10]. In addition to the forthcoming Phase 2 reporting series, the survey data will be made publicly available via a web-based query tool[3]. A similar tool based on the Phase 1 interview data is accessible via the web, as well [22].

The series of volumes throughout the phases provide insight into first responders' context of use, tasks, and user requirements. As this work is within the PSCR User Interface/User Experience portfolio [21], it is intended to be used as a resource for researchers, designers, and developers of communication tools for first responders. The research findings from this multi-phase usability project should drive technology improvement and development across PSCR research portfolios for mission critical voice, location-based services, and data analytics [20].

Acknowledgements

NIST would like to thank the many first responders, public safety personnel, and public safety organizations who graciously gave their time and input for this project.

[3] The survey data will be redacted to remove any potentially identifiable participant or location information before being made public.

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Appendix A – Email Templates

Initial Email Invitation Template

To line: <individualized>
Subject line: Survey on Public Safety Communication Technology

Good morning/afternoon [Title/Name],

The National Institute of Standards and Technology (NIST) is conducting a research survey with public safety personnel to gain a better understanding of the communication technology they currently use, need, and want in the future.

As part of this effort, we need feedback from Law Enforcement, Fire, EMS, and COMMS. Your input is vital in helping NIST figure out how to best meet communication technology needs moving forward. Your voices are important in this effort!

Participation is voluntary, and responses are confidential. The survey takes approximately 15 minutes to complete and works best if taken on a computer.

Please forward the link below to everyone in your agency/department and encourage them to take the survey. We are hoping to hear from as many first responders as possible in your department/agency, as well as from across the country.

We would appreciate it if you would share the link with other departments and agencies as well.

https://publicsafety.nist.gov/.

If you have any problems or issues accessing or taking the survey, please call our Help Desk at XXX-XXX-XXXX.

For questions or concerns about the survey, please contact Kristen Greene at NIST at 301-975-8119 or kristen.greene@nist.gov.

Thank you in advance for your help.

The NIST First Responder Communications Research Team

Reminder Email Template

To line: <individualized>
Subject line: Survey on Public Safety Communication Technology

Good morning/afternoon [Title/Name],

In the last few weeks, we sent you an email from the National Institute of Standards and Technology (NIST) about a research survey we are conducting with public safety personnel to gain a better understanding of the communication technology they currently use, need, and want in the future.

As part of this effort, we are looking for feedback from Law Enforcement, Fire, EMS, and 911/Dispatch. Your input is vital in helping NIST figure out how to best meet communication technology needs moving forward.

If you have already sent the survey link to personnel in your department/agency, THANK YOU SO MUCH!If not, please forward it so we can hear from as many first responders as possible. If you wish not to participate, just let us know and we will not send any more reminders.

Participation is voluntary, and responses are confidential. The survey takes approximately 15 minutes to complete and works best if taken on a computer.

We would appreciate it if you would share the link with other departments and agencies as well.

https://publicsafety.nist.gov/.

If you have any problems or issues accessing or taking the survey, please call our Help Desk at XXX-XXX-XXXX.

For questions or concerns about the survey, please contact Kristen Greene at NIST at 301-975-8119 or kristen.greene@nist.gov.

Thank you in advance for your help.

The NIST First Responder Communications Research Team

Appendix B – Demographic Questionnaire

Questionnaire for all four disciplines (page 1)

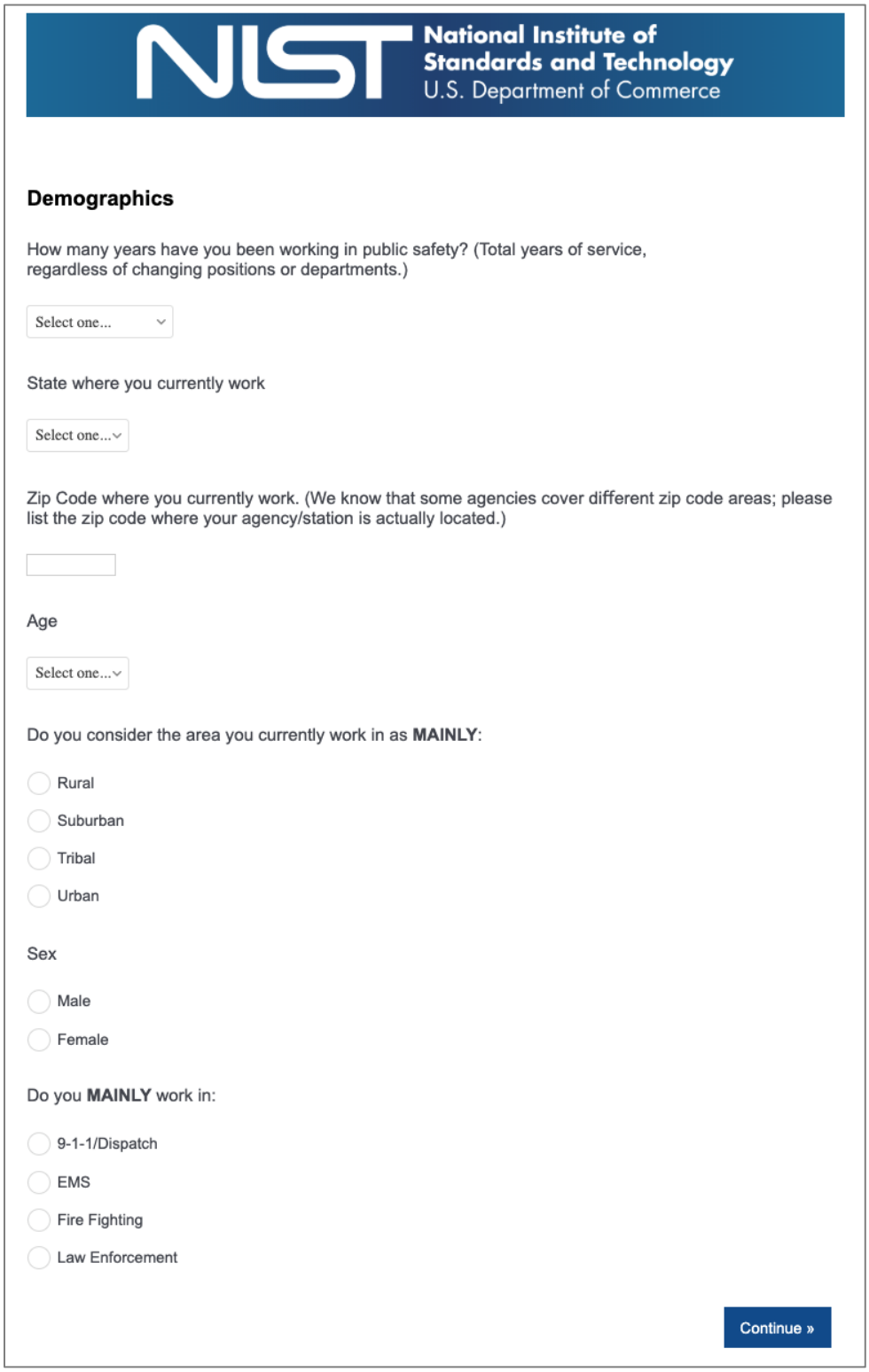
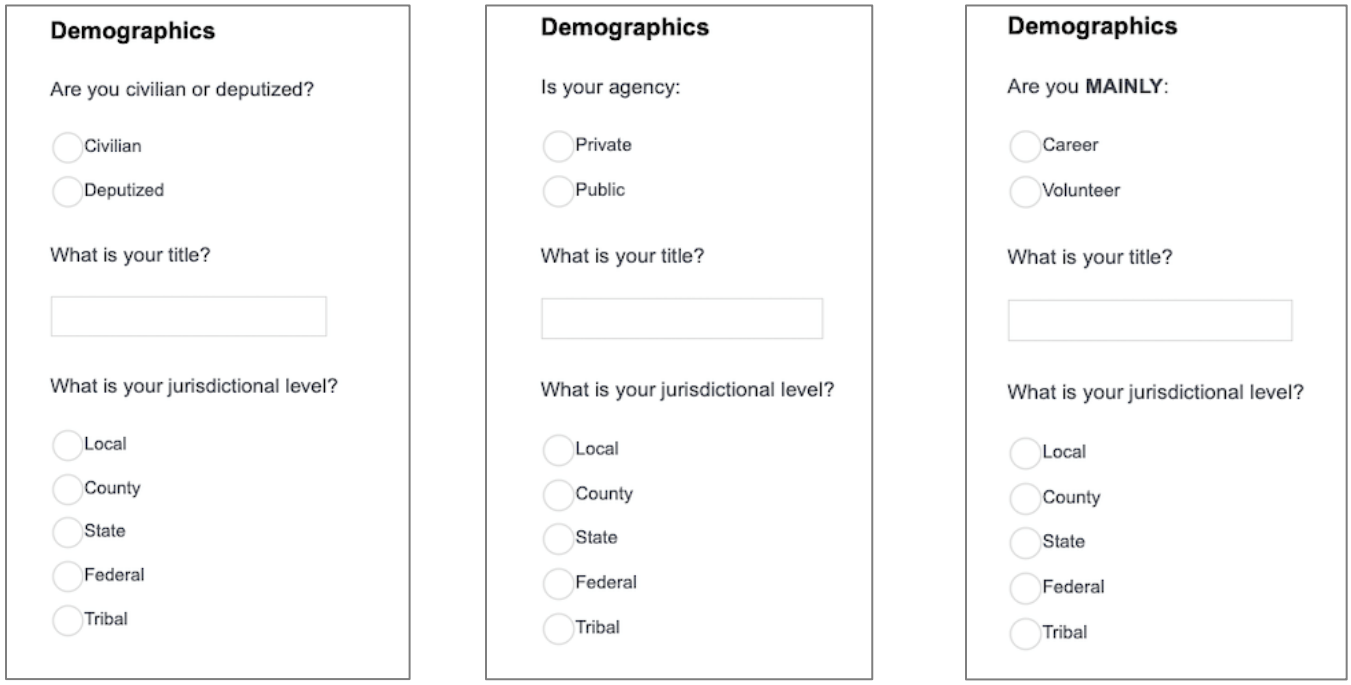


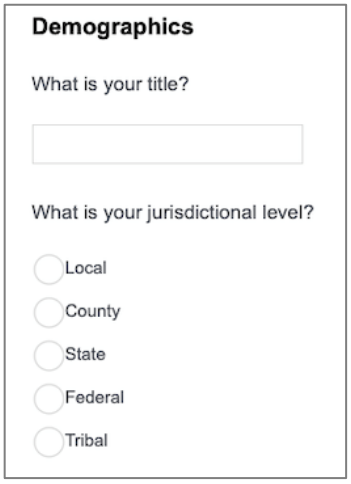
Fig. 20. First page of demographics questionnaire for all disciplines

Questionnaires for all four disciplines (page 2)



COMMS EMS FF

Fig. 21. Second page of demographics questionnaire for COMMS, EMS, and FF



LE

Fig. 22. Second page of LE demographics questionnaire

Appendix C – Technology Lists

For the following tables in Appendix C, a dot indicates that a particular technology appeared in that discipline-specific survey.

Table 10. Technology list for day-to-day devices questions

Day-to-Day Device Use	COMMS	EMS	FF	LE
Computer: desktop	●	●	●	●
Mic: desktop *(COMMS only)* handheld or clip-on *(COMMS only)* wireless *(EMS, FF, LE only)* with cord *(EMS, FF, LE only)*	●	●	●	●
Pager	●	●	●	●
Radio: in-vehicle portable	●	●	●	●
Smartphone: personal work issued	●	●	●	●
Earpiece: wireless (self purchased) wireless (work issued) with cord		●	●	●
Computer: laptop		●	●	●
Flip phone: work issued		●	●	●
MDT/MDC (mobile data terminal/computer)		●	●	●
Tablet		●	●	●
Foot pedal	●			
Headset	●			
Monitor (at your personal workstation)	●			
Monitor (for shared viewing)	●			
Phone: landline	●			
TIC (thermal imaging camera)			●	
Body camera				●
Dash camera				●
Fingerprint scanner				●
License plate reader				●

Table 11. Technology list for day-to-day apps/software questions

Day-to-Day Apps/Software Use	COMMS	EMS	FF	LE
CAD	●	●	●	●
Email	●	●	●	●
Mapping/driving directions	●	●	●	●
RMS	●	●	●	●
Traffic	●	●	●	●
Weather	●	●	●	●
First responder vehicle tracking	●	●		●
Language translation	●		●	●
Report writing software		●	●	●
Criminal Databases	●			●
Electronic policies/laws	●			●
EPCR		●	●	
ERG		●	●	
Emergency notification system (for informing the public)	●			
AED locator		●		
Medication/drug identification or interaction		●		
Hazmat (guides or operating procedures)			●	
Hydrant location			●	
Pre-plan software			●	

Table 12. Technology list for day-to-day futuristic question

Day-to-Day Future Technology	COMMS	EMS	FF	LE
AR	●	●	●	●
Indoor mapping	●	●	●	●
One login (instead of many different usernames and passwords)	●	●	●	●
Real-time on-scene video	●	●	●	●
Smart watch	●	●	●	●
Voice controls for hands-free input	●	●	●	●
VR	●	●	●	●
Drones		●	●	●
Health/vitals monitoring of first responders		●	●	●
HUDs		●	●	●
Robots		●	●	●
Self driving vehicles		●	●	●
Smart buildings		●	●	●
Smart glasses		●	●	●
Voice recognition for identification		●	●	●
AVL		●	●	
Health/vitals monitoring of patients		●	●	
Automatic caller location	●			
Automatic transmission of patient vitals and information to hospital		●		
Remote sensing (by aircraft or satellite)			●	
Facial recognition software				●
First responder tracking				●
Thermal imaging				●
Vehicle tracking				●

Table 13. Technology list for major disaster and large planned event questions

Large Event Technology	COMMS	EMS	FF	LE
Deployable communication technology (such as cell towers on wheels)	●	●	●	●
Drones	●	●	●	●
Mobile command centers	●	●	●	●
Helicopters		●	●	●
Remote sensing (by aircraft or satellite)		●	●	●
Robots		●	●	●
Generators	●			

Problems Lists

The full list of problems associated with each of the day-to-day devices for all three disciplines is presented here (the COMMS survey only included information problems; see Sec. 6). The technology in Table 14 was included in the survey lists for EMS, FF, and LE. The Table 15 technology was only included in the survey lists for FF. The Table 16 technology was only included in the survey lists for LE.

