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Voices of First Responders

Public Safety Communications Research

Law Enforcement

Special Publication 1286pt4

Introduction

The goal of the National Institute of Standards and Technology's (NIST) Public Safety Communications Research (PSCR) program's Usability Team was to provide guidance on the usability of public safety communication technology. Toward that end, the PSCR Usability Team collected and analyzed data related to the contexts in which first responders work and their experiences with communication technology.

Data analysis of first responder needs for, and problems with, communication technology resulted in the development of six user-centered design guidelines. These guidelines serve as a set of best practices for technology developers working to develop and improve communication technology in the public safety domain.

This Special Publication is primarily intended for designers, developers, vendors, and researchers of public safety communication technology, as well as for public safety administrators and decision-makers. It is one of four in a special Voices of First Responders mini-series highlighting the experiences of first responders with communication technology, including their needs for, and problems with, communication technology. The special mini-series focuses on four first responder disciplines: Communication Center & 9-1-1 Services (COMMS); Emergency Medical Services (EMS); Fire Service (FF); and Law Enforcement (LE). Each presents discipline-specific data supporting the six user-centered design guidelines. This publication in the special mini-series focuses specifically on first responders in law enforcement (LE).

In this publication, each of the six user-centered guidelines are discussed, along with supporting data, to provide a succinct view for how to optimize the LE user experience with communication technology. The results presented here are not exhaustive or comprehensive but provide a high-level summary of findings. Additional information can be found in the previous nine volumes of the Voices of First Responders Series which are cited on the final page of this publication. Ultimately, the goal is to provide guidance for ensuring an optimal user experience with communication technology for first responders in LE.

Communication Center & 9-1-1 Services

NIST SP 1286pt1

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Emergency Medical Services

NIST SP 1286pt2

https://doi.org/10.6028/NIST.SP.1286pt2

Fire Service

NIST SP 1286pt3

https://doi.org/10.6028/NIST.SP.1286pt3

Law Enforcement
(this Special Publication)

NIST SP 1286pt4

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What We Did

The NIST PSCR Usability Team conducted an exploratory, sequential, mixed-methods study to gather data about the experiences of first responders in four public safety disciplines – COMMS, EMS, FF, LE. This multi-phase study consisted of in-depth interviews with 193 first responders about their views on communication technology (Phase 1). The results of these interviews informed a large-scale, nationwide survey completed by 7,182 first responders from across the United States (Phase 2). Respondents included first responders from all four disciplines and came from rural, suburban, and urban areas. The results of the study are reported across nine volumes in the Voices of First Responders series.

When quotes from the data are used in this publication, they are followed by a notation that shows where they are from in the data. Notations that begin with INT come from Phase 1 interviews, while those that begin with SUR come from Phase 2 open-ended survey responses. This is followed by the first responder discipline: COMMS; EMS; FF; and LE. Next is an indicator of whether the participant worked in a rural (R), suburban (S), or urban (Urban) area. The notation ends with a participant number. For example, INT-LE-R-200 refers to interview participant number 200 who was in LE and worked in a rural area.

Phase 1 In-Depth Interviews

1 Goals
- Problem
- Purpose
- Research questions

2 Protocol
- Develop protocol
- Identify sample
- Pilot protocol

3 Data Collection
- Recruit participants
- Conduct interviews
- Have data transcribed

4 Analysis
- Create initial code book
- Code interview data
- Identify emergent themes
- Analyze data/codes

5 Results
- Develop relationships
- Identify variables

Phase 2 Nationwide Survey

1 Goals
- Problem
- Purpose
- Research questions

2 Survey Instrument
- Survey items and scales
- Reviews: content and survey experts, pseudo-participants
- Refine instrument

