

# Conceptualizing the Design and Use of Augmented Reality Within a Common Operating Picture for Incident Command Systems

## *Interim Report #2*

March 14th, 2022

For **Indiana University Crisis Technologies Innovation Lab**  
and **Director of User Experience, Sonny Kirkley**

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# Table of Contents

[Executive Summary](#)

[Overview](#)

[What Was Learned](#)

[Next Steps](#)

[Appendix A: Project Definition and Scope](#)

[Appendix B: Annotated Bibliography](#)

[Appendix C: Interview 1 Protocol](#)

[Appendix D: Interview 1 Notes](#)

[Appendix E: Interview 2 Protocol](#)

[Appendix F: Interview 2 Notes](#)

[Appendix G: Interview 3 Protocol and Notes](#)

[Appendix H: Affinity Map for Incident Commanders](#)

[Appendix I: Empathy Map for Incident Commanders](#)

[Appendix J: Persona 1 - “The New Guy”](#)

[Appendix K: Persona 2 - “The Old Dog”](#)

# Executive Summary

The Indiana University Crisis Technologies Innovation Lab (IUCTIL) is developing an augmented reality (AR) system to assist incident commanders and first responders in resolving emergency situations. We are aiding in that effort by discovering what data is necessary for incident commanders to see, demonstrating where AR technology can be best utilized in incident command workflows, generating user interface and experience design criteria and requirements, and recommending a standardized interface from requirements set by incident commanders and first responders.

The first several weeks of our efforts were devoted to getting acquainted with the lead sponsor, Director of User Experience, Sonny Kirkley, and learning more about the previous work completed on the project. During several information sessions, project objectives and scope were determined. The team wrote and submitted an initial draft of the Project Definition and Scope document.

The project sponsor introduced the team to an expert stakeholder, Dale Rolfson, Chief Technology Officer of the Indianapolis Fire Department. An initial interview was conducted on February 11th, 2022. This interview was a conjunctive effort including questions developed from both active augmented reality teams. This interview was recorded virtually on the Zoom platform and notes were taken.

Feedback received from the project sponsor informed significant revisions to the Project Definition and Scope Document. These revisions were guided by ongoing team research and information obtained during the interview. Specific attention was given to the development of expected project activities and deliverables.

As the second project phase begins, a follow-up interview will be conducted with Dale Rolfson on February 25th, 2022. Additional questions will be compiled, and responses recorded. The focus of this interview will clarify the different types of people in his workplace who may interact with the AR technology visualized in this project.

Dale Rolfson invited the team to a tour of the Indianapolis Metro Police Department's incident command center. The tour provided insights that the team never imagined before. Allowing researchers to place themselves in the same environment as their user base gave a new perspective on workflows and the type of user to focus on. Dale has graciously offered another tour of a different facility soon.

Another interview took place on March 8th, 2022, with Kirk McKinzie, a retired firefighter and smart technology consultant. Kirk answered our team's questions with a focus on current location-based technologies and handed over an immense number of resources. Due to the interview being shared with other research groups, the team's time with Kirk was limited. Another interview has been set up for Phase 3 and our team will be focusing on more task-oriented questions to keep in line with Phase 3's overall goal.

The deliverables for Phase 2 went smoothly due to the knowledge obtained about what kind of users will be placed in the incident command role. Creating the affinity map, empathy map, and the personas provided us with a sharp focus on the users that will interact with AR technology. All three (3) deliverables were shared to enable future development teams to concentrate on the design and development of an AR product with a focus.

After all interviews are complete, results discussed, and project deliverables have been rendered, a second Interim Report was written and delivered to the project client demonstrating continued progress towards project objectives. Additionally, the personas, an empathy map, and an affinity map will be submitted as project artifacts. Upon feedback, the group will proceed with activities, as detailed in the Project Definition and Scope document.

For phase three, the team will be conducting an additional interview revolving around collecting information about all the different tasks incident commanders need to perform and how they go about performing them currently. This will eventually culminate into a Task Analysis Diagram that establishes the use cases for the system. An experience map will also be created, and it will visually illustrate the user's needs while including the steps the users will take to achieve their goals and satisfy needs. A second interview will also be conducted with subject matter expert Kirk McKinzie on March 22nd to gain additional insights into the current knowledge and technological gaps for incident commanders and how AR can solve them. Storyboard and Scenarios will also be created to help future designers visualize a third interim report to provide an update on what was achieved in the last few weeks. Finally, the team will produce how the intended users perform tasks so that future teams can gain important insight on how to help users achieve their goals efficiently.

# Overview

In the first phase of the project, we completed the following activities:

- **Initial draft of Project Definition and Scope (January 31)**
  - This was the first attempt at developing the project definition and scope. The paper received considerable constructive feedback which was applied for the next iteration
- **Completed first interview with Subject Matter Expert (February 11)**
  - The interview was conducted with Battalion Chief, Dale Rolfson using the Interview 1 Protocol detailed below (Appendix C). The protocol was used as a rough guideline of points we wanted to hit, while also letting the interviewee guide the direction of the interview by giving insights we had not considered. This interview was used to gain high-level insight about what the problem space entails and help the team further clarify what is needing to be defined and scoped
- **Revision of Project Definition and Scope (February 21)**
  - The revision of the project definition and scope (Appendix A) was determined by the needs of the team to continue the research progress. Future deliverables and methods were changed, added, and identified to accommodate the increased understanding
- **1st Interim Report (February 23)**
  - A summary and overview were written to encompass what the team has learned and performed so far on the project



In the second phase of the project, we completed the following activities:

- **Completed second interview with Subject Matter Expert (February 25)**
  - An interview was conducted with Dale Rolfson with the intent of defining specific traits about incident commanders. Such as their approach to work, their values, their needs, and their workflows. The expected outcome of this interview was to have enough qualitative data to begin steps to complete a persona document. (Appendix E and Appendix F)
- **Completed tour of facility with Subject Matter Expert (March 2)**
  - This interview was not defined in the project definition and scope document; the opportunity spontaneously arose via a connection with Dale Rolfson.
  - Tour of the Incident Command Center at the Indianapolis Metropolitan Police Department with Battalion Chief, Jacob Spence.
  - The tour elicited specific details about how AR technology could enhance commander current workflows. The hour-long tour was audio-recorded and later transcribed. Several photos of the command center were taken.
- **Created an Affinity Map (March 5)**
  - To code the qualitative data gathered from interviews and tours thus far, an affinity map was created. (Appendix H)
  - The map highlighted overarching themes about incident commander's personalities, approaches to work, needs, values, and goals as they relate to commanding emergency scenarios.
  - The affinity map would be later used to create an empathy map and persona document.
- **Completed third interview with Subject Matter Expert (March 8)**
  - The interview was with a retired firefighter Kirk McKinzie who provided information regarding his career.
  - Information was obtained about current technology used by first responders. Much of the discussion was focused on the future of firefighters and how AR can improve their current workflows. (Appendix G)
  - Due to the valuable information and discussion received, another interview is scheduled with Kirk for Phase 3
- **Created an Empathy Map (March 10)**
  - Served to gain further insight into incident commanders and what they may be thinking or feeling while performing their job (Appendix I)
  - Worked as a stepping stone for creating and fleshing out two personas

- **Created two (2) Personas (March 13)**
  - Our personas have established two main user groups: younger incident commanders who are willing and want to use advanced technology (“The New Guy”), and seasoned incident commanders who are competent with their current workflows and shy away from using advanced technology (“The Old Dog”) (Appendix J and Appendix K)
- **2nd Interim Report (March 13)**
  - The summary and overview were expanded to encompass what the team has learned and performed so far on the project.

# What Was Learned

After conducting the initial interview and upon examining the secondary research, the team realized that further exploration was needed. The team decided that conducting a future user task analysis will be necessary to proceed with future project objectives. Furthermore, the exploration of such topics as firefighter placement, firefighter biometrics, and environmental variables. Including relation to structural weaknesses, would help the team focus on the next steps. The team learned about the daily working life of potential users as well as the challenges they faced while on emergency calls. This helped them obtain the information needed to develop an affinity to real-life users. Leading to the creation of the empathy and affinity map, and two personas. These methods allowed the team to consider what strengths augmented reality could offer them during emergency incidents.

The focus of the second phase was to gain a greater understanding of the users. This was accomplished with two interviews with subject matter experts that have first-hand experience in incident command. Insight was gained into the different personalities of incident commanders as well as their goals, values and needs. The team was able to translate what was learned into an affinity map, an empathy map, and two personas. These deliverables helped to tighten the focus of the project and will guide the work going forward by providing future design teams information about the users they are designing for. The interview with our AR subject matter expert, Kirk McKinzie, allowed us to investigate and explore a different part of this project, dealing with the actual technology and its use in today's world. Kirk's interview has also given the team multiple opportunities to reach out to other industry professionals if needed. Since Kirk was a wonderful outside connection, the team hopes to continue with more interviews in the future due to his insights given thus far. The combination of the Indianapolis Fire Department and outside consultants like Kirk have allowed us to prepare for task analysis and experience mapping.