Table 14. Problems for devices presented to EMS, FF, and LE

Devices	Problems
DESKTOP COMPUTER	Internet connection
	Interoperability
	Loggins/passwords
	Outdated/old
	Price: too expensive
	Software crashes
	Software updates/upgrades

Devices	Problems
EARPIECE	Audio quality
	Battery life
	Durability
	Fit/Falling out
	Outdated/old
	Price: too expensive
	Volume
	Wireless (Bluetooth pairing, etc.)
LAPTOP	Battery life
	Durability
	Glare
	Internet connection
	Interoperability
	Loggins/passwords
	Outdated/old
	Power source/recharging issues
	Price: too expensive
	Size/bulkiness
	Software crashes
	Software updates/upgrades
	Weight
MDT/MDC (mobile data terminal/computer)	CAD (computer-aided dispatch)
	Durability
	Glare
	Interoperability
	Lack of portability
	Mapping/navigation
	Logins/passwords
	Outdated/old
	Price: too expensive
	Size/bulkiness
	Using while driving

Devices	Problems
MICROPHONE	Audio quality
	Cord
	Durability
	Falling off
	Outdated/old
	Placement on body
	Price: too expensive
	Talk button location
	Talk button size
PAGER	Battery life
	Durability
	Falling off
	Outdated/old
	Price: too expensive
	Size/bulkiness
RADIO	Audio quality
	Battery life
	Channel switching
	Cord
	Coverage/dead zones
	Durability
	Interoperability
	Outdated/old
	Price: too expensive
	Radio discipline/etiquette
	Size/bulkiness

Devices	Problems
SMARTPHONE	Battery life
	Coverage/dead zones
	Data plans/data limits
	Dropped calls
	Durability
	Glare
	Logging in (PINS, passwords, usernames, etc.)
	Interoperability
	Outdated/old
	Permission/access to apps
	Policies about usage
	Price: too expensive
	Subpoena possibility for personal smartphone
	Subsidy for personal smartphone (insufficient or no subsidy)
TABLET	Battery life
	Durability
	Glare
	Internet connection
	Interoperability
	Loggins/passwords
	Outdated/old
	Price: too expensive
	Report writing
	Size/bulkiness
	Touchscreen
	Weight

Table 15. Problems for FF-specific devices

Devices	Problems
TIC (thermal imaging camera)	Accuracy of information
	Battery
	Durability
	Outdated/old
	Price: too expensive
	Size/bulkiness
	Small screen

Table 16. Problems for LE-specific devices

Devices	Problems
BODY CAMERA	Battery life
	Falling off easily
	Interoperability
	Placement/location on body
	Outdated/old
	Price: too expensive
	Size/bulkiness
	Turning on/off
	Using/tagging recorded video data
	Video quality
	Video transfer/storage

FINGERPRINT SCANNER	Battery life
	Capture of fingerprints
	Glare
	Interoperability
	Logging in (PINS, passwords, usernames, etc.)
	Outdated/old
	Price: too expensive
	Quality of fingerprints
	Receiving fingerprint results quickly
	Sending fingerprints
	Size/bulkiness
LICENSE PLATE READER	Ability to accurately read plates
	Interoperability
	Outdated/old
	Power source
	Price: too expensive
	Range
	Receiving results quickly

Appendix D – Survey Question Exemplars

This appendix includes a selection of survey question screenshots to illustrate the question and response option formatting and presentation style used throughout the survey. Full surveys available on request. In this appendix, Figs. 22 through 41 show screenshots from the LE survey as exemplars, as the LE, FF, and EMS surveys were so similar. Fig. 42 shows the final EMS survey page, as it had one additional question on it regarding medical technology. Figs. 43 through 56 show screenshots from the COMMS survey.

Use of technology in your DAY-TO-DAY work

We know there is no such thing as a "typical" day in public safety. However, for this set of questions, focus on the kinds of things you use in your day-to-day work.

Think about your **DAY-TO-DAY** work and your use of the following **devices**.

	Use a lot	Use occasionally	Have, but do not use	Do not have
Body camera	○	○	○	○
Computer: desktop	○	○	○	○
Computer: laptop	○	○	○	○
Dash camera	○	○	○	○
Earpiece: wireless (self purchased)	○	○	○	○
Earpiece: wireless (work issued)	○	○	○	○
Earpiece: with cord	○	○	○	○
Fingerprint scanner	○	○	○	○
Flip phone: work issued	○	○	○	○
License plate reader	○	○	○	○
MDT/MDC (mobile data terminal/computer)	○	○	○	○
Mic: wireless	○	○	○	○
Mic: with cord	○	○	○	○
Pager	○	○	○	○
Radio: in-car	○	○	○	○
Radio: portable	○	○	○	○
Smartphone: personal	○	○	○	○
Smartphone: work issued	○	○	○	○
Tablet	○	○	○	○

Other (please specify)

« Back Continue »

Fig. 23. LE day-to-day devices frequency question

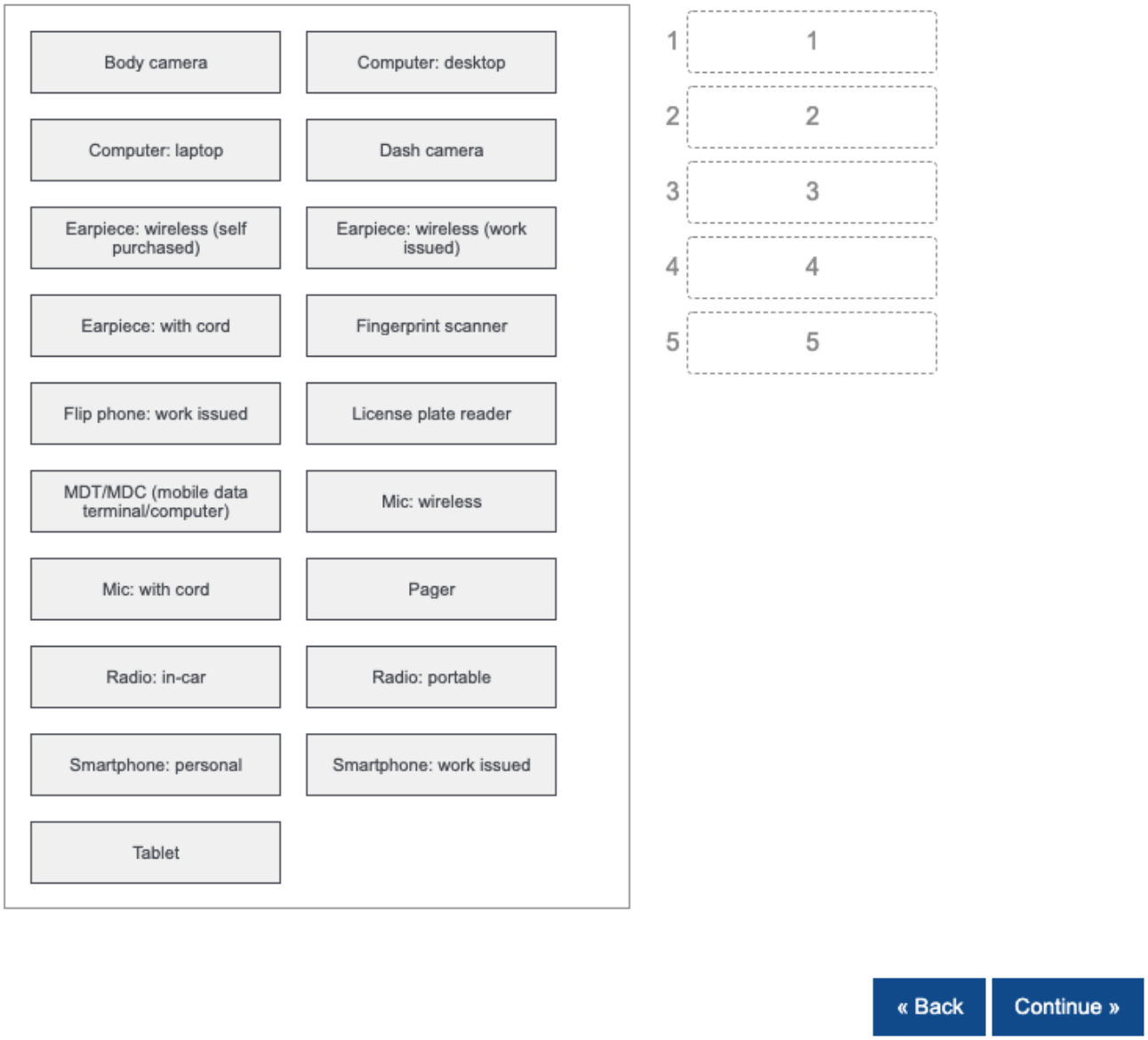
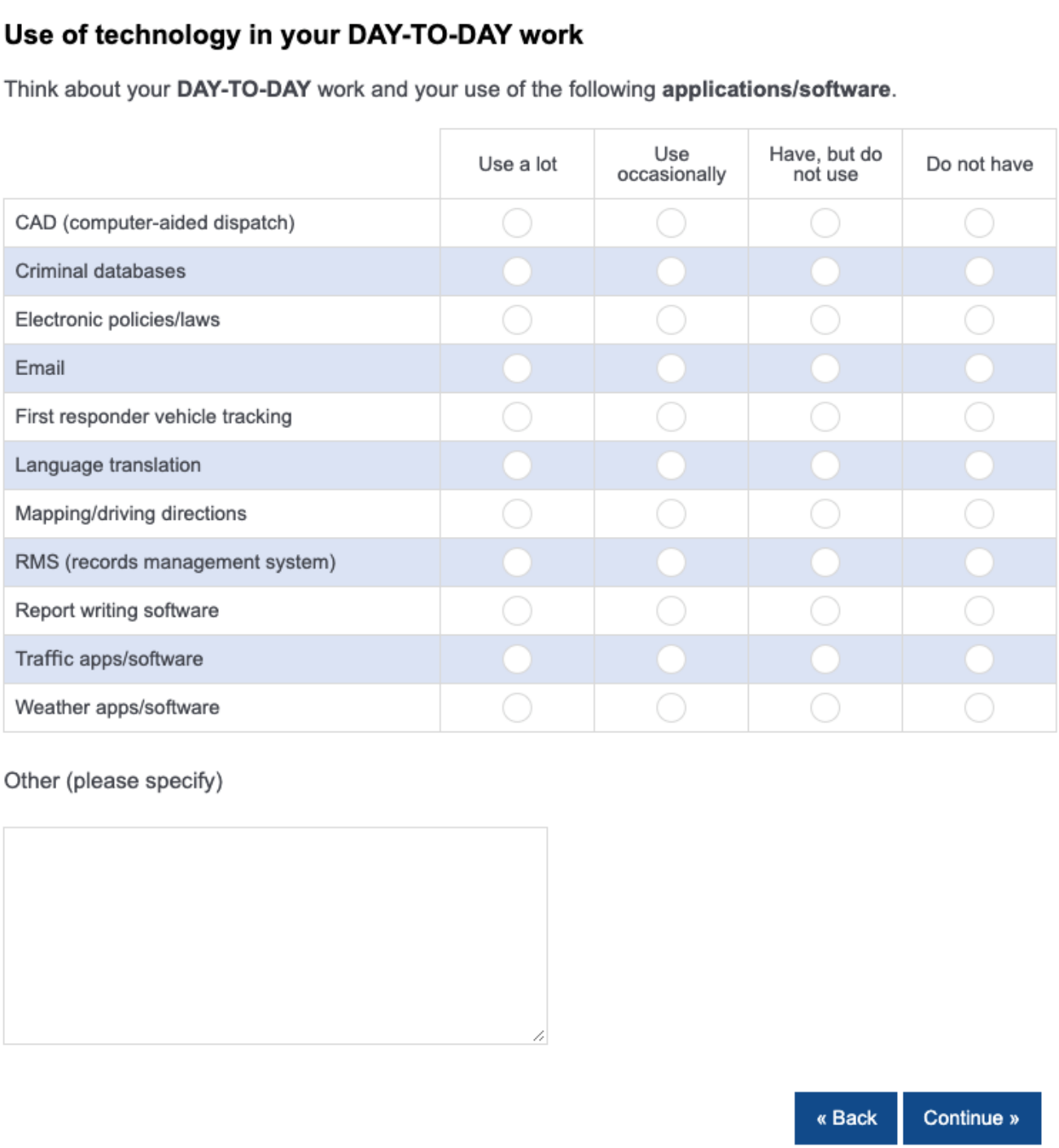


Fig. 24. LE day-to-day devices ranking question



Use of technology in your DAY-TO-DAY work

Think about your **DAY-TO-DAY** work and your use of the following **applications/software**.

