THE FLOW OF COMMUNICATION

Multi-Modal Tools for EMS First Response

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Capstone - 2025

Word Count: 4,585

AUTHENTICITY STATEMENT

This is to certify that to the best of my knowledge, the content of this report is my own work. This report has not been submitted for any subject or for other purposes. I certify that the intellectual content of this report is the product of my own work and that all the assistance received in preparing this report and sources have been acknowledged.

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AI USAGE STATEMENT

I have utilised Generative AI, (ChatGPT and ChatPDF) to assist in various ways. The way I have used AI includes:

1. Assisting in sourcing relevant research materials within the background and benchmarking research

2. Analysing large bodies of text for easier interpretation of key findings and data, (location of information within texts), information regularly cross-referenced for accuracy, truthfullness and authenticity

3. Assisting in editing, grammar, and structure to ensure clarity, conciceness and cohesion

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EXECUTIVE SUMMARY

The following report explores the current weaknesses of communication and decision-making within the emergency medical service (EMS) system. Highlighting how the existing implementation of technologies and softwares heavily rely on the verbal input of callers. Yet, research findings bring forth the concern of how stress, confusion and panic often impair the ability of callers to relay critical information, such as nature and location of an emergency, in times of critical urgency.

Via the process of desktop and primary research in the form of surveys and interviews, five key points were raised to guide design innovation, (Enhancing communication & Situational Awareness, improving technology trust and transparency, constructing secure feedback loops, integrating intelligent automation, and ensuring smooth integration with current systems). These themes demonstrate the need for human centred design solutions that reduce caller burden and further strengthen the EMS dispatch process & preparedness.

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SECTION ONE:

INTRODUCTION

Every 26 seconds, a Triple-Zero call is answered by the Queensland Ambulance Service, totalling over 3,300 calls in a single day. Of these calls, over 85%, (~2,750 calls on an average day), are classified as Code 1 or Code 2 incidents (QAS, 2024) requiring urgent, if not, immediate response, to best assist potentially life-threatening scenarios. Where minutes, and even seconds can mean the difference between life and death.

Despite the important role of the EMS responders, they can often find themselves underequipped and underprepared when arriving at a scene, due to incomplete or unreliable information provided. This is due to dispatchers' heavy reliance on the descriptions of callers rather than actual scene conditions, where callers can be unclear, inaccurate, panicked and potentially untruthful. It is crucial for dispatchers to obtain reliable information within the early minutes of an incident, as it helps to better understand and respond to life-threatening scenarios.

As Australia continues to grow in population and urban scale, existing resources are being put under strain, the need for innovation within the EMS system has never been more prevalent (Görgens, 2025). First responders must be provided with the necessary tools for enhanced communication, situational awareness and decision-making support to ensure Triple-Zero services remain efficient during unpredictable times.

The aim of this study is to explore how multimodal technologies could soon be implemented within the emergency service system to improve awareness, communication and decision-making to better support emergency personnel.

BACKGROUND

First response revolves around the ability to provide immediate, life saving assistance to those in need. This is achieved by stabilising scenes, providing medical care, and protecting life/property until additional help arrives. Due to the time-sensitive nature of emergencies, its crucial EMS staff operate with speed and efficiency to provide the best possible care in the early moments of an incident, often referred to as the “Golden Hour” (Nickson, 2019).

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Early Response Benefit

The golden hour refers to the critical 60-minute window following a traumatic incident, where survival rates are significantly higher if treatment is provided quickly. An observational study involving 320 people showed that for those who received treatment within this window, mortality rates dropped from 31.8% to 7.1% (Bin Holiel et al., n.d.). This equates to a 4.5 times higher chance of survival for patients in life-threatening conditions, underscoring the importance of minimizing any delays in care delivery.

Studies such as this bring to question what tools can be provided to EMS personnel to improve results and decrease overall mortality rates. In order accurately address how the golden hour period can be supported, the process of call and response must be deconstructed.

Communication Under Stress

The call taker exists as the initial point of contact in any emergency, and is required to quickly gather accurate, reliable information from callers undergoing a significant amount of stress. During tragic events, a caller's ability to provide relevant and/or useful information is often hindered, as trauma can trigger a plethora of adverse reactions such as impaired cognitive function, emotional distress, difficulty prioritizing, distorted perception, disconnection, and communication breakdown, (SAMHSA, 2014).