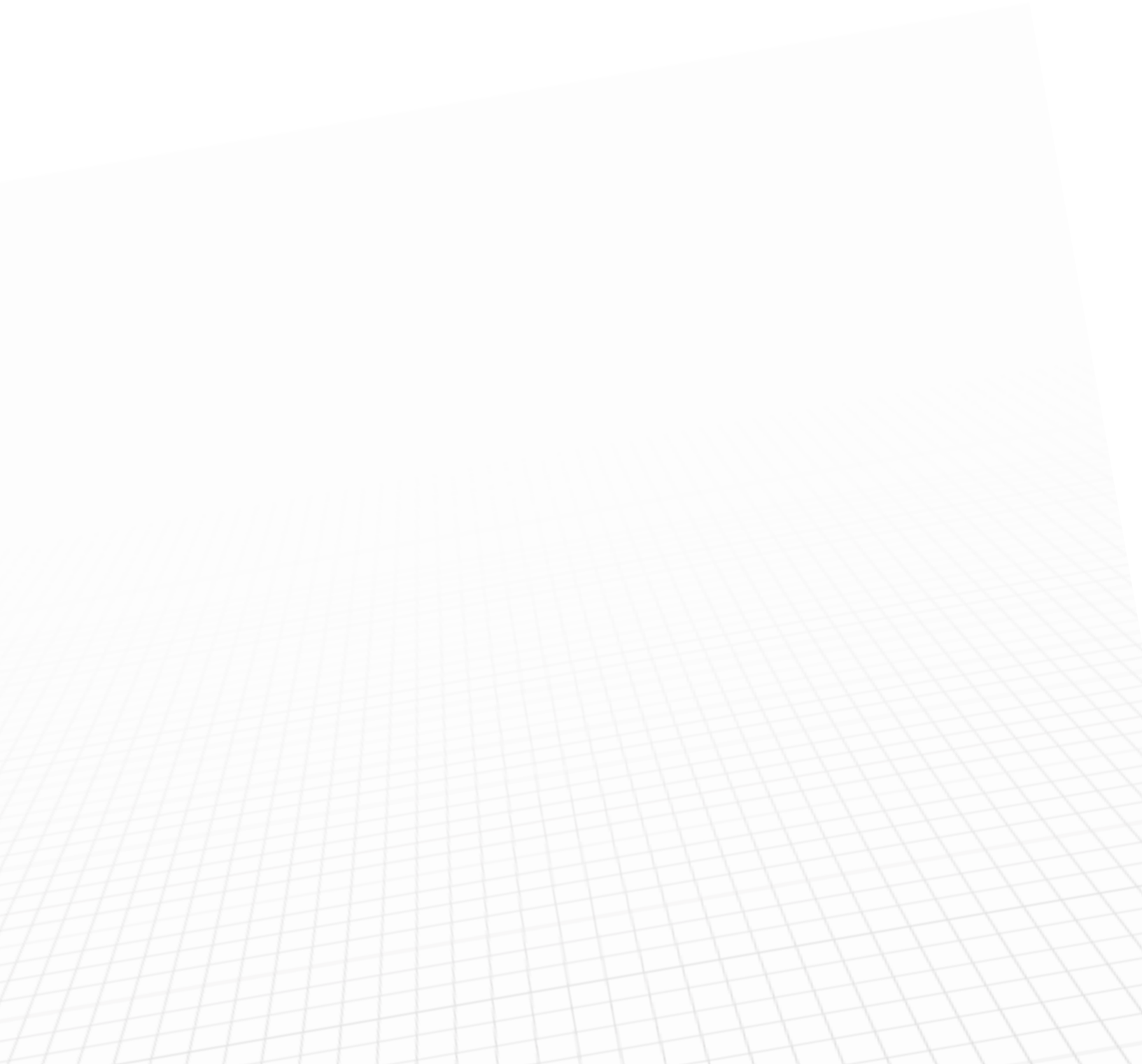
# Next Steps

Date	Action	Goals	Deliverable
March 18	Complete an interview that will focus on task analysis	Define certain tasks an incident commander will partake in during an incident	Interview notes
March 22	Complete a second interview with Kirk McKinzie, talking about AR tech	Find out the gaps he believes are out there for incident commanders and how AR can solve them	Interview notes
March 22	Create a Task Analysis Diagram that is influenced by research and interviews done so far	Determine how users perform tasks to gain insight into how to help them achieve their goals efficiently	Task Analysis Diagram
March 25	Create scenarios and storyboards that help visualize and create a picture of the workflow for ICS in AR	To help designers visualize the use cases for the system	Scenarios Storyboards
March 27	Create an experience map to further visualize the end-to-end experience a user will go through to accomplish their goals	Visually illustrates the user's needs and as they take steps to achieve their goals and satisfy their needs.	Experience Map

<b>April 4</b>	Write up a third interim report to update project definition with scope	Provide status update of project objectives	3rd Interim Report
<b>March 16 - April 6</b>	Conduct a team meeting every Wednesday or Thursday evening and every Sunday evening	To collaborate on project advancement	N/A

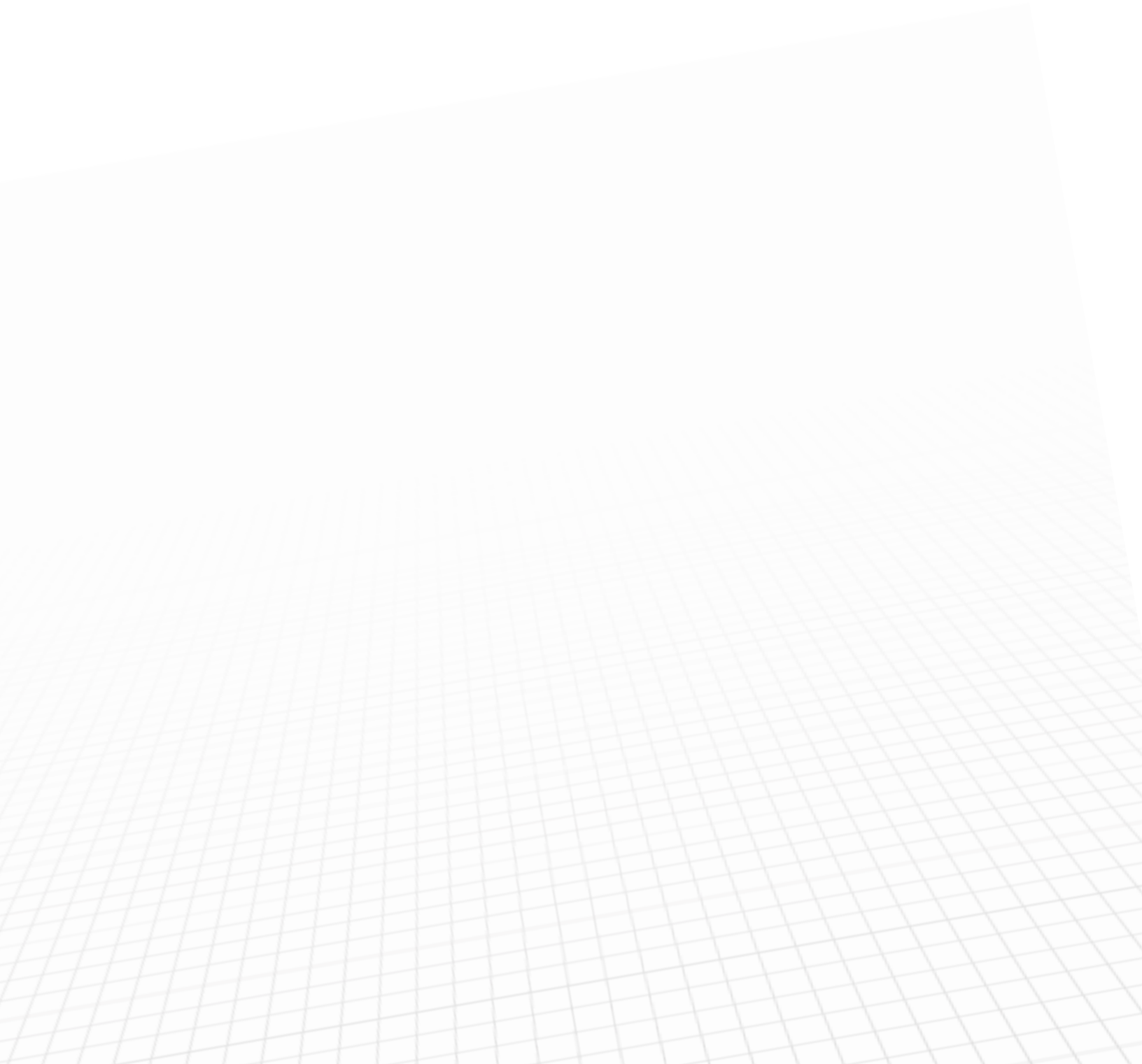
# Appendix A: Project Definition and Scope