	Use a lot	Use occasionally	Have, but do not use	Do not have
CAD (computer-aided dispatch)	○	○	○	○
Criminal databases	○	○	○	○
Electronic policies/laws	○	○	○	○
Email	○	○	○	○
First responder vehicle tracking	○	○	○	○
Language translation	○	○	○	○
Mapping/driving directions	○	○	○	○
RMS (records management system)	○	○	○	○
Report writing software	○	○	○	○
Traffic apps/software	○	○	○	○
Weather apps/software	○	○	○	○

Other (please specify)

« Back Continue »

Fig. 25. LE day-to-day devices apps/software frequency question

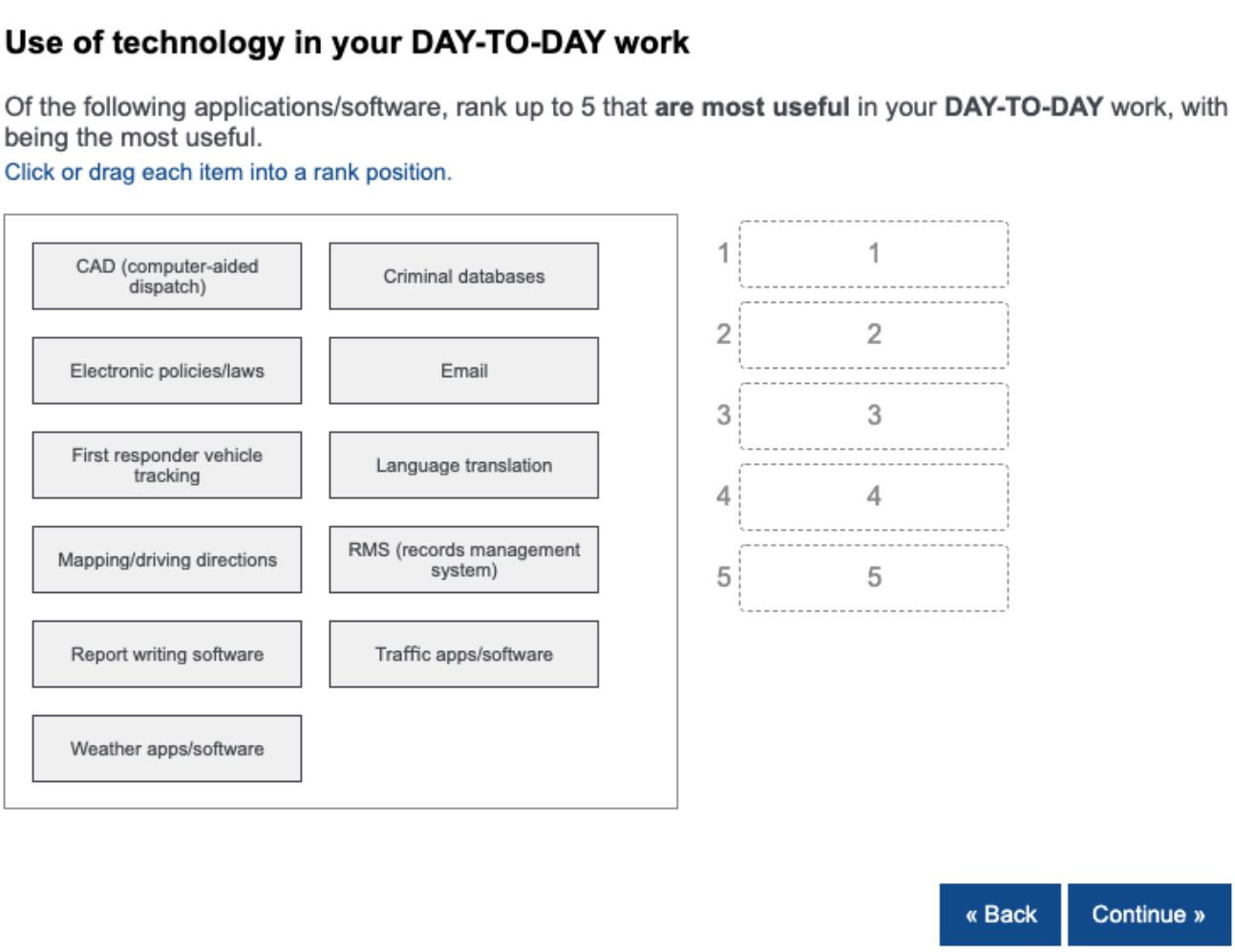


Fig. 26. LE day-to-day devices apps/software ranking question

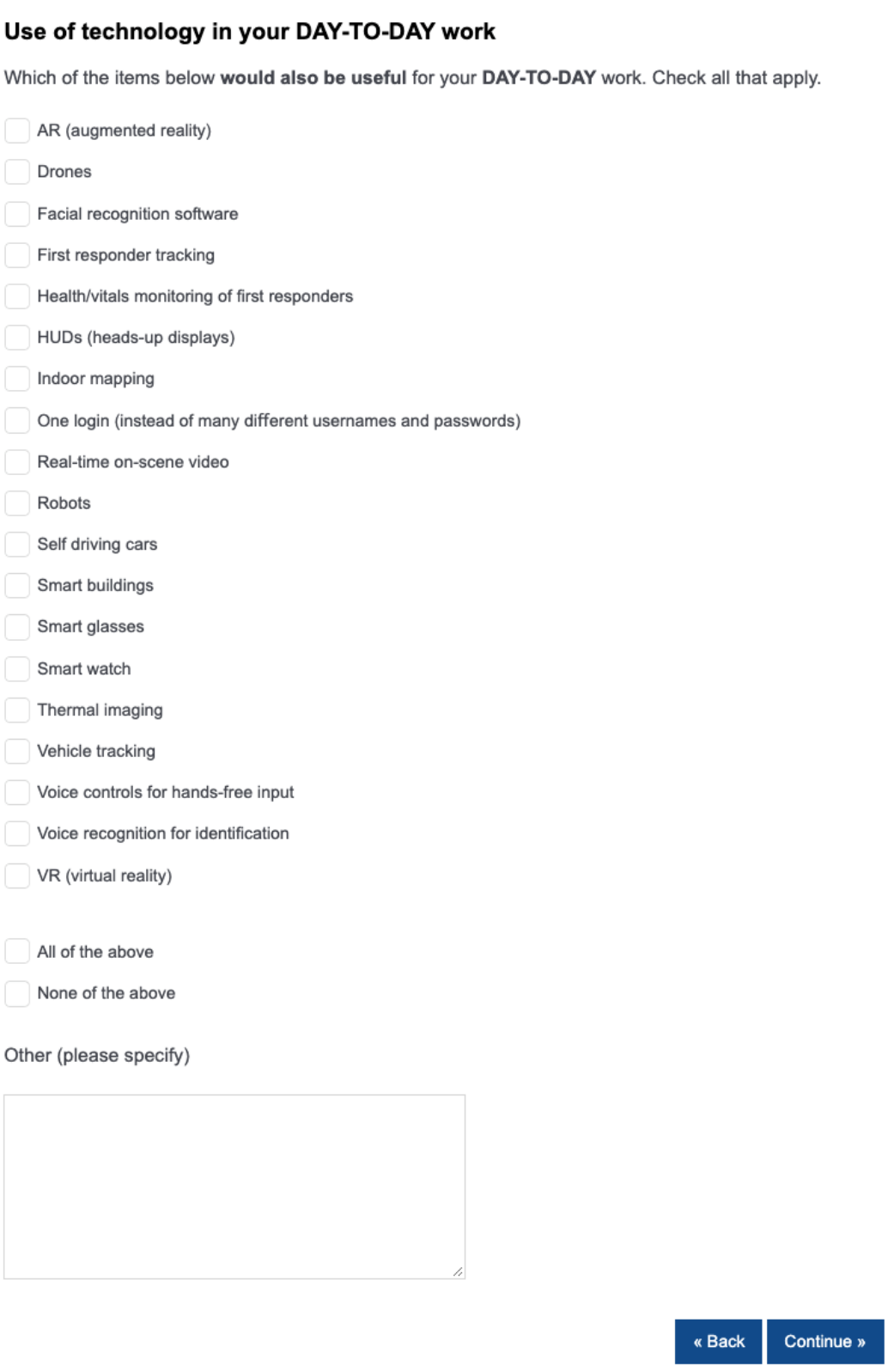


Fig. 27. LE day-to-day futuristic technology question

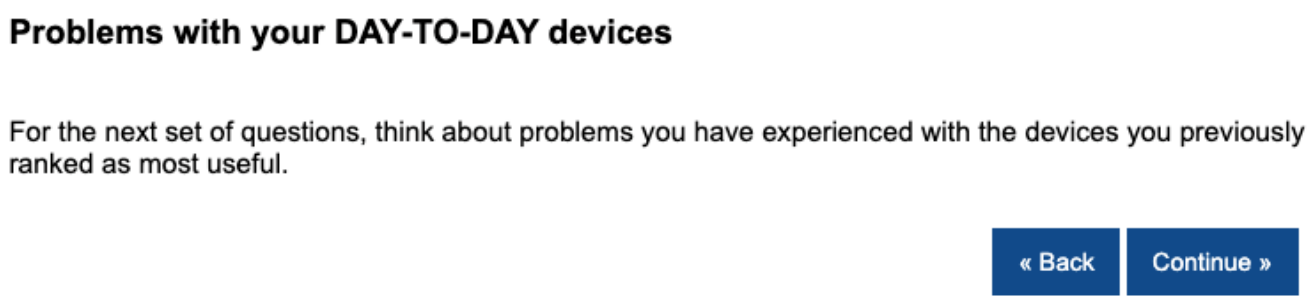


Fig. 28. LE day-to-day devices problems framing page

With your **RADIO**, have you experienced problems with:

	Always	Most of the time	Sometimes	Rarely	Never	Does not apply
Audio quality	○	○	○	○	○	○
Battery life	○	○	○	○	○	○
Channel switching	○	○	○	○	○	○
Cord	○	○	○	○	○	○
Coverage/dead zones	○	○	○	○	○	○
Durability	○	○	○	○	○	○
Interoperability	○	○	○	○	○	○
Outdated/old	○	○	○	○	○	○
Price: too expensive	○	○	○	○	○	○
Radio discipline/etiquette	○	○	○	○	○	○
Size/bulkiness	○	○	○	○	○	○

Have you experienced other problems with your **RADIO**?

○ No

○ Yes

Please list.

« Back Continue »

Fig. 29. LE radio problems question

With your **SMARTPHONE** (work-issued or personal), have you experienced problems with:

	Always	Most of the time	Sometimes	Rarely	Never	Does not apply
Battery life	○	○	○	○	○	○
Coverage/dead zones	○	○	○	○	○	○
Data plans/data limits	○	○	○	○	○	○
Dropped calls	○	○	○	○	○	○
Durability	○	○	○	○	○	○
Glare	○	○	○	○	○	○
Logging in (PINS, passwords, usernames, etc.)	○	○	○	○	○	○
Outdated/old	○	○	○	○	○	○
Permission/access to apps	○	○	○	○	○	○
Policies about usage	○	○	○	○	○	○
Price: too expensive	○	○	○	○	○	○
Subpoena possibility for personal smartphone	○	○	○	○	○	○
Subsidy for personal smartphone (insufficient or no subsidy)	○	○	○	○	○	○

Have you experienced other problems with your **SMARTPHONE** (work-issued or personal)?