Research confirms this claim, as highlighted in an observational study of 1,830 ambulance calls in the UK. Where 26.3% of calls were associated with communication problems, delaying ambulance dispatch and/or the delivery of first aid advice (Higgins et al., 2001). The most common barrier prevalent within these observed calls regarded the emotional state of the caller, accounting for more than a third of the delays within these calls (Higgins et al., 2001).

Similar findings were additionally observed in out-of-hospital cardiac arrest studies, where distressed callers took significantly longer in providing key details, inevitably slowing the recognition of the incident at hand and delaying CPR instructions (Chien et al., 2025). Early-stage delays bring forth consequences beyond just medical emergencies, as an analysis of police response times identified that just a 10% increase in response time resulted in a 1.6% rise in the probability of injury. Confirming that even small delays in dispatch can alter the trajectory of an incident (DeAngelo et al., 2023).

Photo by Mikhail Nilov: https://www.pexels.com/photo/paramedics-giving-first-aid-to-a-person-lying-on-a-stretcher-8942729/

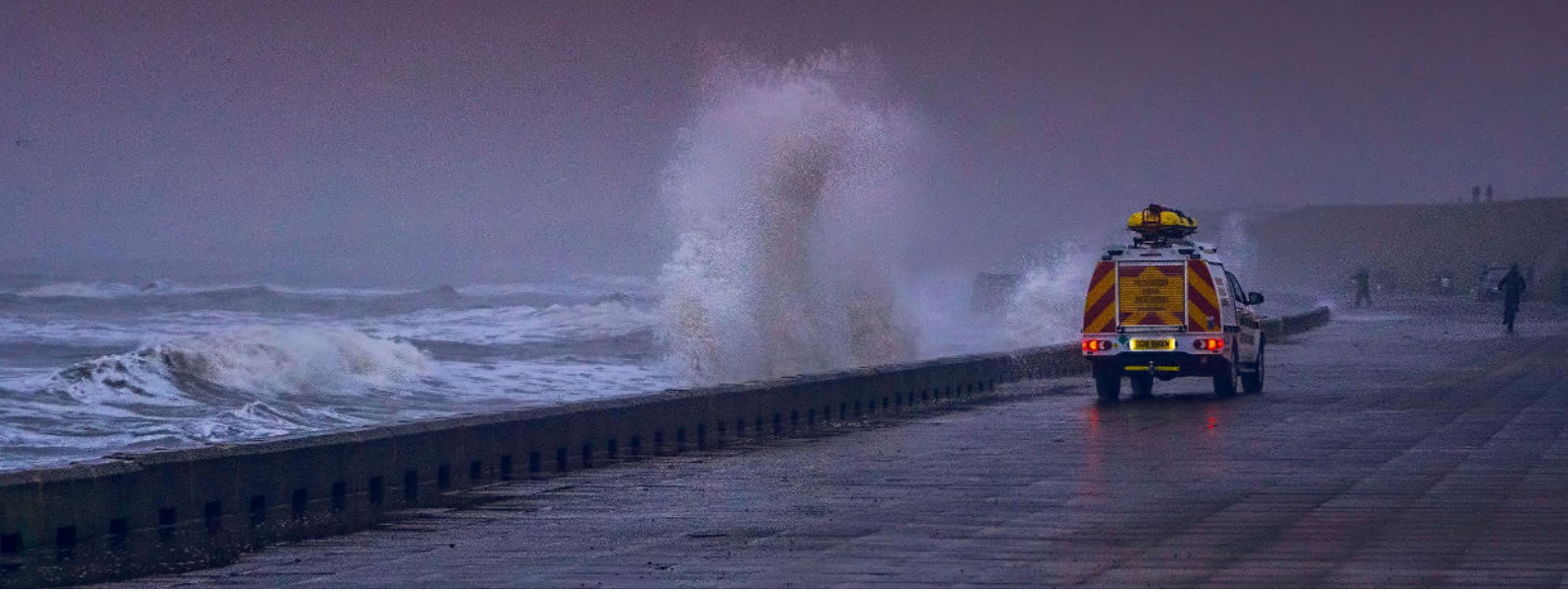


Photo by Ray Bilcliff: https://www.pexels.com/photo/vehicle-near-beach-1494729/

Systemic Communication Barriers

Broader systemic issues are affecting first response. Queensland Police Service did not meet its own urgent-incident response time targets in 2023–24, attending only 74.3% of Code 1-2 incidents within 12 minutes against a target of over 80%, indicating sustained pressure on emergency response capacity (Queensland Police Service 2024; Queensland Audit Office 2024).