[View AR in COP - Project Definition and Scope.pdf](#)



# Appendix B: Annotated Bibliography

[View AR in COP - Annotated Bibliography.pdf](#)



# Appendix C: Interview 1 Protocol

## Time and Date:

Friday, February 11th, 2022 at 4:00 pm

## Participant:

Dale Rolfson - Chief Technology Officer for Indy Fire Department

[Watch on Kaltura](#)

[Download Dale Rolfson Interview 1 - 02\\_11\\_2022.mp4](#)

## Preliminary Steps

1. Thank the participant for agreeing to speak with us
2. State Interview Purpose – To understand the work processes of incident command and first responders in order to target pain points where Augmented Reality technology could assist them in their day to day lives
3. Ask their permission to record – if they say no take good notes
4. Let them know if they feel uncomfortable with any of the questions to let us know and we will move on
5. Ask them if they have any questions before you begin.

## Background:

1. Can you start by telling me about your current work?
2. What is your position there?
3. How long have you been working there?
4. Did you work anywhere else in this field before the job you have now?
5. How long have you been working in this field in total?

## Work Experiences:

6. Can you walk me through a recent day you've worked? What did you do and work on?
  - a. Was that a typical day for you?
  - b. If not, how was this day different from a normal day?
7. What are your responsibilities at your job?
8. How do you communicate with other people at work?
  - a. Can you give me examples of specific words or phrases you'd use?
9. Can you tell me about a time when you had difficulty communicating with someone during an emergency?

### **Technology:**

10. What kinds of technology do you use at work?
11. Tell me about a time when technology made your job easier.
12. Tell me about a time when technology made your job more difficult.
  - a. How would you fix that problem?

### **Decision Making: Common Mistakes**

1. What are mistakes you see in new recruits?
2. What are common mistakes you see with experienced firefighters? What are the causes of these mistakes?
3. What are common problems or concerns you see arise in first responder situations?
4. Tell me an experience where an issue arises that was difficult to handle? How did you solve the problem?

### **Situational Awareness: New environments**

1. What are situations that firefighters are trained to do but don't really encounter on a regular basis?
2. Tell me about a time where you failed to be more aware of a situation? Why?
  - a. Would you change anything about your work to prevent that situation from happening?

### **Situational Awareness: Durations**

1. How do you track the duration of an emergency?
2. What do you keep track of in an emergency?

### **Wrap Up:**

13. Is there anything I haven't asked you about that you think I'd like to know about?
14. Can I contact you in the future if I have additional questions?

***Thank the participants for their time and generosity.***



# Appendix D: Interview 1 Notes

## Time and Date:

Friday, February 11th, 2022 at 4:00 pm

## Participant:

Dale Rolfson - Chief Technology Officer for Indy Fire Department

## [Watch on Kaltura](#)

## [Download Dale Rolfson Interview 1 - 02\\_11\\_2022.mp4](#)

Been with Indy Fire Department for 34 years, went to school for computer science. Also drove a ladder truck, did fire investigations and worked in public education

- Colors in HUD: green, amber, red
  - Red = get out
- Situational Awareness Tech
  - PASS – personal alerting system
    - Senses lack of movement, gives warning beeps
    - Longer you go without movement, louder it gets
  - RFID system
    - Wand
    - Based on the sound, closer you get the louder / faster the beeps are
    - For finding where someone is
    - Takes a lot of time
      - Rather have GPS coordinates – including Z coordinate
- Incident command doesn't have a visual of where everyone is
  - Could have 8 firefighters in a building, don't know exactly where they are
    - Assume based on smoke / fire etc.
  - Can be alleviated by using a drone (to find resources)
    - Find exposures
      - E.g. dogs, electrical wires, cars parked nearby, etc.
- Incident commanders
  - Battalion chiefs
    - Indy has 8?
    - His executive officer is a captain's rank
    - Tools:
      - Have incident command sheet
        - Could be a map of structure, etc.
      - White boards w/ wax pencil so it doesn't wash away
      - Command board for large incidents
      - Laptop / tablet in every fire truck and battalion chief vehicle

- Show water mains and hydrants
  - Important for knowing which ones to use
- Looking for a software solution for incident command
  - Offered to send us options they have looked at
  - Cons:
    - Bad weather, could damage laptops etc.
    - Using a touch screen is hard when it's wet
      - Sometimes put tablet in a freezer bag to keep the screen dry
      - Indiana task force 1 uses tablets, not fire department
      - Scott air management system – only tablets fire departments are using right now
        - Doesn't have GPS
        - Safety chief uses it
- A, B, C, D seats in all fire engines and ladders
  - A seat is passenger seat – officer (in charge)
    - Lieutenant or captain
  - B: directly behind officer – generally a “rookie”
  - C: right behind the driver – more seasoned / veteran firefighter
- Incident Command walkthrough
  - Call 911 about fire, goes through police dispatch (working on adding fire)
  - Dispatch sends to fire & ambulance
    - They have location based on where the call is placed
  - Based on given info, send appropriate apparatus
  - Fire alerting system
  - Dispatch Debbie – recorded voice like Alexa that reads the info from the computer
    - To avoid a person being overly emotional
  - First arriving apparatus will give size up report and establish command
    - They're incident commander for the time (until first arriving chief comes and takes command)
      - Generally Battalion Chief, could be safety chief
  - Shift commander shows up if it's a bigger incident
    - Highest ranking chief / firefighter on duty
  - Operations – manages the incident
  - 2 in 2 out – firefighters
- Battalion Chief tasks
  - Incidents
    - Fire
    - Vehicle accident
    - Hazmat spill
    - Rope rescue
  - Incident command system gives a chain of command
  - Time is key – better survival