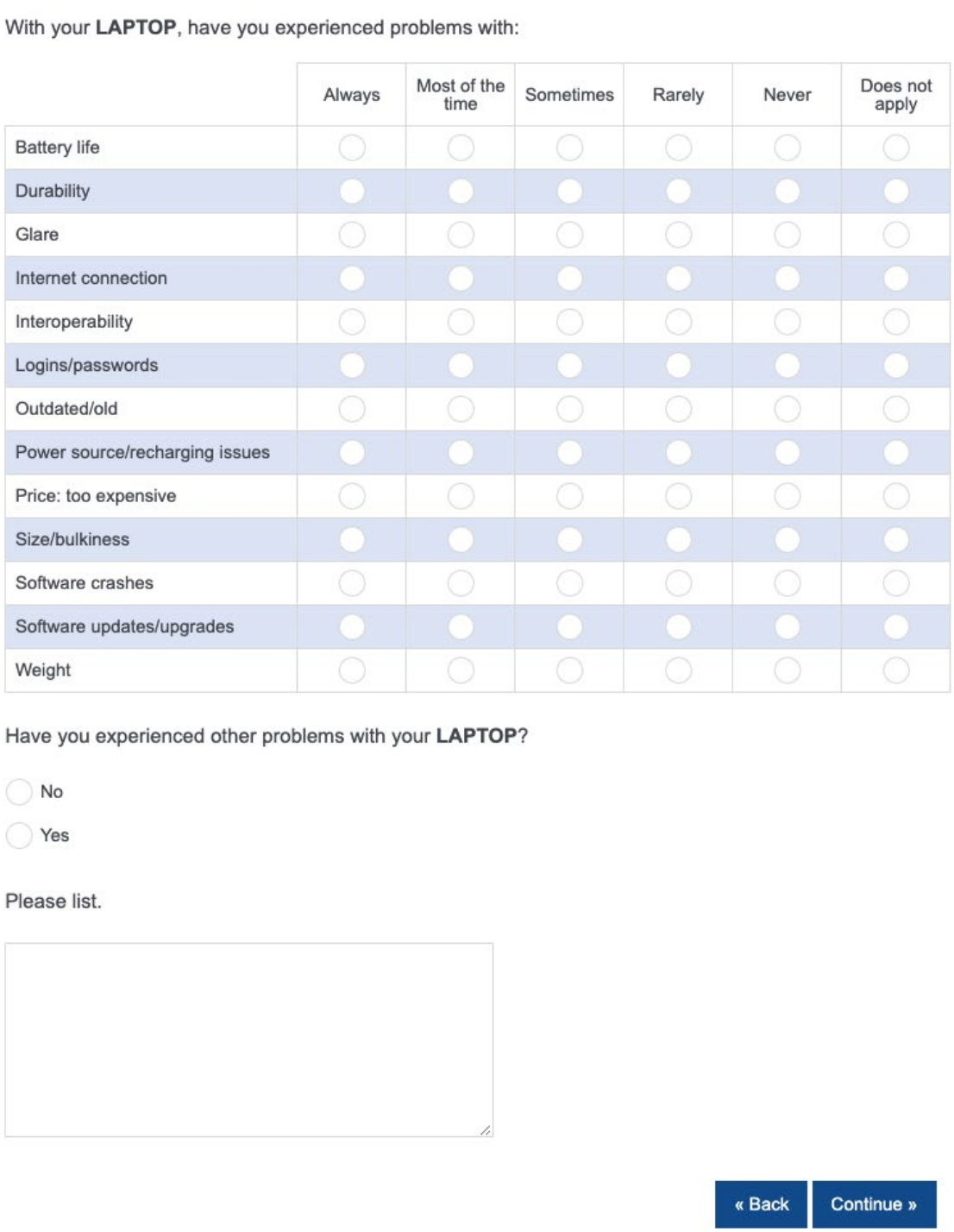
○ No

○ Yes

Please list.

« Back Continue »

Fig. 30. LE smartphone problems question



With your **LAPTOP**, have you experienced problems with:

	Always	Most of the time	Sometimes	Rarely	Never	Does not apply
Battery life	○	○	○	○	○	○
Durability	○	○	○	○	○	○
Glare	○	○	○	○	○	○
Internet connection	○	○	○	○	○	○
Interoperability	○	○	○	○	○	○
Logins/passwords	○	○	○	○	○	○
Outdated/old	○	○	○	○	○	○
Power source/recharging issues	○	○	○	○	○	○
Price: too expensive	○	○	○	○	○	○
Size/bulkiness	○	○	○	○	○	○
Software crashes	○	○	○	○	○	○
Software updates/upgrades	○	○	○	○	○	○
Weight	○	○	○	○	○	○

Have you experienced other problems with your **LAPTOP**?

○ No

○ Yes

Please list.

« Back Continue »

Fig. 31. LE laptop problems question

With your **MDT/MDC (mobile data terminal/computer)**, have you experienced problems with:

	Always	Most of the time	Sometimes	Rarely	Never	Does not apply
CAD (computer- aided dispatch)	○	○	○	○	○	○
Durability	○	○	○	○	○	○
Glare	○	○	○	○	○	○
Interoperability	○	○	○	○	○	○
Lack of portability	○	○	○	○	○	○
Mapping/navigation	○	○	○	○	○	○
Logins/passwords	○	○	○	○	○	○
Outdated/old	○	○	○	○	○	○
Price: too expensive	○	○	○	○	○	○
Size/bulkiness	○	○	○	○	○	○
Using while driving	○	○	○	○	○	○

Have you experienced other problems with your **MDT/MDC**?

○ No

○ Yes

Please list.

« Back Continue »

Fig. 32. LE MDT/MDC problems question

With your **MIC**, have you experienced problems with:

	Always	Most of the time	Sometimes	Rarely	Never	Does not apply
Audio quality	○	○	○	○	○	○
Cord	○	○	○	○	○	○
Durability	○	○	○	○	○	○
Falling off	○	○	○	○	○	○
Outdated/old	○	○	○	○	○	○
Placement on body	○	○	○	○	○	○
Price: too expensive	○	○	○	○	○	○
Talk button location	○	○	○	○	○	○
Talk button size	○	○	○	○	○	○

Have you experienced other problems with your **MIC**?

○ No

○ Yes

Please list.

« Back Continue »

Fig. 33. LE mic problems question

With your **BODY CAMERA**, have you experienced problems with:

	Always	Most of the time	Sometimes	Rarely	Never	Does not apply
Battery life	○	○	○	○	○	○
Durability	○	○	○	○	○	○
Falls off easily	○	○	○	○	○	○
Interoperability	○	○	○	○	○	○
Placement/location on body	○	○	○	○	○	○
Outdated/old	○	○	○	○	○	○
Price: too expensive	○	○	○	○	○	○
Size/bulkiness	○	○	○	○	○	○
Turning on/off	○	○	○	○	○	○
Using/tagging recorded video data	○	○	○	○	○	○
Video quality	○	○	○	○	○	○
Video transfer/storage	○	○	○	○	○	○

Have you experienced other problems with your **BODY CAMERA**?

○ No

○ Yes

Please list.

« Back Continue »

Fig. 34. LE body camera problems question

With your **EARPIECE**, have you experienced problems with:

	Always	Most of the time	Sometimes	Rarely	Never	Does not apply
Audio quality	○	○	○	○	○	○
Battery life	○	○	○	○	○	○
Durability	○	○	○	○	○	○
Fit/falling out	○	○	○	○	○	○
Outdated/old	○	○	○	○	○	○
Price: too expensive	○	○	○	○	○	○
Volume	○	○	○	○	○	○
Wireless (bluetooth pairing, etc.)	○	○	○	○	○	○

Have you experienced other problems with your **EARPIECE**?

○ No

○ Yes

Please list.

« Back Continue »

Fig. 35. LE earpiece problems question

With your **TABLET**, have you experienced problems with:

	Always	Most of the time	Sometimes	Rarely	Never	Does not apply
Battery life	○	○	○	○	○	○
Durability	○	○	○	○	○	○
Glare	○	○	○	○	○	○
Internet connection	○	○	○	○	○	○
Interoperability	○	○	○	○	○	○
Logins/passwords	○	○	○	○	○	○
Outdated/old	○	○	○	○	○	○
Price: too expensive	○	○	○	○	○	○
Report writing	○	○	○	○	○	○
Size/bulkiness	○	○	○	○	○	○
Touchscreen	○	○	○	○	○	○
Weight	○	○	○	○	○	○

Have you experienced other problems with your **TABLET**?

○ No

○ Yes

Please list.

« Back Continue »

Fig. 36. LE tablet problems question

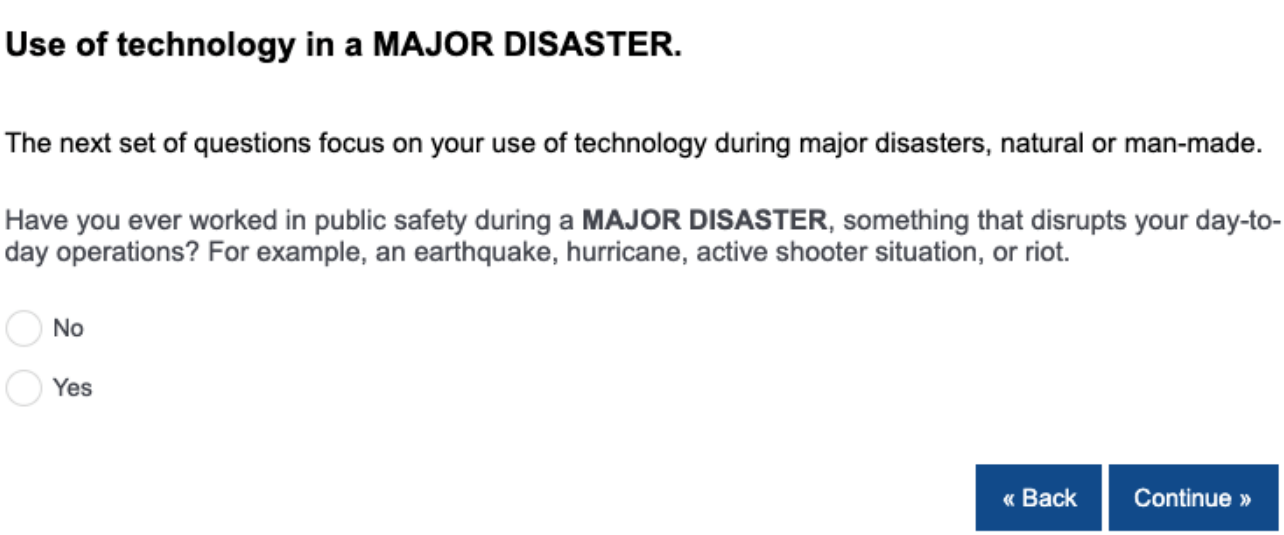


Fig. 37. LE major disaster questions, first page

Use of technology in a MAJOR DISASTER.

Think about the technology you use during a **MAJOR DISASTER**. How similar or different is it than the technology you use during your day-to-day work?

- ( ) I use mostly the same technology.
- ( ) I use some of the same technology, with some specialized technology.
- ( ) I use very different technology.

Please list the **specialized** technology you use during a **MAJOR DISASTER**.

Please list the **most important** technology you use during a **MAJOR DISASTER**.

In addition to the technology you use day-to-day, which of the following do you think would be helpful during a **MAJOR DISASTER**? Check all that apply.