Weaknesses in communication systems have further been exposed in events of large-scale disasters, where for responders, floods and wildfires highlighted how incompatible radio systems across agencies stunted cross-department coordination, causing unintended duplications of effort and further dangerous delays (Bridging the communication gap, 2025). Evident also on the caller side, where the input overload of the 2009 Victorian bushfires left 18,000 Triple-Zero calls unanswered or with delays due to system failure (Royal Commission into Victoria's Bushfires, 2009).

Inconsistencies in cross-department communication continues to delay the allocation of resources, highlighting the recurring challenge where reliance on current early-stage communication methods leaves response vulnerable to delay. Desperately suggesting the need for additional tools to supplement and strengthen information exchange in these initial stages. These challenges highlight the repeating critical point that the early minute of an emergency is just as important as the actual care delivered on scene. Dispatchers simply cannot afford to work with incomplete, delayed, or unclear information as patient lives are lost if first responders are disadvantaged before they even arrive.

The Case for Enhanced Support

In total, these findings highlight the need for supportive tools and systems to reduce reliance on caller clarity, provide faster scene analysis, and provide dispatchers and first responders alike with improved situational awareness. Emerging innovations and approaches focus on enriching caller-provided information, further improving the insights dispatchers have access to during live, unfolding events.

These innovations aim to streamline the call-taking process and reduce points of stress in the early stages of response to support call takers in dispatching critical resources quickly and accurately.

Unsplash.com, 2025

BENCHMARKING

The benchmarking section aims to evaluate technologies across the emergency response timeline to identify critical market gaps and justify potential product interventions. Insights gained throughout this evaluation will provide the foundation for developing new tools to strengthen and support the EMS system in early-stage decision making and dispatch.

The Market Gap

The examination of the EMS system, inclusive of each key stage of first response, (Call, Dispatch, Response, Care, Transport, and Handover), aims to identify critical market gaps and highlight potential room for improvement (see Figure 1). Technologies analysed are divided into two categories, software and hardware, where software solutions manage and interpret information through tools such as Computer-Aided Dispatch (CAD) platforms, AI-assisted triage, and electronic patient records. Hardware solutions, by contrast, provide physical interfaces or independent streams of data, including dispatcher consoles, patient monitors, drones, and telemetry devices.

While both categories provide great value to first response, their distribution across emergency stages is unbalanced. Earlier stages of emergency response are dominated almost entirely by software interventions, leaving dispatchers purely reliant on a caller's ability to provide accurate and reliable information. This dependence highlights the flaw embedded within entirely software-based solutions, where their success is driven entirely by human input. The implementation of hardware-based tools in contrast, showcases the potential to deliver improved situational awareness, providing dispatchers with additional reference points for decision-making. This overall reduces the reliance on caller cooperation, reducing pressure and strengthening the early-stage process of an emergency.