- How long has the structure been burning? How much longer before firefighters need to evacuate?
  - Indy department always goes in – aggressive interior attack style fire fighting
  - Managing personnel
  - Seeing what hazards there are
  - Go on the defensive – e.g. use aerial nozzles on trucks
  - Building construction – how old is the building?
    - Drone footage helps to figure out construction
- Communicate with a radio
  - Officer from each apparatus does radio talking
  - Try to minimize radio traffic
- How can AR be used in incident command?
  - Similar to the death star in star wars lol
  - 3D representation of the scenario
    - Stick and ball
    - Every stick and ball is a gps location of a firefighter / emergency responder, etc
    - Select it, and it shows who it is
      - Heart rate
      - Blood pressure
      - Core temp
      - Breathing rate
      - Atmospheric conditions
        - Oxygen level
        - Explosive limits
        - Hazardous chemicals in the area
        - Be able to visualize these (red or yellow, etc)
          - Can let them know what areas to be worried about
    - Tag victims
      - Dead, walking, wounded, etc.
      - Triage
        - How many hospitals to contact
        - Which victims are priority, etc.
  - Commanders in command center
    - Could be a van, back of battalion buggy
    - Some sort of command vehicle – out of the elements
    - Portable tent
  - Would be useful to have 3D visual
    - With GPS
    - Fire apparatus all have GPS in them right now (trucks)
- Pain Points
  - “Firefighters don’t like change and they hate the way things are”
  - Older people don’t generally love the new technology
    - Younger firefighters are better with it
  - Not having a visual of the scenario because you’re removed from the incident

- Don't want the incident commander to be in the middle of it (too dangerous, can't control with an air pack, etc.)
  - Lose track of resources
- Faster mitigation of incident = save more lives and property
- Want thermal imaging technology
  - Thermal imaging cameras
    - Allow firefighters to see temperatures
    - See a body through the smoke
  - Incident commander can see
- All of this helps with making tactical decisions
- Look Up:
  - FDIC – fire department instructors conference
    - Manufacturers lists for current technology
      - MSJ
      - Scott?
        - These don't let you touch their stuff
        - Possible that these would void manufacturer warranties (in case of dead firefighters, litigation etc.)
- Video games with tactical controls
  - Dragon Age
  - Mass Effect
  - Assassins Creed: Origins
  - Fire Emblem
  - Stellaris

# Appendix E: Interview 2 Protocol

## Time and Date:

Friday, February 25th, 2022 at 4:00 pm

## Participant:

Dale Rolfson - Chief Technology Officer for Indy Fire Department

## [Watch on Kaltura](#)

[Download Dale Rolfson Interview 2 - 02\\_25\\_2022.mp4](#)

## Goal of meeting:

Discover Firefighting Incident Commander's mindsets, motivations, and behaviors

Capture what Incident Commanders

- Say
- Do
- Think
- Feel

After this meeting we will be creating an affinity map of all of the qualitative data we have captured. That will allow us to generate an empathy map that will support the development of incident command personas.

## Interview Structure:

Greet- Build rapport. Discuss weather, weekend plans, etc.

Ask Dale to describe scenarios where he has performed in an incident command chain or observed it. We should go very slow here and investigate what the incident commander is saying, doing, thinking, and feeling at critical moments in the incident command process. During this interview, we will also likely capture several workflows that will enable us to define common or overarching themes and derive generic "workflow steps" in performing Incident Command.

## Define Demographics:

Age-

M/F-

Education level-

Technological familiarity-

Willingness to adopt new tech-

- 1.) Battalion chief- are there other tiers we would be designing for?  
In terms of who will be using the technology or benefitting from it.

In your mind, who is using this technology? Are there different tiers?

- a. Is “Incident Commander” even a job title?
  - b. What do you call them, who might serve as an “incident commander” in an emergency?
- 2.) Do you have personal experience acting as a battalion chief in and performing incident command?
  - a.) Have you observed someone else in this scenario?
- 3.) Can you recall that experience for me? Describe in detail each step- what were you thinking, feeling? What was important to you at that moment? What were your goals? What was the outcome of that scenario, how did that make you feel?
- 4.) We’ve done some research on what an incident commander’s priorities might be, such as:
  - a.) Control the flow path in the structure.
  - b.) Remove occupants from endangered areas.
  - c.) Locate and extinguish the fire.
  - d.) Overhaul the fire.
  - e.) Conduct salvage work.
  - f.) How do you keep track of who goes into a building and shows out?
- 5.) Outside of an incident command scenario, what are your daily tasks- what are you motivated by when not in an emergency scenario.
- 6.) What do you feel the biggest impact of performing as a battalion chief is?
- 7.) How does your department collaborate with other police and medical departments during an incident? Is this something the incident commander manages or is focused on?
- 8.) More explanation on problems they encounter?
  - a. More explanation on solutions they’ve found in the past?
- 9.) Why do you think AR Tech is a better solution than Motorola (digital flat screen interface) ?
  - a. Incident command in the field potentially?