3 Data Collection
- Disseminate survey
- Send reminders
- Monitor responses

4 Analysis
- Perform data analysis
- Quantitative
- Qualitative

5 Results
- Describe sample
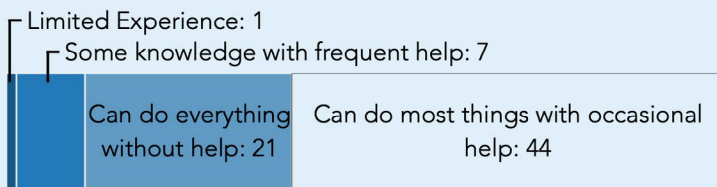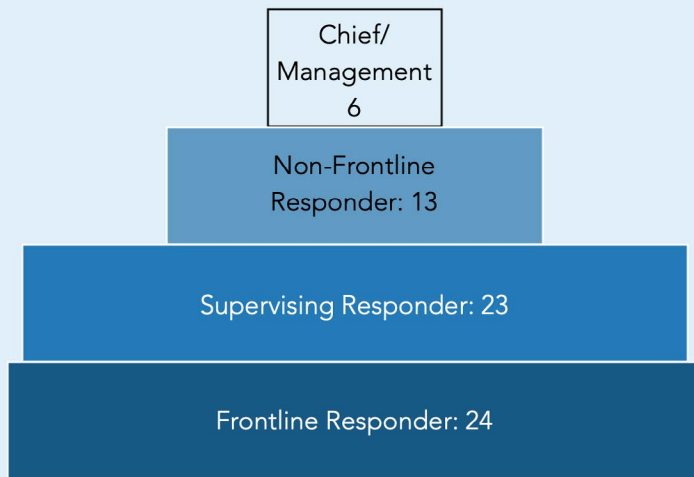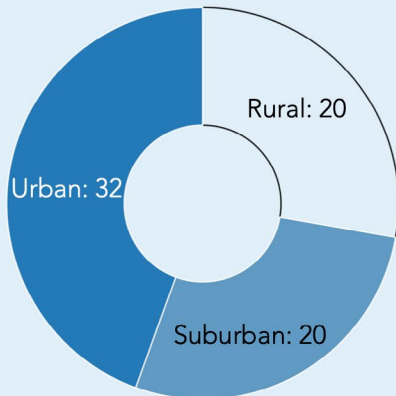- Draw inferences
- Identify usability requirements

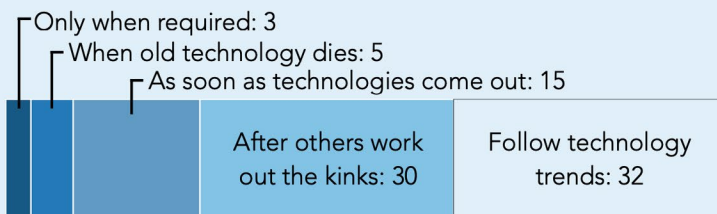# The Voices We Heard

Law Enforcement Participants

72

First responders interviewed

Average 17 years experience

Rural: 20
Urban: 32
Suburban: 20

Chief/Management 6

Non-Frontline Responder: 13

Supervising Responder: 23

Frontline Responder: 24

Limited Experience: 1
Some knowledge with frequent help: 7
Can do everything without help: 21
Can do most things with occasional help: 44

Experience with Technology

Only when required: 3
When old technology dies: 5
As soon as technologies come out: 15
After others work out the kinks: 30
Follow technology trends: 32