- [ ] Deployable communication technology (such as cell towers on wheels)
- [ ] Drones
- [ ] Helicopters
- [ ] Mobile command centers
- [ ] Remote sensing (by aircraft or satellite)
- [ ] Robots

Other (please specify)

« Back Continue »

Fig. 38. LE major disaster questions, second page

Fig. 39. LE large planned event questions, first page

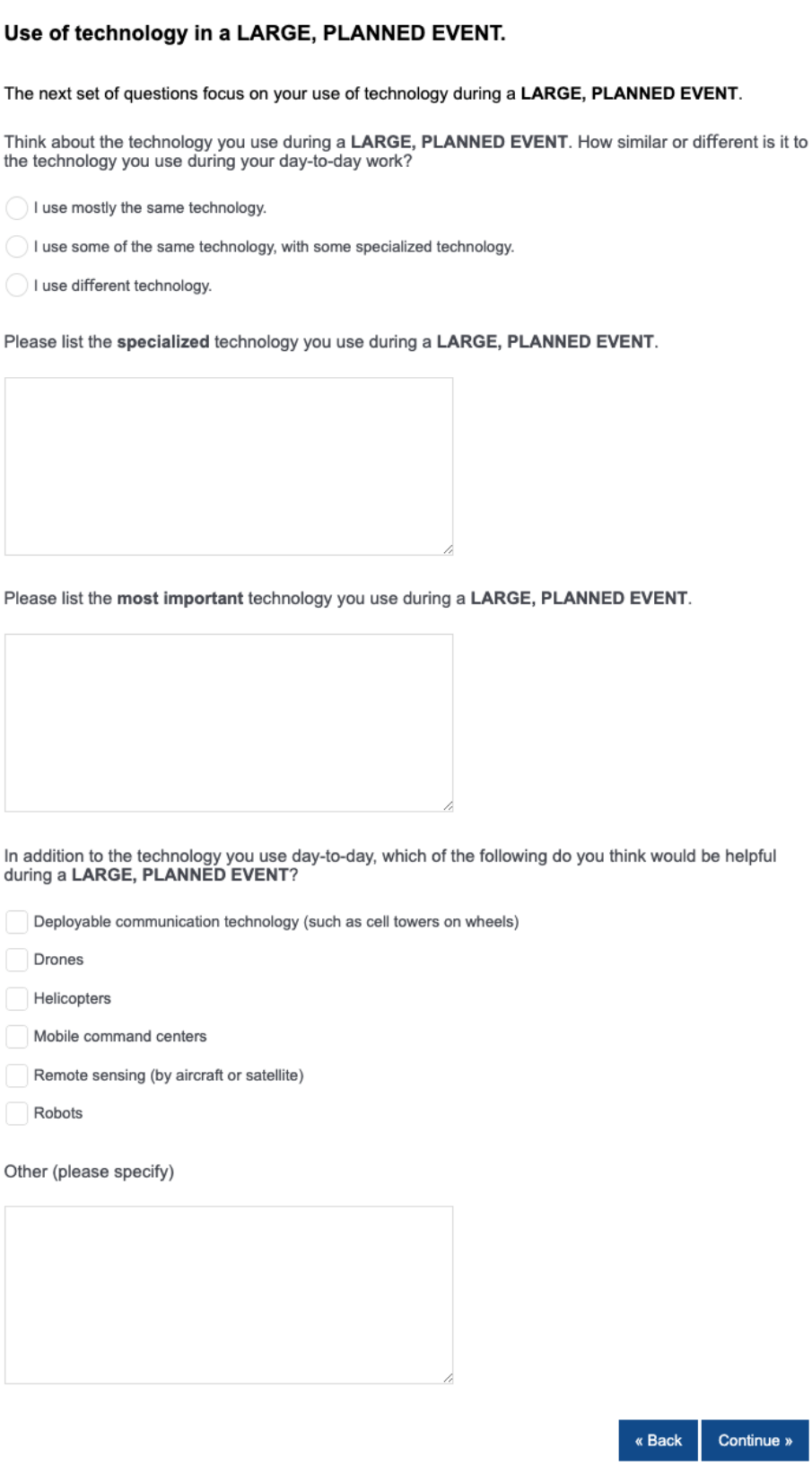


Fig. 40. LE large planned event questions, second page

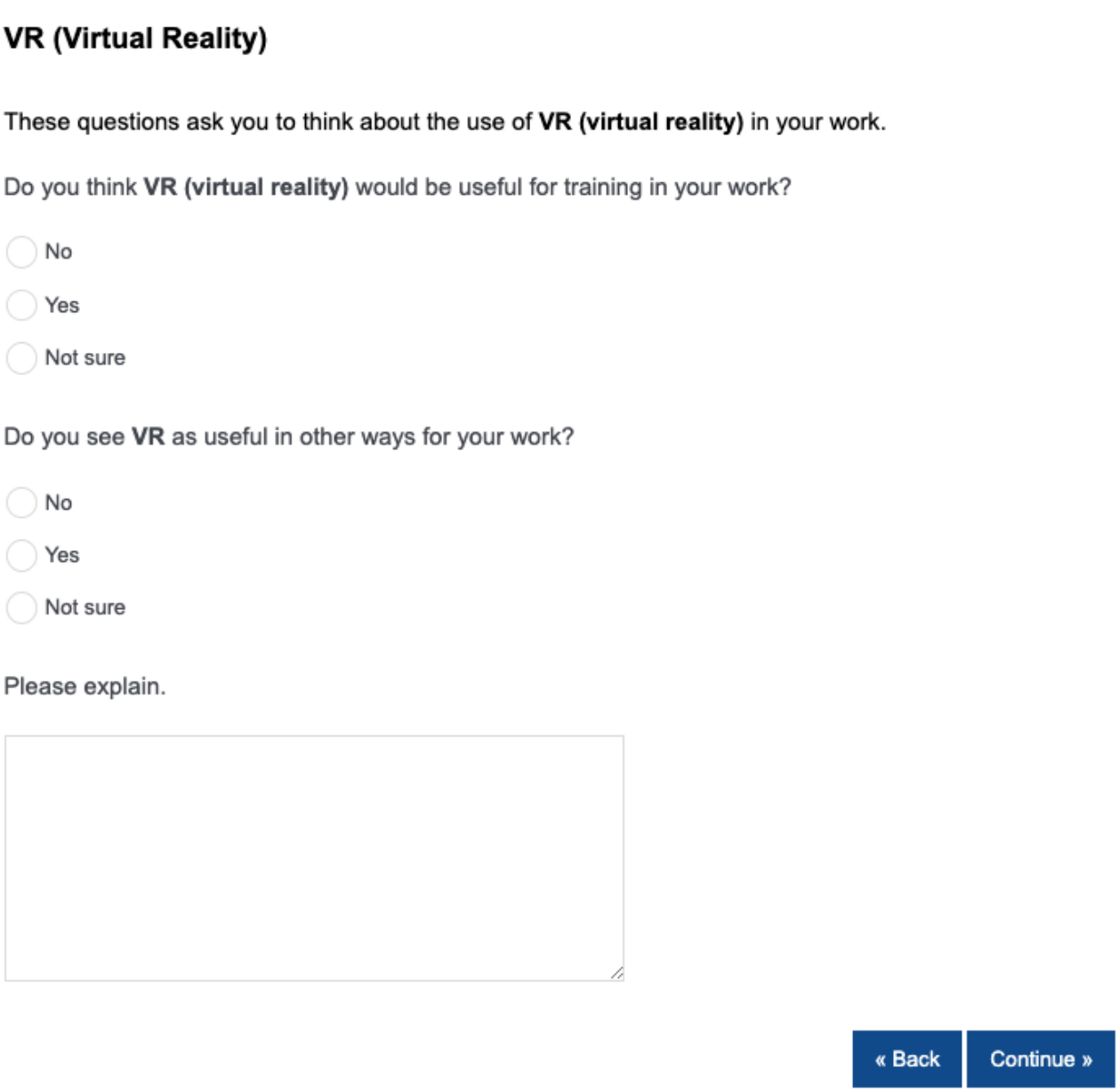


Fig. 41. LE VR questions

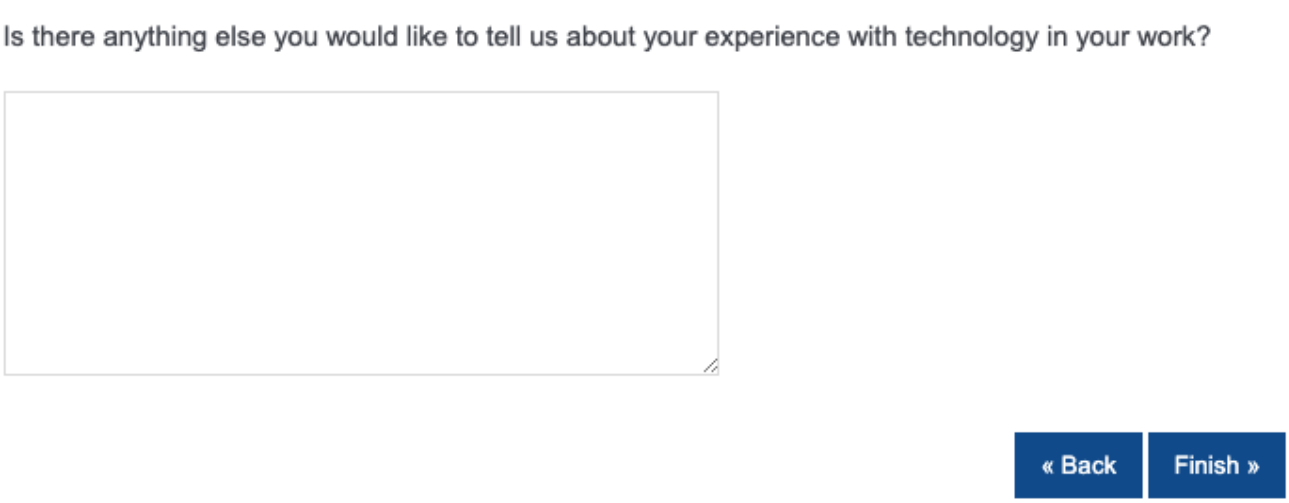


Fig. 42. LE final question

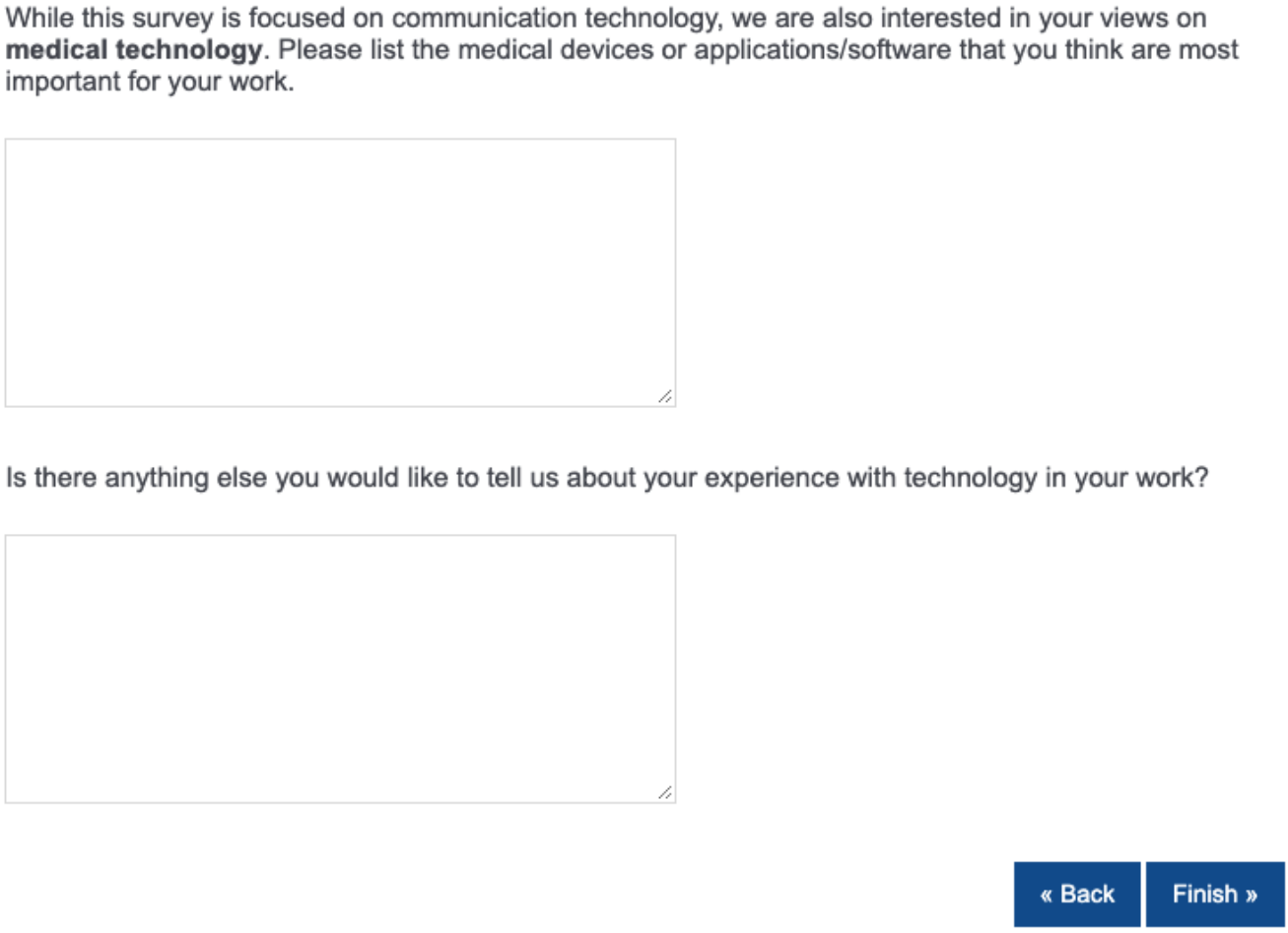
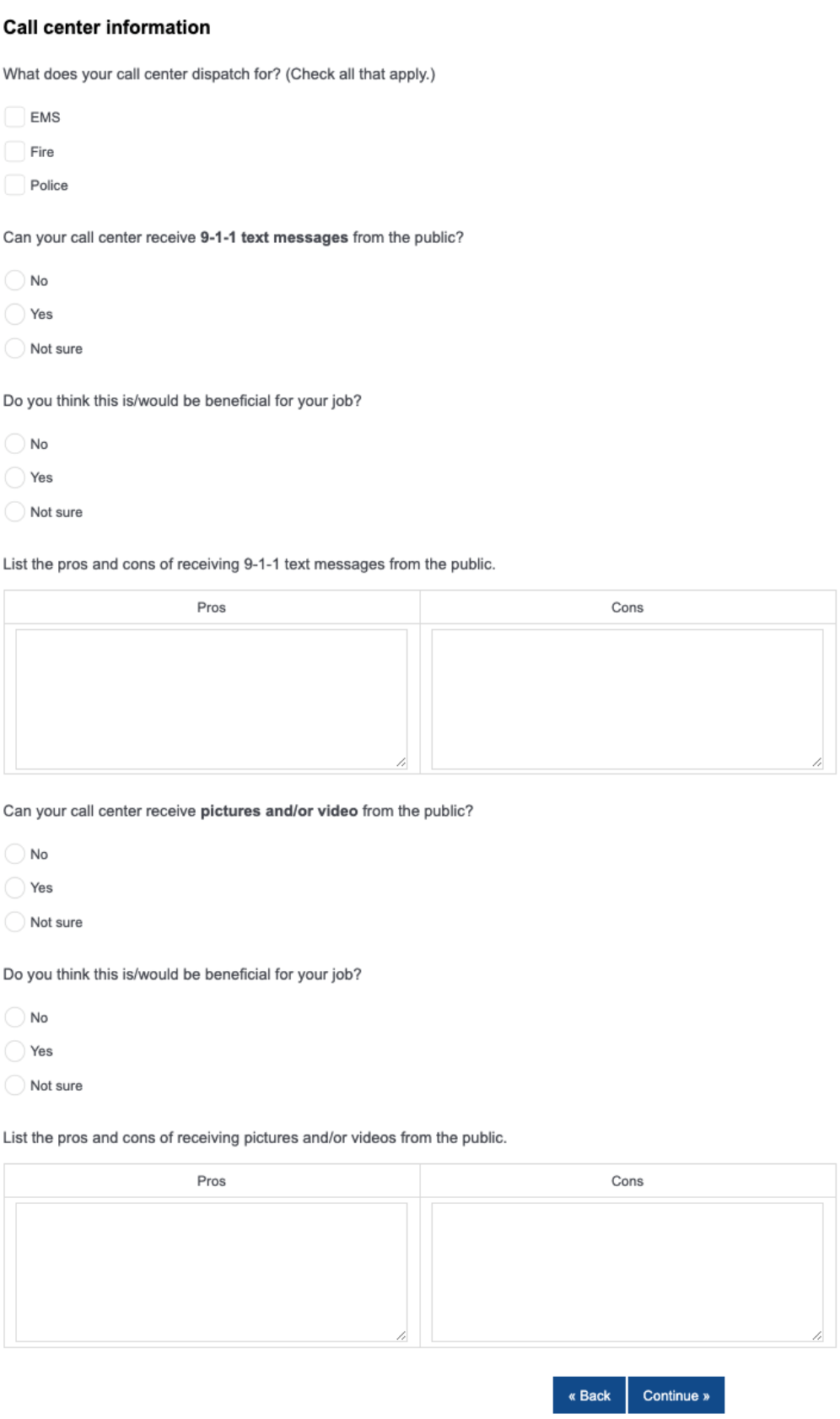