# Appendix F: Interview 2 Notes

## Time and Date:

Friday, February 25th, 2022 at 4:00 pm

## Participant:

Dale Rolfson - Chief Technology Officer for Indy Fire Department

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[Download Dale Rolfson Interview 2 - 02 25 2022.mp4](#)

### 1. Demographics

- a. AGE Incident commander, 25+ years of experience
- b. Chain of command
  - i. Privates
  - ii. Lieutenants
  - iii. Captains
  - iv. Battalion chief
  - v. Shift commander, division chiefs
  - vi. Deputy Chief
  - vii. Assistant Chief
  - viii. Actual Chief
- c. Need to follow chain of command, private should not go to chief directly
- d. Standard fire apparatus (fire engine)
  - i. Engine, two lieutenants and a captain assigned
  - ii. A shift and b shift, lieutenants
  - iii. C shift, captain
  - iv. Captain is in charge of equipment
  - v. Officer rides out is in charge of apparatus
  - vi. Private will ride in officer seat if they have training
  - vii. First engine establishes command
  - viii. Monitor situation until first chief arrives, then chief takes control as incident commander
  - ix. If scene progresses, shift commander will take hold (they are highest ranking on shift)
  - x. Battalion chief will take operations or forward command
  - xi. First arriving apparatus in charge until chief gets there
    1. Must have 5 years experience before you can get promoted
    2. Lieutenant for 3 years before promotion to captain
  - xii. Appointed vs. merit
    1. Merit - you've gone through a process and that is your rank

- a. Can be demoted (rare)
- 2. Appointed - chief appoints someone
- 3. "Earned respect and given respect"
  - a. Given a title, but still need to earn it in the eyes of the people you work for / with

## 2. Communication

- a. Huge need for open communication
- b. A lot of communication in an incident is face to face
- c. Put as little on the radio as possible - need to keep the lines open
- d. Generally the crew isn't going to be broken up
- e. Two in two out rule
- f. Captain / chief relays information to incident commander
- g. IC - incident commander, usually just be called "command"
  - i. On a smaller incident might call them what their chief designation is

## 3. Scenario

- a. Address and call type – this can tell you how the building was constructed (based on location)
  - i. Gives an idea of how the fire will burn
  - ii. Can tell a lot about a fire by looking at the smoke
    - 1. Color, is it puffing, etc.
      - a. Brown = structural timbers burning
      - b. Black = contents burning - "stuff" (plastics / hydrocarbons)
    - 2. Tells what is burning
    - 3. Tells how long the fire has / will burn
  - iii. Has there been any ventilation done?
    - 1. Want to ventilate near the ? of the fire?
    - 2. Vertical ventilation - cut holes in the roofs so smoke rises out = better visibility
      - a. Better chance of survival for victims – most die from smoke not burning
- b. Size up report – taking in a lot of information, on the way to the scene
- c. People respond better to someone who is calm and direct & knowledgeable – these make the best chiefs
- d. Highest level is usually the battalion chief of that district – just need to wait till they get there
  - i. If the safety chief gets there first, battalion chief might just let them run it – it depends
  - ii. Generally once a chief has taken command, they keep command, unless it escalates and a shift commander takes over
- e. Chief location in relation to the fire – depends on who you are and their preferences
  - i. Some will be out on the yard, on the A side (address side) of the structure
  - ii. Goes clockwise, next side is B, back is C, other side is D side

1. These terms are used in communication with command
- iii. Some will sit in their buggy somewhere nearby towards the front
- f. Boards
  - i. Used to make different assignments
    1. Roof ventilation, backup, water, primary search and utilities, etc.
  - ii. They have a roster to know who is assigned to each apparatus for that day – names of the firefighters
    1. PAR - personnel accountability report (via radio)
- g. What things are the IC doing?
  - i. Benchmarks - key things they look for in a fire incident (aka tactical worksheet)
    1. How long has the fire been burning
    2. Weather report - is the weather going to change soon? High winds? Rainstorm? Etc.
    3. Utilities being shut off
    4. Ventilation
    5. Primary search
    6. Secondary search
    7. Rehab setup
    8. Is TSU on the scene to replace air bottles?
  - ii. XO's role depends on the chief
  - iii. Computer
    1. Look at the time the run came out
    2. How the call came in - helps with the time factor
  - iv. Shift Commander - can come in and take command
    1. Won't do this w/o a face to face with the IC
    2. Announces this over the radio to dispatch (if they take over)
- h. AR - what does an IC need to see?
  - i. Doesn't know how much this would help on a bread and butter fire (room and contents fire, fire is out in 10 min)
  - ii. Sees it being helpful in major incidents
    1. Large fires, warehouse fires, apartment buildings, airplane crashes, etc.
    2. Major incident where they're there for hours
    3. Need to see atmospheric conditions
    4. Air conditions
    5. Individuals
      - a. Heart rate, core temp, breath sound?
    6. Be able to see the firefighters temps – thermal imaging cameras on their fire gear (this would also be useful on smaller fires)
    7. Can see faster how fires will spread and structural integrity / where the fire is etc.
  - iii. Be able to see where the other allies are (fire fighters)

1. Won't have time to click on each individual firefighter, but if an individual's bio markers are going bad (red), being able to see an alert for that would be helpful
- i. IC is visualizing what is going on, will know the floorplan, with their experience they can give commands to tell others what to do next
- j. 4 FF on every engine / ladder
  - i. Squad has 2
  - ii. Battalion chief has 2
  - iii. Safety chief is 1
  - iv. 20 just off a main fire apparatus
  - v. 26 FF min on a small room / contents fire
- k. Motorola right now –
  - i. Gives incident information
  - ii. What they see on fire trucks
  - iii. Minor customizations from agency to agency (v. minor)
  - iv. MD = medic
  - v. On the map, as you zoom in the letters all stay the same size
- l. Engine vs. ladder
  - i. Ladder truck – fire truck w/ big steel ladder on the top that can move around / extend (aerial ladder, most are 100 ft)
    1. Carry certain # of feet of ground ladders
    2. Don't have pumps
  - ii. Engine truck – carry hose & have a pump