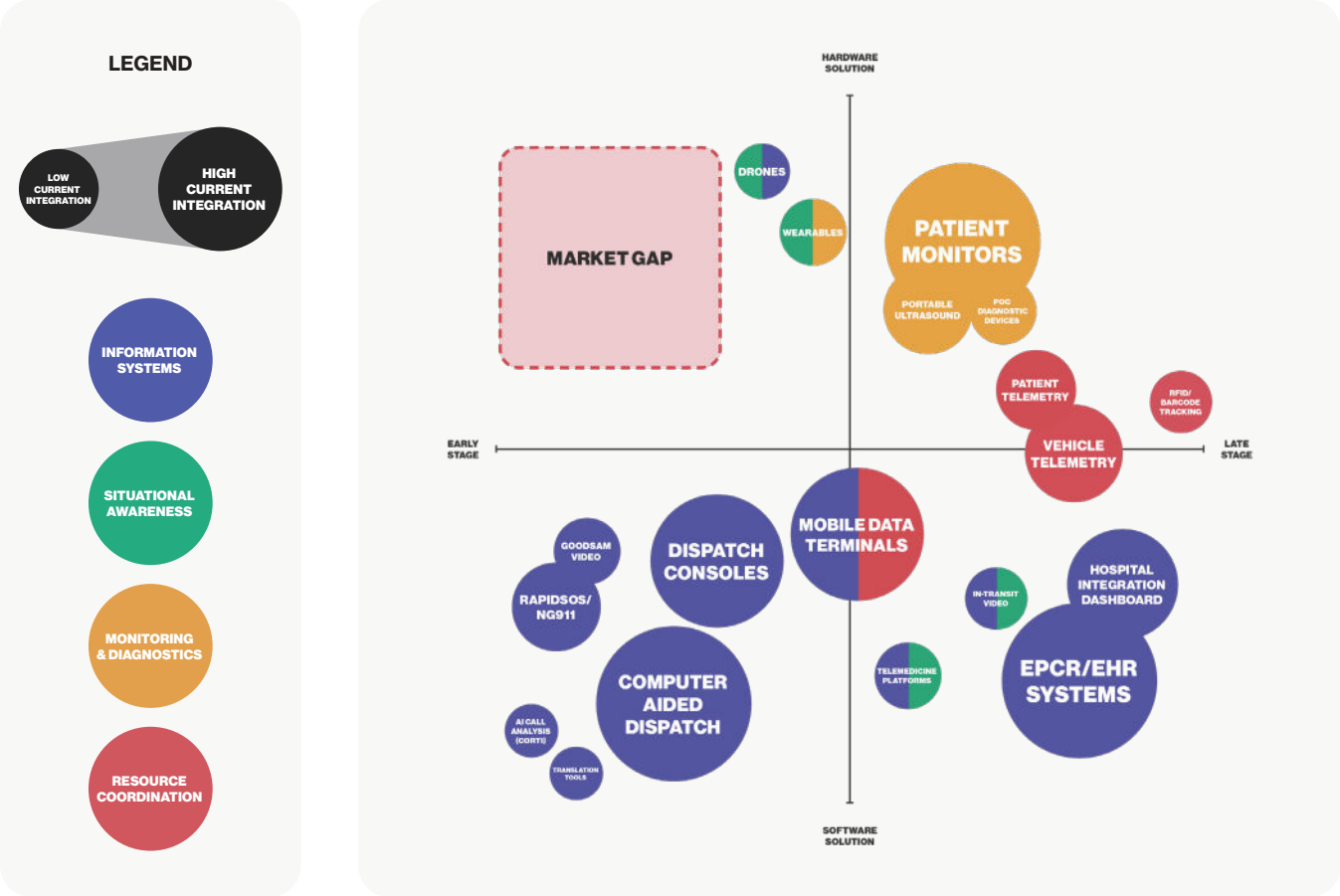


Figure 1 - Benchmarking Matrix: Software & Hardware EMS Timeline

Emerging Technologies

Within the market gap and other areas of the system, several underutilised solutions have emerged, (innovations such as Drones and Wearables). These technologies both show promising potential and have demonstrated their benefits via implementations in pilot programs however, remain far from full adoption into mainstream emergency response. It is therefore important to analyse these emerging technologies to identify where the challenges of early-stage communication are located to better inform potential design solutions (see Figure 2).