Fig. 43. EMS final questions



Call center information

What does your call center dispatch for? (Check all that apply.)

- [ ] EMS
- [ ] Fire
- [ ] Police

Can your call center receive **9-1-1 text messages** from the public?

- ( ) No
- ( ) Yes
- ( ) Not sure

Do you think this is/would be beneficial for your job?

- ( ) No
- ( ) Yes
- ( ) Not sure

List the pros and cons of receiving 9-1-1 text messages from the public.

Pros	Cons

Can your call center receive **pictures and/or video** from the public?

- ( ) No
- ( ) Yes
- ( ) Not sure

Do you think this is/would be beneficial for your job?

- ( ) No
- ( ) Yes
- ( ) Not sure

List the pros and cons of receiving pictures and/or videos from the public.

Pros	Cons

« Back Continue »

Fig. 44. COMMS call center questions, first page

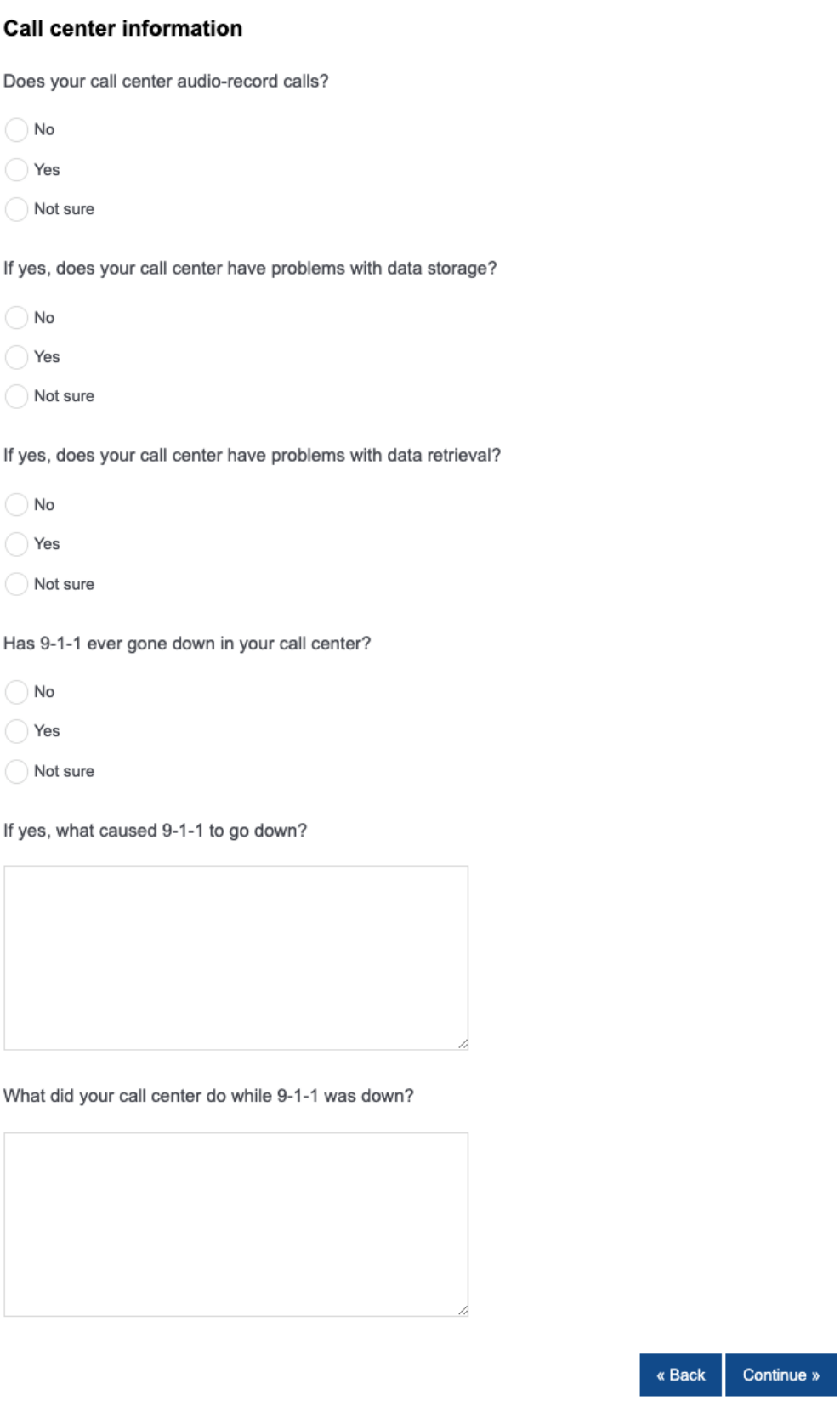


Fig. 45. COMMS call center questions, second page

Use of technology in your DAY-TO-DAY work

We know there is no such thing as a "typical" day in public safety. However, for this set of questions, focus on the kinds of things you use in your day-to-day work.

Think about your **DAY-TO-DAY** work and your use of the following **devices**.

	Use a lot	Use occasionally	Have, but do not use	Do not have
Computer: desktop	○	○	○	○
Foot pedal	○	○	○	○
Headset	○	○	○	○
Microphone: desktop	○	○	○	○
Microphone: handheld or clip-on	○	○	○	○
Monitor (at your personal workstation)	○	○	○	○
Monitor (for shared viewing)	○	○	○	○
Pager	○	○	○	○
Phone: landline	○	○	○	○
Radio	○	○	○	○
Smartphone: personal	○	○	○	○
Smartphone: work issued	○	○	○	○

Other (please specify)

« Back Continue »

Fig. 46. COMMS day-to-day device frequency question

Use of technology in your DAY-TO-DAY work

Think about your **DAY-TO-DAY** work and your use of the following **applications/software**.

	Use a lot	Use occasionally	Have, but do not use	Do not have
CAD (computer-aided dispatch)	○	○	○	○
Criminal databases	○	○	○	○
Electronic policies/laws	○	○	○	○
Email	○	○	○	○
Emergency notification system (for informing the public)	○	○	○	○
First responder vehicle tracking	○	○	○	○
Language translation	○	○	○	○
Mapping/driving directions	○	○	○	○
RMS (records management system)	○	○	○	○
Traffic apps/software	○	○	○	○
Weather apps/software	○	○	○	○

Other (please specify)

« Back Continue »