# Appendix G: Interview 3 Protocol and Notes

## Time and Date:

Tuesday, March 8th, 2022 at 11:00 am

## Participant:

Kirk McKinzie - President McKinzie Smart Technologies LLC

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[Download Kirk McKinzie Interview 1 - 03\\_08\\_2022.mp4](#)

- Thank you for your time ... etc
- I've watched some videos of your work and ideas on YouTube and it's great to see the evolution of the 911-GO system that you've placed a large effort on
- I'm mostly interested in what's been accomplished so far:
  - **Has the technology and ideas you've consulted on been implemented yet in the field in emergency situations? Or is it still in proof of concept stages?**
    - If so, what has been the reception towards the use of it? Were there any glaring issues or recommendations reported by users?
    - If not, is there a timeline to when federal or local departments are wanting to proceed with the plans?
  - **What have been the biggest challenges associated with the progress you've made so far?**
    - Is there much of an interest by private or public organizations to implement such technologies?
    - Any potential legal hurdles that have been encountered so far?
- ICS 100 -> ICS 800, levels within incident command systems used?
- Using 70s tech/tools to solve 2020 problems

## Resources from Kirk (see video for full explanations):

- Using AR toolkits today: <https://www.linkedin.com/in/pedro-ramos-343482104/>
- <https://firescope.caloes.ca.gov/>
- <https://www.ara.com/>
- <https://www.youtube.com/watch?v=iSHFjqlkadQ>
- [https://www.motorolasolutions.com/content/dam/msi/docs/dt/consensusforchange/Consensus\\_for\\_Change\\_Report\\_V13.pdf](https://www.motorolasolutions.com/content/dam/msi/docs/dt/consensusforchange/Consensus_for_Change_Report_V13.pdf)
- <https://www.goodsamapp.org/>



- San Antonio FD:  
<https://www.sanantonio.gov/gpa/News/ArtMID/24373/ArticleID/19876/SAFD-implements-new-GoodSam-telemedicine-program>
- Fire Dept Chain of Command:  
<https://www.cityofsantamaria.org/home/showdocument?id=8413>
- <https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.1191.pdf>
- <https://www.dhs.gov/publication/st-frg-audrey>
- <https://www.nasa.gov/feature/jpl/ai-could-be-a-firefighter-s-guardian-angel>
- <https://www.fireengineering.com/apparatus-equipment/artificial-intelligence-firefighting/#gref>
- <https://ccc.ca.gov/wp-content/uploads/2019/08/CCC-10-Standard-Orders-18-Watch-Outs.pdf>
- My talk at MIT on AR: <https://www.youtube.com/watch?v=RJtVklvLqO8>
- Next Gen Curriculum 2021:  
[https://docs.google.com/document/d/1heWdoiKhhyjwO6zKsUBPwLYqizJaqMqKfo\\_7z-7XdmQ/edit?usp=sharing](https://docs.google.com/document/d/1heWdoiKhhyjwO6zKsUBPwLYqizJaqMqKfo_7z-7XdmQ/edit?usp=sharing)
- <https://www.linkedin.com/in/andreas-aj-johansson-28334b51/>
- <https://www.youtube.com/watch?v=OXO1GWj05Vk>
- <https://www.linkedin.com/in/dave-zader-8a36a7b/>
- CRITICAL AND EMERGING TECHNOLOGIES LIST UPDATE - Feb 2022:  
<https://www.whitehouse.gov/wp-content/uploads/2022/02/02-2022-Critical-and-Emerging-Technologies-List-Update.pdf>
- National Artificial Intelligence Research Resource Task Force:  
<https://www.whitehouse.gov/ostp/news-updates/2021/06/10/the-biden-administration-launches-the-national-artificial-intelligence-research-resource-task-force/>
- Executive Order on AI: <https://trumpwhitehouse.archives.gov/ai/>
- National Science Foundation Convergence Accelerator:  
[https://www.nsf.gov/od/oia/convergence-accelerator/documents/Cohort%20Guide\\_Final.pdf](https://www.nsf.gov/od/oia/convergence-accelerator/documents/Cohort%20Guide_Final.pdf)
- Learning Environments with Augmentation and Robotics for Next-Gen Emergency Responders:  
<https://www.nsf.gov/od/oia/convergence-accelerator/team-videos/video-pages/learner.jsp>
- Enhanced Dynamic Geo-Social Environment (EDGE) virtual training through DHS:  
<https://www.dhs.gov/science-and-technology/EDGE>



# Appendix H: Affinity Map for Incident Commanders

[Download Affinity Map - 03\\_03\\_2022.png](#)

## Personality

Calm and collected disposition

Adapt to a  
stressful  
situation

To avoid  
panic  
during a  
crisis

Prefers consistency in workflow  
structure

To follow  
a  
consistent  
workflow  
structure

Needs are not often recognized

To have  
a  
consistent  
workflow  
structure

To have  
a  
consistent  
workflow  
structure

## Values

Respect for seniority and hierarchy

rank

Highest  
ranking  
chief

chain of  
command

"rookie"