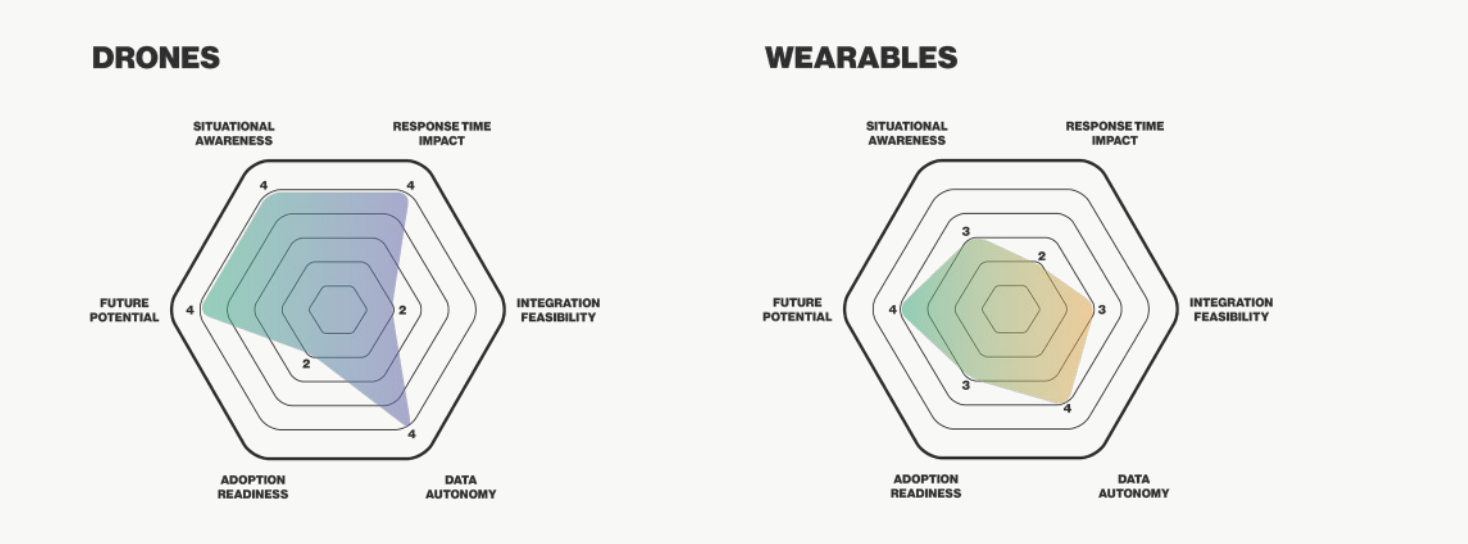


Figure 2 - Radar Chart: Drones and Wearables

HIGHEST SCORE RANKING (POSITIVE)

LOWEST SCORE RANKING (NEGATIVE)

Although promising demonstration within pilot programs, drones and wearables remain far from mainstream adoption due to several factors. These include regulatory restrictions, infrastructure limitations, concerns around reliability and public trust in these technologies.

Addressing these challenges requires the development of supporting innovations to reduce barrier and build confidence in its use. Building from this, the benchmarking conducted aims to examine existing drone and wearable technologies within both EMS and other industries (see Figure 3).

PRODUCT	REGULATORY BARRIERS	INFRASTRUCTURE LIMITATIONS	OPERATIONAL RELIABILITY	SYSTEM INTEGRATION	USER ACCEPTANCE
 **DRONE-IN-A-BOX SYSTEM** **"DJI DOCK"**	BVLOS* operation tightly regulated, largest obstacle in drone use	Requires fixed stations for storage, charging, & automated deployment	Highly reliable in controlled conditions, vulnerable to weather, & obstruction	No current implementation within EMS CAD. Potential integration but largely experimental in EMS	Remotely accessible drones raise privacy concern
 **AED DELIVERY SYSTEM** **"EVERDRONE"**	Operational in other countries, regional scaling issues	Requires hubs for storage but less demanding than docks	Proven effective in pilot programs, limited by weather/range in adverse conditions	Currently integrated in some EMS pilots, not fully standardised	Generally positive public perception, especially as a lifesaving tool
 **TETHERED RECON DRONE** **"FOTOKITE"**	Tethered avoids potential airspace restrictions, easier to deploy than other drones	Vehicle mounted setup required, deployment limited to vehicle on scene	Practically unlimted tethered flight, very reliable once deployed	CAD/Dispatch integration limited (on-site), multi data input (video, thermal)	Visible, on-scene operation generally yields more positive public perceptions
 **CRASH/FALL DETECTION** **"APPLE WATCH"**	Consumer device, Series 4+ have FDA cleared ECG function	Independent device integrating with common IOS system, no direct EMS integration	Proven success in real life scenarios, still subject to false positives/negatives	No direct EMS link, requires development into the CAD system	Highly adopted, extremely popular with proven track record of public confidence
 **HEALTH MONITORING** **"OURA RING"**	Consumer grade device, not FDA cleared for medical grade	Minimal infrastructure, (no hubs, docks, etc)	Proven effectiveness in wellness tracking, some reliability in EMS	No current direct links to EMS dispatch	Highly adopted among the wellness centered public

BVLOS - Beyond Visual Line of Sight

Figure 3 - Benchmarking Heatmap: Existing products

SECTION TWO:

RESEARCH

The primary data collection stage is critical to justifying the previously conducted research regarding possible intervention and support within the EMS system. For the most part, the research section consists of qualitative data collection with sections coded, analysed and presented in a quantitative manner. The focus around research conducted within this stage was to attain first hand insights surrounding experience within the EMS system and the technologies aimed to support that process.