Fig. 47. COMMS day-to-day apps/software frequency question

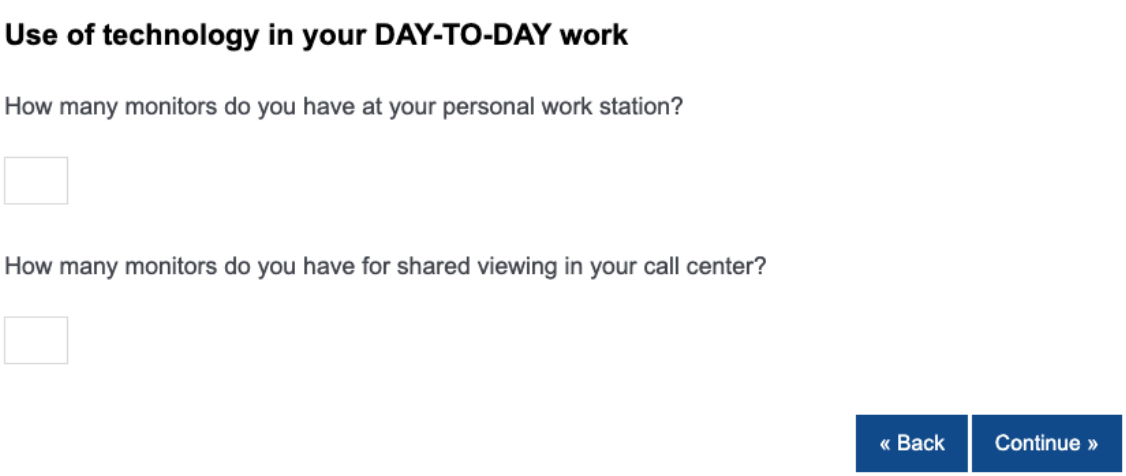


Fig. 48. COMMS monitors questions

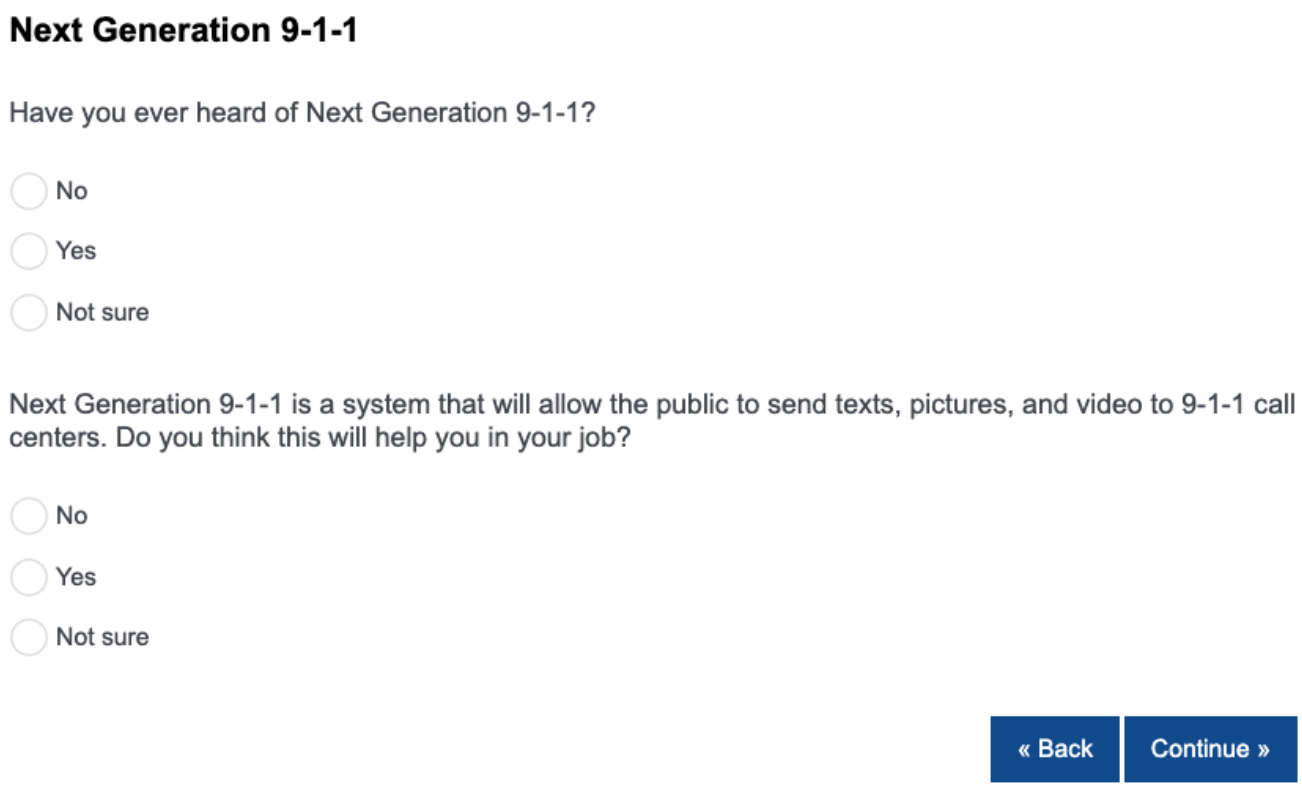


Fig. 49. COMMS NG 911 questions

Information Problems

We know you rely on accurate information to do your job. Looking at the list below, how often do you experience problems with:

	Always	Most of the time	Sometimes	Rarely	Never	Does not apply
Callers: inaccurate or missing information	○	○	○	○	○	○
Cell phones: inability to accurately track caller location	○	○	○	○	○	○
Information overload: too many calls at once	○	○	○	○	○	○
Information overload: too much information to monitor at once	○	○	○	○	○	○
Maps/databases: missing or inaccurate information	○	○	○	○	○	○

Other (please specify)

« Back Continue »

Fig. 50. COMMS information problems question

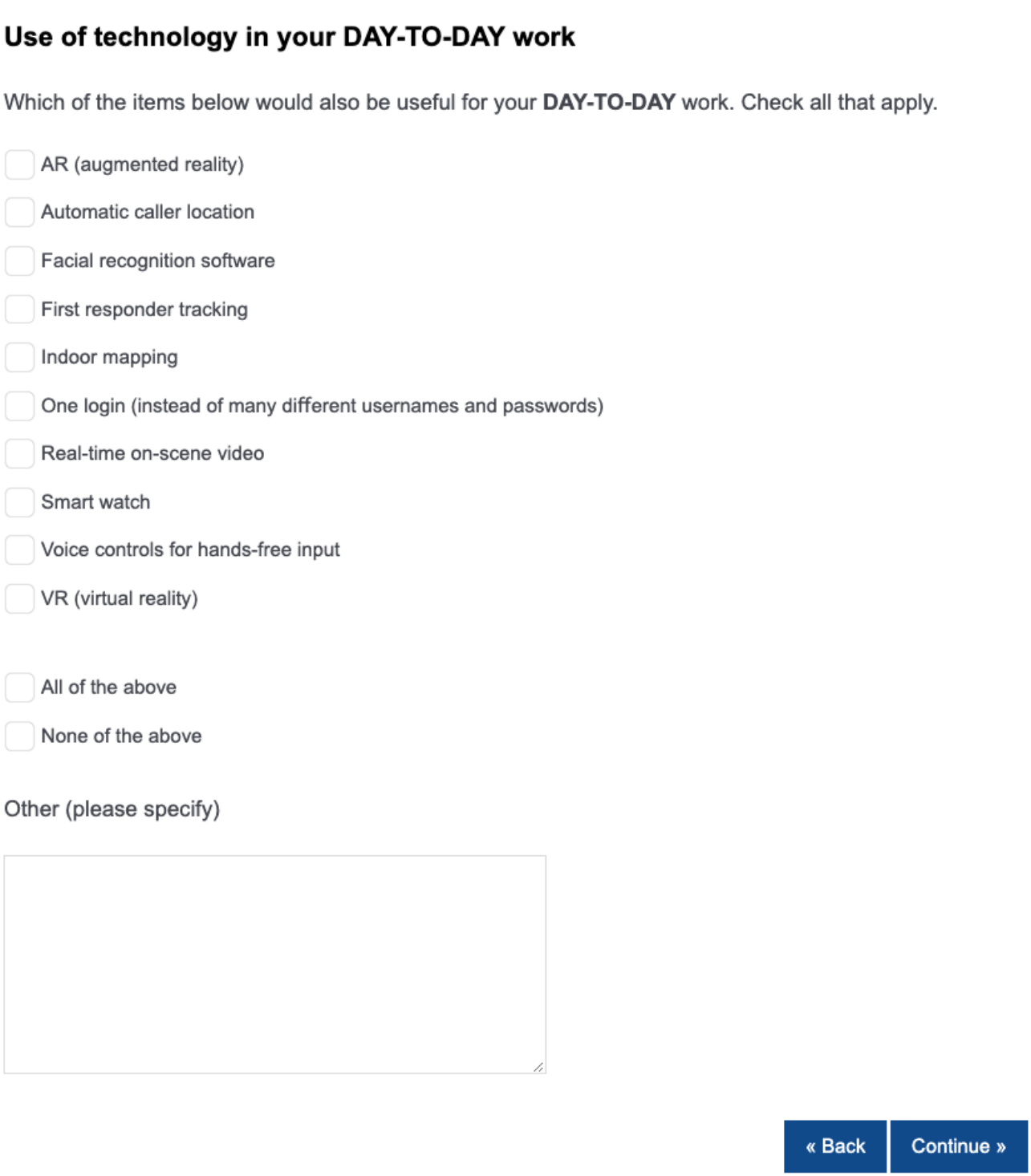


Fig. 51. COMMS day-to-day futuristic technology question

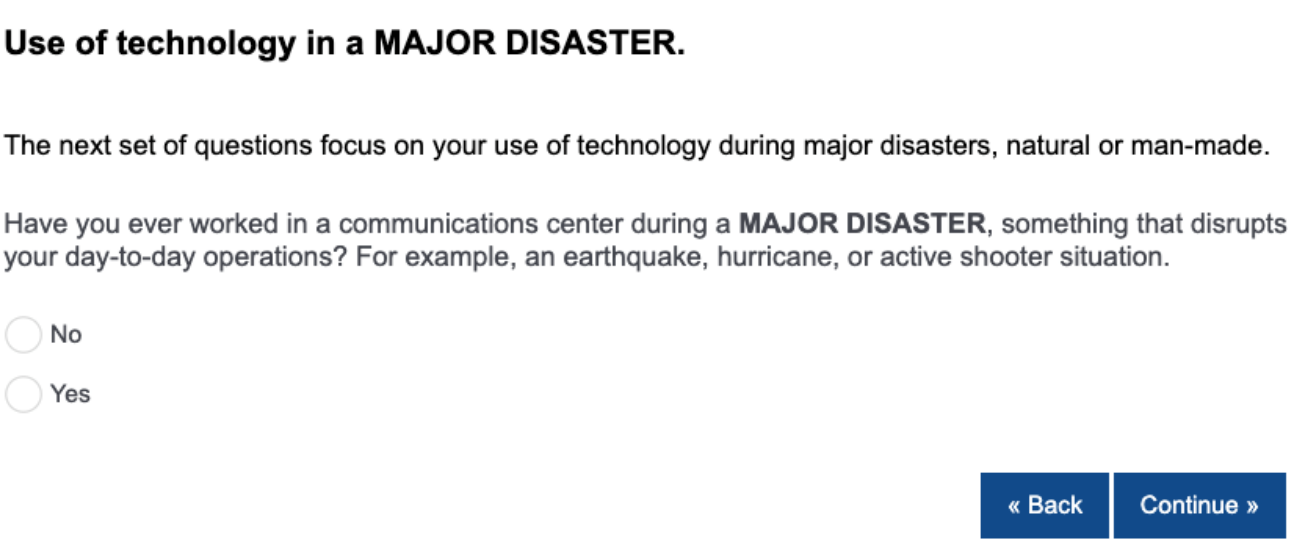
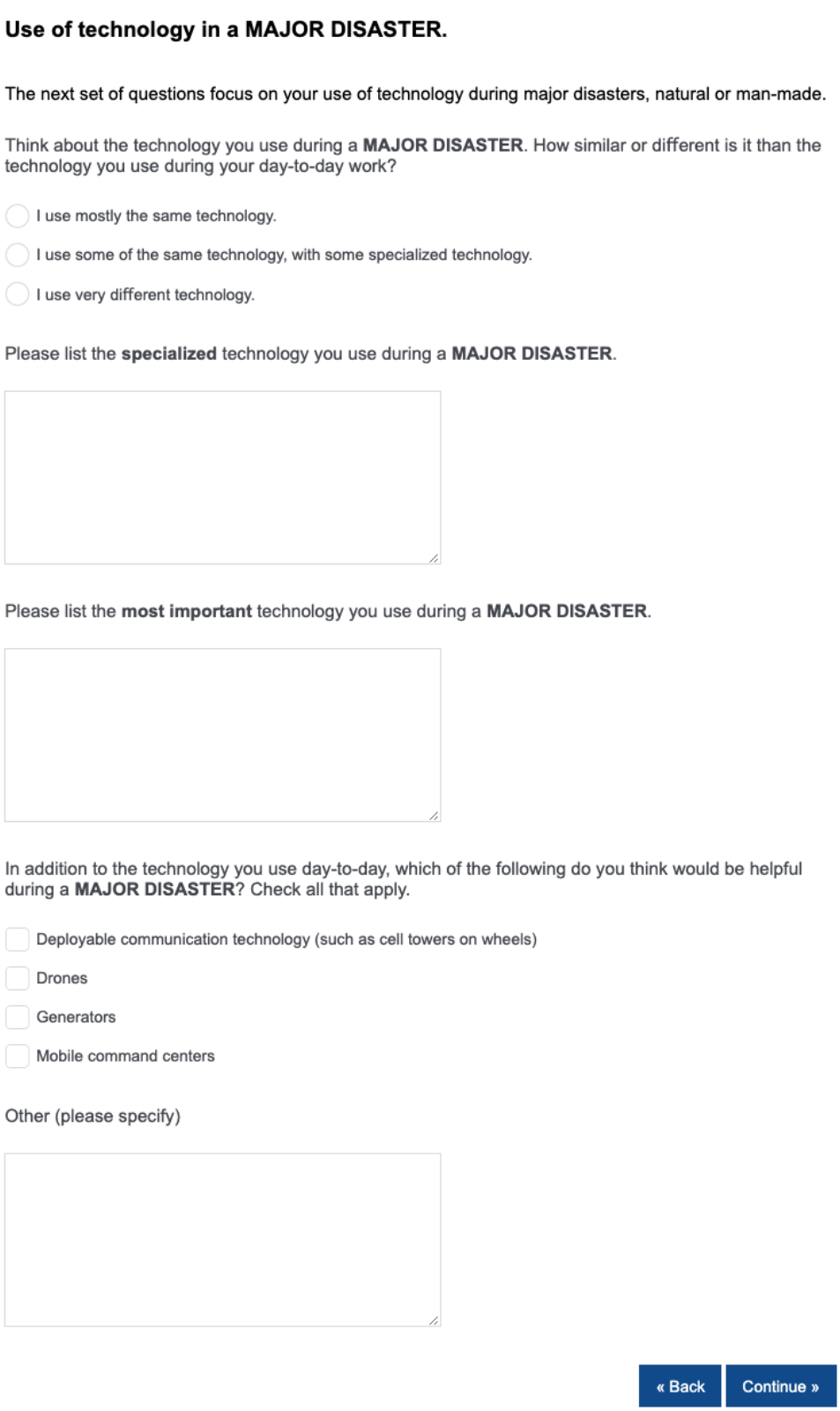


Fig. 52. COMMS major disaster questions, first page



Use of technology in a MAJOR DISASTER.

The next set of questions focus on your use of technology during major disasters, natural or man-made.

Think about the technology you use during a **MAJOR DISASTER**. How similar or different is it than the technology you use during your day-to-day work?

- ○ I use mostly the same technology.
- ○ I use some of the same technology, with some specialized technology.
- ○ I use very different technology.