25+ years  
of  
experience

Polarized affect towards technology

Dislike  
technology  
and  
automation

Love  
technology  
and  
automation

Dislike  
technology  
and  
automation

Love  
technology  
and  
automation

## Goals

Commanders aim to minimize harm as quickly as possible

Save  
time  
and  
money

Reduce  
risk  
of  
incident

Better  
survival

Save  
what  
matters  
most

They seek to gather as much situational awareness as possible

Situational  
awareness

Share  
what  
you  
know

They are responsible for supporting large events

Large  
scale  
incidents

Large  
scale  
incidents

Large  
scale  
incidents

## Approach to Work

They use various tools that support collaboration and shared awareness

Laptop  
/ tablet

Command  
center

Mobile  
devices  
and  
apps

Software  
tools  
and  
apps

They are very process oriented

Tactical  
decisions

Managing  
personnel

On  
the  
defensive

Focus  
on  
the  
incident  
area

Focus  
on  
the  
incident  
area

Focus  
on  
the  
incident  
area

They collaborate with their team to coordinate and distribute resources

Resource  
management

Resource  
management

Resource  
management

Resource  
management

Resource  
management

## Needs

There is a need to form a unified mental model among remote commanders and field workers

Communication - there must always be an open line to communicate efficiently

Communication  
tools  
and  
apps

Communication  
tools  
and  
apps

Communication  
tools  
and  
apps

Communication  
tools  
and  
apps

Communication  
tools  
and  
apps

Time - time is a valuable resource. Actions should be completed as soon as humanly possible

Time  
is  
a  
valuable  
resource

Time  
is  
a  
valuable  
resource

Time  
is  
a  
valuable  
resource

Time  
is  
a  
valuable  
resource

Time  
is  
a  
valuable  
resource

Visuals - Commanders rely on maps and other visual communication to inform their strategy

Visual  
communication  
tools  
and  
apps

Visual  
communication  
tools  
and  
apps

Visual  
communication  
tools  
and  
apps

Visual  
communication  
tools  
and  
apps

Visual  
communication  
tools  
and  
apps

Data - Commanders rely on data to inform their next decision

Data  
tools  
and  
apps

Data  
tools  
and  
apps

Data  
tools  
and  
apps

Data  
tools  
and  
apps

Data  
tools  
and  
apps

# Appendix I: Empathy Map for Incident Commanders

[Download Empathy Map - 03\\_10\\_2022.png](#)



# Appendix J: Persona 1 - “The New Guy”

[Download Persona - The New Guy - 03\\_13\\_2022.png](#)

## Norm The “New Guy”



*“How can we save lives if we don’t use the best technology? We need to update our systems!”*

**Age:** 25 years old  
**Job Title:** Incident Commander  
**Education:** Bachelor’s Degree  
**Experience:** 6 months

### Personality:

- Level-headed
- Lively
- Alert
- Serious
- Approachable
- Kind
- Innovative

### Goals:

- Minimize harm among civilians
- Communicate effectively across departments
- Acquire optimum situational awareness
- Use resources as efficiently and effectively as possible

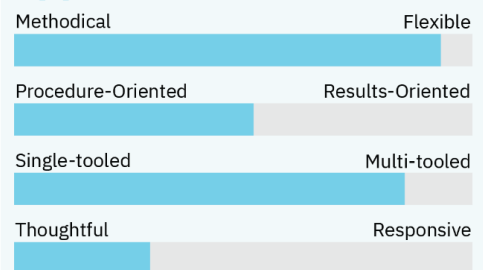
### Motivations:

- Desires to grow their skills and advance in their career
- Wants to acquire advanced tools and technologies to better response time
- Using any means possible to save as many lives as possible

### Frustrations:

- Does not always feel listened to by higher-ups
- Relies on radio communication to gain a clear picture of an emergency scenario
- Delays in communication hinder situational awareness

### Approach to Work:



### Needs:

- Advanced Technology - tools that utilize the latest technology to enhance situational awareness
- Open Communication - seconds wasted by an occupied radio can cost lives
- Responsiveness - optimize response times

### Values:

- Respect those with greater tenure but wants to push them to achieve higher standards through technology
- Wants to have confidence in the fact that he is doing absolutely everything he can for the people he is trying to help

# Appendix K: Persona 2 - “The Old Dog”

[Download Persona - The Old Dog - 03\\_13\\_2022.png](#)

## Oliver The “Old Dog”



*“Technology reliance only causes problems. We’re better without it in the end”*

**Age:** 57 years old  
**Job Title:** Lead Commander  
**Education:** High School  
**Experience:** 27 years

### Personality:

- Composed
- Stoic
- Decisive
- Parental
- Honest to a fault
- Reliable
- Respectful

### Goals:

- Doesn’t want to be phased out before retirement
- Maintain confidence so they can continue to lead their team
- Passionate about saving lives and property

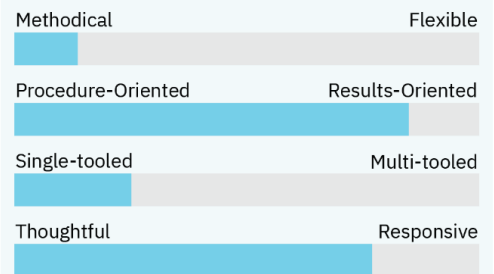
### Motivations:

- Wants to ensure the safety of their team as they respond to incidents
- Wants their team to trust them and to appear as a strong confident leader
- Cares about saving lives and property within the community he serves

### Frustrations:

- Thinks learning a new computer system will slow them down or cause harm if they make mistakes
- Doesn’t like new technology. Is not convinced it is accurate, stable, or reliable
- Worried that rookie commanders will not know how to function should the new technology crash

### Approach to Work:



### Needs:

- Intuitive usability – needs a system that works as quickly and reliably as their brain
- Education – learning how a new system works
- Comprehension – needs proof of improved outcomes
- Confidence – lack of system failure

### Values:

- Proud of their past accomplishments, but never forgets the result of a poor call
- Honors the well-established procedures as they’ve proven successful
- Doing things the easy way versus trying to fix what isn’t broken