Technology Adoption

2,099

Survey respondents

Average 23 years experience

Urban: 560
Rural: 678
Suburban: 842

Non-Frontline Responder: 264

Chief/Management: 352

Supervising Responder: 545

Frontline Responder: 841

Federal: 25
County: 580
Local: 1,419
State: 58
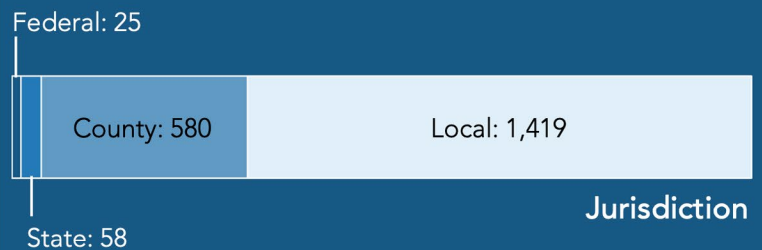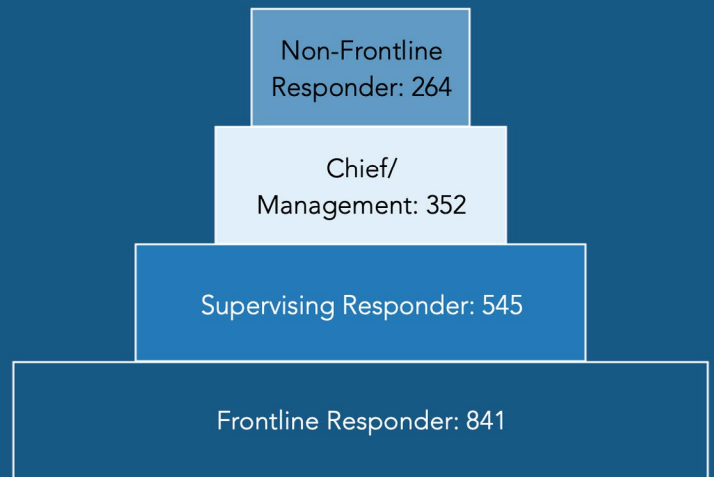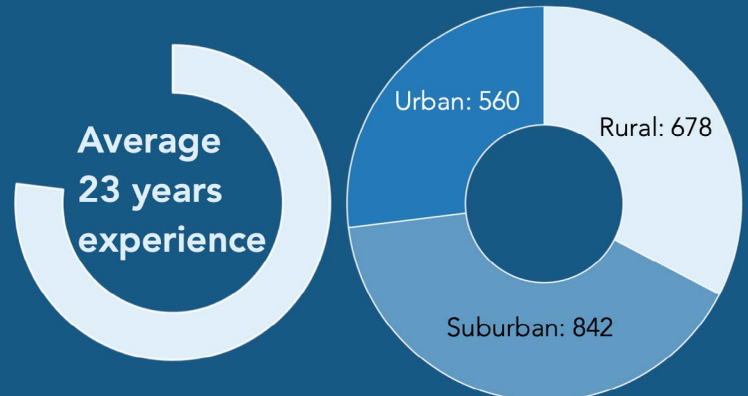
Jurisdiction

What We Recommend

User-Centered Design Guidelines

Guideline #1: Improve current technology

Improve functionality of what first responders currently have, make technology more affordable and more reliable. It is not necessarily new technology that first responders want, but the improvement of current technology that they believe is most important.

Guideline #2: Reduce unintended consequences

Develop technology that does not interfere with first responders' attention to their primary tasks. Technology interference can cause distraction, loss of situational awareness, cognitive overload, and over-reliance on technology.

Guideline #3: Recognize "one size does not fit all"

While there are similarities across the first responder disciplines and standardization is important for consistency, compatibility, and quality, technology must accommodate the wide variety of public safety needs–across disciplines, personnel, departments, districts, and contexts of use. All are different, requiring easy adaptability and configurability.

Guideline #4: Minimize "technology for technology's sake"

Develop technology with and for first responders driven by their user characteristics, needs, requirements, and contexts of use.

Guideline #5: Lower product/service costs

Develop technology at price points that departments can afford, lowering costs for technology. The goal should not only be to design the tool, but to design it at a price-point that makes it feasible and scalable for use.

Guideline #6: Require usable technology

Know thy user and develop 'Fisher-Price' solutions – simple, easy to use, light, fast, and not disruptive. Technology should make it easy for the user to do the right thing, hard to do the wrong thing, and easy to recover when the wrong thing happens.

GUIDELINE 1:
Improve Current Technology

Designers, developers, vendors, and researchers of public safety communication technology need to focus their efforts on addressing the issues, including price, that first responders continue to face with the devices they use the most for day-to-day incident response.

- Improve the current technologies LE first responders continue to experience significant problems with, including with the devices they rank as most useful for their day-to-day incident response listed on the right.

- LE survey responses show that "price: too expensive" is the top problem that LE first responders "Always" experience with communication technology. Both qualitative and quantitative data show that the top problems across the most used devices for LE are coverage and connectivity, reliability, usability, and price.

- Improving their current technology is more important to LE participants than having access to futuristic forms of technology. When asked about futuristic forms of technology on the survey, the one "futuristic" technology that over 50% of LE survey respondents said would be useful is one login (single sign-on or SSO), which is widely used in other domains and generally not considered an advanced technology.

Devices Ranked Most Useful

1. Portable radio
2. Work-issued smartphone
3. Desktop computer
4. In-vehicle radio
5. Mobile Data Terminal
6. Personal smartphone
7. Body camera

"Focus on making the technology we currently have work, and work properly before introducing more technology into the L.E. workplace that may bring the same struggles."