Please list the **specialized** technology you use during a **MAJOR DISASTER**.

Please list the **most important** technology you use during a **MAJOR DISASTER**.

In addition to the technology you use day-to-day, which of the following do you think would be helpful during a **MAJOR DISASTER**? Check all that apply.

- ☐ Deployable communication technology (such as cell towers on wheels)
- ☐ Drones
- ☐ Generators
- ☐ Mobile command centers

Other (please specify)

« Back Continue »

Fig. 53. COMMS major disaster questions, second page

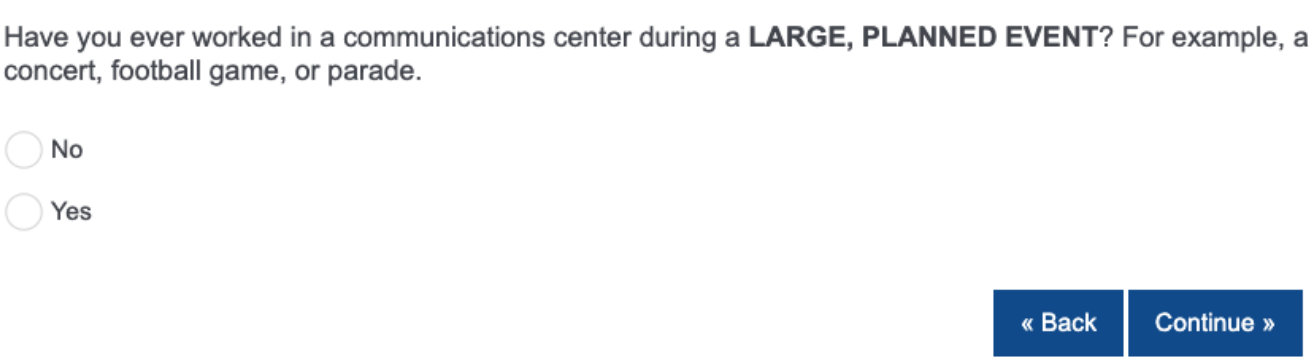


Fig. 54. COMMS large planned event questions, first page

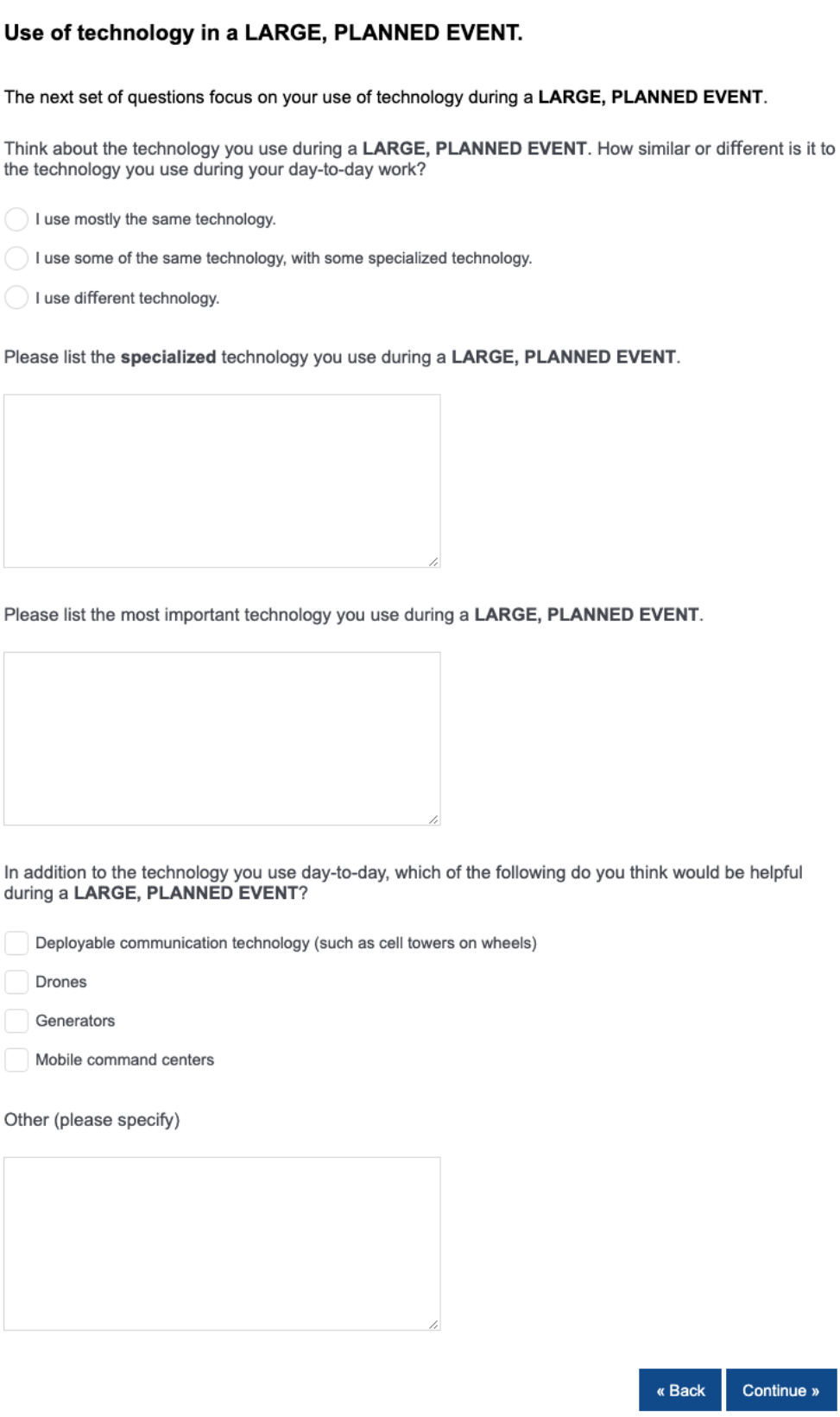


Fig. 55. COMMS large planned event questions, second page

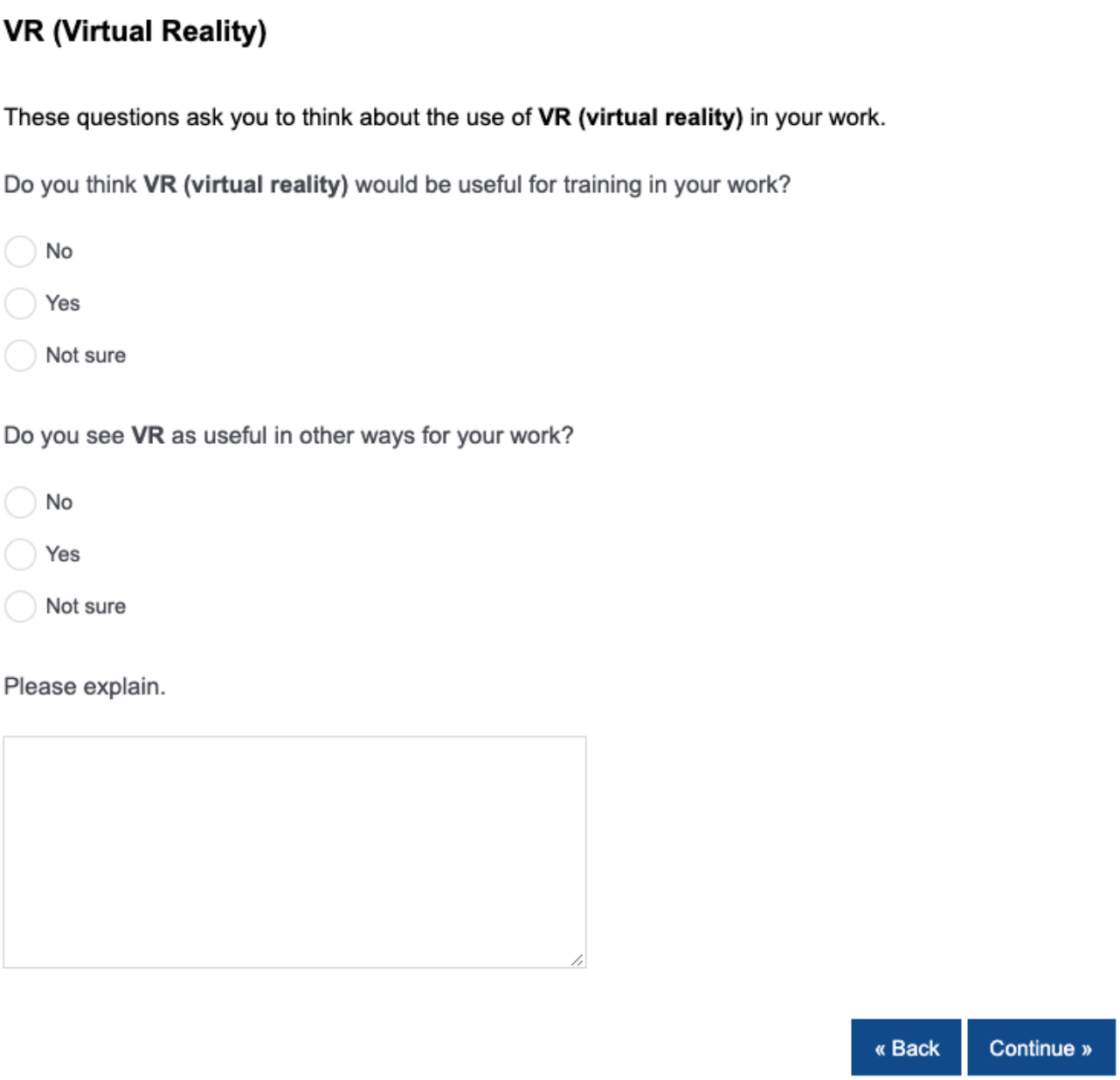


Fig. 56. COMMS VR questions

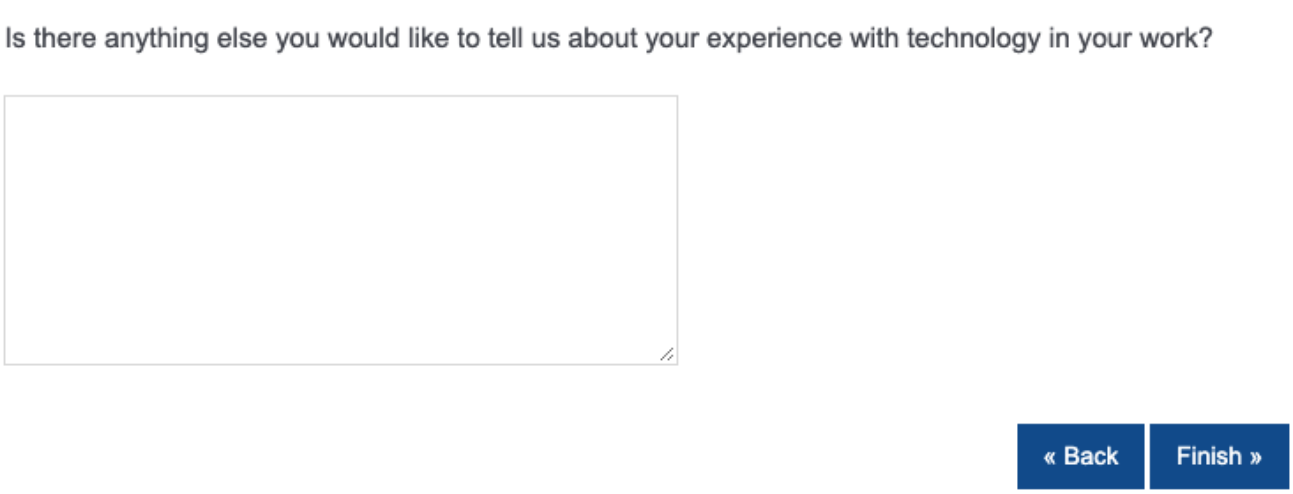


Fig. 57. COMMS final question

Appendix E – Outreach to Public Safety Organizations

Table 17. List of organizations contacted about survey[4]

AAST (American Association of State Troopers)
APCO (Association of Public Safety Communications Officials)
Daily Dispatch
EMS1 (ems1.com)
FireRescue1 (firerescue1.com)
IACP (International Association of Chiefs of Police)
IAFC (International Association of Fire Chiefs)
MCC (Mission Critical Communications)
Major Cities Chiefs Association (MCCA)
NACSA (National Association of Campus Safety Administrators)
NCCPS (National Center for Campus Public Safety
NENA (National Emergency Number Association)
NFPA (National Fire Protection Association)
NHTSA (National Highway Traffic Safety Administration)
NHTSA's National 911 Program (911.gov)
NHTSA's Office of EMS (ems.gov)
NSA (National Sheriffs' Association)
NVFC (National Volunteer Fire Council)
PoliceOne (policeone.com)
PSCR's constituents newsletter and NIST social media
Signal Magazine

[4] Other public safety organizations were considered but outreach did not occur if contact information could not be found.