(SUR:LE:S:3)

"Anything that you could make lighter that we have to carry is always going to be good because we carry a lot of stuff."

(INT-LE-S-037)

"The radio is extremely important. It is our lifeline. When we need it, it doesn't always work."

(INT-LE-R-018)

Top problems across devices

price

coverage & connectivity

reliability

usability

GUIDELINE 2:
Reduce Unintended consequences

In both Phase 1 and Phase 2 data, LE first responders note that new technology often comes with, or can create, unintended consequences, such as those with body cameras noted on the right. While a new technology might be useful in one area of their work, it may also create problems or burdens in other areas. Technology interference can cause distraction, loss of situational awareness, cognitive overload, and over-reliance on technology. These can result in dangerous situations for LE first responders.

Designers, developers, vendors, and researchers of public safety communication technology need to make sure that there are no unintended consequences with the technologies they develop for first responders that might interfere with their attention to their primary tasks.

Case: Body Cameras

A unique technology challenge for police officers is a byproduct of the increasing use of body cameras. While police officers recognize the benefits of body cameras, they expressed concerns with the burdens of their use. For example, having to remember turning it on and off; the difficulty with having it attached to their uniforms, especially while performing strenuous physical activities; and issues with uploading videos. There are also concerns about officer safety, for example, the flashing light on the body camera could reveal their location; the distraction caused when turning on the body camera while facing a suspect.

"Sometimes you just got to figure out how to talk to people… people hide behind technology."

(INT-LE-R-017)

"If I'm now taking pictures of a crime scene, can my whole phone be subpoenaed? Are they going to see all of my text messages? This is none of their business. This is my personal cell phone."

(INT-LE-U-004)

1 in 3

LE survey respondents were concerned over subpoena possibilities for their smartphones at least "Sometimes"

"I don't want that important officer safety to get lost in the snowstorm of information coming towards them."

(INT-LE-U-029)

GUIDELINE 3:
Recognize "one size does not fit all"

Communication technology is paramount to all first responder disciplines, however, the contexts of use, needs, and problems vary across disciplines. Designers, developers, vendors, and researchers of public safety communication technology need to make sure that technology they develop attends to the specific contexts of use and needs of first responders, rather than providing "generic" technology that may or may not address their needs and problems.

- Survey responses show that LE first responders use different devices and software/apps than first responders in other disciplines. For example, more LE used corded earpieces, wireless mics, and criminal database software than their counterparts.
- The contexts of use, needs, and problems also vary amongst LE first responders. For example, rural LE have very different needs than their suburban and urban counterparts, lacking many basic resources and desiring existing technology solutions as shown below.

"I have a hard time trying to fit everything on my belt as required in policy. Especially if you're some of the smaller officers, male or female just depending on your waist size, it's like you don't have enough real estate to fit all this stuff that's required."

(INT-LE-U-007)

Considering LE Environments

Rural vs. Urban and Suburban Areas

- Rural LE are *more* likely to:
  - use in-vehicle radios
  - have problems with the price of radios
- Rural LE are *less* likely to:
  - have mobile data terminals (MDTs) and license plate readers (LPR)
  - have computer-aided dispatch software (CAD)

Chief/Management vs. Frontline Responders

- LE chiefs are *more* likely to:
  - use work-issued smartphones and desktop computers
  - have problems with the price of radios, laptops, desktop computers, smartphones, body cameras, and MDTs
  - use records management system software (RMS)
- LE chiefs are *less* likely to:
  - use MDTs
  - have tablets and laptops
  - have CAD and report writing software

GUIDELINE 4: Minimize "technology for technology's sake"

Designers, developers, vendors, and researchers of public safety communication technology need to recognize that just because we can, doesn't mean we should—just because technology exists, does not mean it will be helpful for first responders. Focusing on what they see as useful is a better strategy for optimizing the user experience and encouraging adoption and usage.

Both qualitative and quantitative data show that first responders did not see most forms of futuristic technology as something they would find "useful for [their] day-to-day work." On the survey, respondents were asked which futuristic technologies they thought would be "useful for your day-to-day work." Participants could select from a technology list, which consisted of futuristic technology as well as more current devices that participants did not already have.

- Of all the futuristic technology listed in the survey, one login (single sign-on or SSO) is the only technology selected by more than half of LE respondents.
- More than 1 in 5 LE survey respondents did not already have the technologies shown on the right, but thought they would be most useful for their work.

Make "Good, Basic Technology"

- Existing technology many LE respondents did not have, but thought would be useful:
  1. License plate reader
  2. Fingerprint scanner
  3. Work-issued smartphone
  4. Laptop
  5. Wireless earpiece (work issued)
  6. Body camera
  7. Mobile Data Terminal
  8. Dash camera
  9. In-vehicle radio
  10. Tablet

"In my opinion, technology should make life easier not harder. Right? … with these new radios, I'm not accessing any new channels that I didn't have privy to before. They're mainly for if for whatever reason you're doing law enforcement stuff out of state or whatever … But majority of the officers are never going to do that."

(INT-LE-U-003)

"Give us good, basic technology."

(INT-LE-U-013)

Least selected futuristic technology

Over half of the futuristic technologies listed on the survey were selected by less than 20% of LE. Some of the most futuristic technology in the list, like those shown here, were selected by less than 10% of LE.

Augmented reality (AR)

Self-driving vehicles

Smart glasses
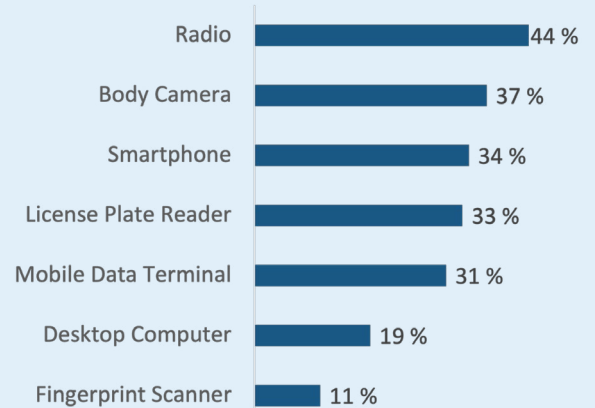
Robots

Smart buildings

Virtual reality (VR)

GUIDELINE 5:
Lower product/service costs

The cost of technology was a major issue identified by LE participants in the Phase 1 interview data. Likewise, survey data show that "Price: too expensive" was the top problem "Always" experienced by LE respondents with each of the 12 devices listed on the survey. Cost issues were wide-ranging, and not only refer to the initial cost of purchasing the technology, but also auxiliary costs such as maintenance, upgrades, IT support, training, and data plans. Participants reiterated time and time again that technology must be developed at price points they can afford. This was especially true for rural participants whose funding sources were often woefully inadequate to support their work and the tools they need to accomplish it. LE first responders also see changes with technology as happening so quickly that they find it difficult to keep up, financially and technologically.

Designers, developers, vendors, and researchers of public safety communication technology need to address this major pain point for first responders, recognizing the important role that budgets and finances play in the usage and adoption of new technology. When designing new or improving current technology, it needs to be affordable, with scalability for

Problems with Cost

Top LE ranked and LE-specific devices: Percentages of LE who had problems with price all or most of the time.

Device	Percentage
Radio	44 %
Body Camera	37 %
Smartphone	34 %
License Plate Reader	33 %
Mobile Data Terminal	31 %
Desktop Computer	19 %
Fingerprint Scanner	11 %

"Well, I think in general, law enforcement's always been way behind the curve in terms of technology because we're government. We're lowest-bidder type of government, so the stuff we have is the cheapest. It's usually decades old."

(INT-LE-U-003)

"Poor repeaters city has no money to fix."

(SUR:LE:U:3976)

$$$

Our survey data show that COST was the top problem across devices and public safety disciplines

"Pure age keeping up with technology. Costs every five years or so are high to outfit the entire department."

(SUR:LE:R:2358)

GUIDELINE 6:
Require Usable Technology

Many problems with communication technology faced by first responders are in some way usability issues. Both interview and survey data show that participants repeatedly identify usability issues with their communication devices as major problems they face during incident response. First responders are not opposed to technology, but they want technology that makes sense to them within their contexts of use. The goal is for technology to make it easier for them to accomplish their primary tasks. Ultimately, first responders require technology that is easy to use, easy to learn, and easy to integrate into their contexts of use.

Designers, developers, vendors, and researchers of public safety communication technology need to recognize that usability and usefulness figure heavily into decisions about adoption and usage. Listening to and taking into consideration the voices of first responders could go a long way in helping them trust (and thus be willing to use) improved and newly developed technology.

- LE first responders experience significant problems with their ability to efficiently and effectively access and use the devices they rely on every day for incident response, like radios, body cameras, and MDTs.
- LE first responders expressed problems with logging into devices, with switching channels on radios, and with devices that fall off.

Human factors & Ergonomics (HFE)

HFE considerations
- Perceptual
- Cognitive
- Physical
- Environmental
- Social & Organizational

Usability considerations
- Efficiency
- Effectiveness
- Satisfaction

"In the police world, if you want somebody to use something, it has to be simple. The more complicated it is, it's very seldom getting used."

(INT-LE-R-001)

"[Problems with radios] getting stuck in scanning mode or having the channel lock engaged and not being able to switch channels. Also trouble with accidentally flipping to a different channel during foot chases." (SUR:LE:R:7128)

"[Body cameras] have significantly more opportunity for user error… The cameras don't have standardized features yet like most in-car cameras and officers suffer from that." (SUR:LE:U:6121)

"[MDTs] cannot recalibrate at user level, keyboard does not brighten at night, night mode on screen is not viewable due to lack of contrasting colors… touch pads does not react, no instant dim switch." (SUR:LE:U:3222)

"That's the biggest thing with a lot of the stuff is you make it, but you never test it out on the real person who's going to use it. And then will it get lost in translation, and then it becomes useless. You may have thought it was a great idea. And it might be a great idea, but there's a few tweaks that don't make it useful at all."

(INT-LE-U-036)

VOICES OF LAW ENFORCEMENT

Phase 2 Nationwide Survey Highlights

Urban 24%	Suburban 40%	Rural 32%

2,099 Respondents

Devices Used & Top Problems

Radio
Portable 96%
Vehicle 84%

Coverage
Audio Quality
Price
Battery Life

Desktop Computer
92%

Software Updates
Login/Passwords
Outdated
Internet Connection

Smartphone
Personal 80%
Work-issued 61%

Battery Life
Coverage
Price
Login/Passwords

Laptop
77%

Internet Connection
Login/Passwords
Software Updates
Battery Life

Mobile Data Terminal
65%
Computer Aided Dispatch
Using while driving
Login/Passwords
Outdated

Corded Mic
60%

Audio Quality
Outdated
Placement on Body
Price

Apps Used

- Email 100%
- Criminal Databases 90%
- Report Management Software 87%
- Policies 87%
- Computer Aided Dispatch 79%

Futuristic Technology Needs

- Facial Recognition Software 39%
- Thermal Imaging 38%
- Drones 38%
- One-Login 55%
- Real-time on-scene Video 27%

Tech. Needs for Major Disasters

- Deployables 76%
- Mobile Command Centers 74%
- Drones 72%

Voices of First Responders Publications

Voices of First Responders, Phase 1: Findings from User-Centered Interviews

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

Voices of First Responders, Phase 2: Nationwide Survey

- Volume 1 - Methodology: Development, Dissemination, and Demographics (NISTIR 8288)
- Volume 2 - Mobile Devices, Applications, and Futuristic Technology (NISTIR 8314)
- Volume 3 - Day-to-Day Technology (NISTIR 8400)
- Volume 4 - Statistical Analysis Results (NISTIR 8444)

- How to Facilitate Adoption and Usage of Communication Technology: *An Integrated Analysis of Qualitative and Quantitative Findings* (NISTIR 8443)
- PSCR Usability Results Tool: https://publicsafety.nist.gov/

Other relevant publications from NIST's PSCR Usability Team

- Incident Scenarios Collection for Public Safety Communications Research: Framing the Context of Use (NISTIR 8181)
- Usability Handbook for Public Safety Communications - Ensuring Successful Systems for First Responders (NIST Handbook 161)

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https://www.nist.gov/ctl/pscr/user-interface-user-experience-publications
https://www.nist.gov/programs-projects/usability-and-public-safety-communications-research