Methodology

As mentioned above, the collection of qualitative data constitutes the main component of this research process, consisting of a combination of surveys and interviews. The reasoning behind the research structure being qualitative focused rather than quantitative, was due to the complex nature of communication within early stages of the emergency timeline. By shifting focus into uncovering the “Why” and “How” of communication and information barriers, this process aims to uncover potential pain points through the experiences of affected patients, witnesses and first responders.

METHOD: *SURVEYS*

Survey Durations:
~10 Minutes each

The use of surveys, administered via the web platform 'Google Forms', was one of the primary research methods employed within this stage of the study. The platform was utilised to design, distribute and securely store participant responses. Recruitment was carried out via social media platforms including Instagram, Facebook and LinkedIn, (see Appendix 1 & 2), using a publicly accessible account to ensure a diverse pool of respondents from the general public. This recruitment took the form of several temporary posts, ensuring data collection remained limited to this research stage.

These short surveys consisted of 13 questions presented in, multiple-choice, checkbox, Likert scale and short-answer question formats. This enabled efficient data collection, allowing for swift survey completion, supporting engagement and accessibility. Questions requiring user text input which could raise confidentiality or sensitivity concerns were made to be optional.

The survey avoided collecting invasive or identifiable data by structuring demographic questions into broad, non-identifiable categories, such as age groups and general global /community regions. Additionally, due to the survey's accessible, anonymous nature, the use of age categories ensured a precautionary measure to filter out any potential under 18 responses in line with ethical participation standards. Although no under 18 responses were received.

SURVEY 1

Drones in Emergencies. ..... *Public Perception*
30 Responses - General Public

SURVEY 2

Triple Zero Emergency Calls ..... *Public Experience*
11 Responses - General Public

METHOD: *INTERVIEWS*

Interview Durations:
30-60 Minutes each

Initial outreach to EMS experts, (first responders, dispatchers and call-takers), via email and social media, (see Appendix 3 & 4), yielded no response. Hence, the research adapted, focusing on collecting data from "secondary stakeholders," including members of the public with direct, and in-direct experience calling 000.

Recruitment was initiated via the optional end question of *Survey 2,* where respondents could provide contact details or reach out directly via email. 5 volunteers came forward, but only 2 were ultimately interviewed due to time constraints and data volumes. These participants represented opposing demographics in age, gender, and EMS experience (direct and indirect), offering a breadth of perspectives.

Participants were informed of the ethical considerations as well as additional support resources available. This was achieved via information provided in the survey conducted beforehand, as well as additional consent forms and information sheets distributed before interviews. These interviews allowed for richer, personalised perspectives as opposed to the sometimes-quantitative data surveys provide, overall providing deeper insights in the public's experience with emergency first response calls. These interviews were conducted online and in person, with digital recording and transcription tools (see Appendix 5, 6, 7, 8) used to ensure accuracy.

INTERVIEW 1

Information Flow in EMS Calls ..... *Bystander Perspective*
55 Minutes 43 Seconds

INTERVIEW 2

Wearable Tech in Emergencies ..... *Patient Perspective*
33 Minutes 4 Seconds

ANALYSIS & FINDINGS

After the surveys and interviews were conducted, a combination of qualitative and quantitative data analysis methods were implemented to triangulate and interpret key themes and findings within this primary research process.

SURVEY ANALYSIS

Data was collected from a total of 41 respondents across both surveys. The response demographic consisted of the general public in both instances, centered around those with perspectives or experience regarding the following survey topics:

- **Survey 1:**
  Public Perception of Drone Use in EMS

  Data from this survey focused on gaining insight into general perceptions around drones and the implementation of new technologies within the emergency service industry. It aimed to highlight how willingness of the public to adopt these new innovations and what concerns they had surrounding their use.

- **Survey 2:**
  Public Perspective on Emergency Calls

  This survey aimed to capture people's perspectives and potential difficulties that might be present when making triple zero calls. Respondents were asked to either reflect on their past experiences needing to call emergency services, or to put themselves in the perspective of a caller and express their concerns.

Limitations

The initial demographic of these surveys aimed to be centered around was the perspectives of primary stakeholders in the EMS workplace. This included first responders such as police, firefighters, paramedics and SES workers, as well as those operating within the dispatch stage, such as *Telstra* operators, Triple Zero call-takers and emergency service dispatchers. Unfortunately, prior to the publication of these surveys, outreach aimed at recruitment within this demographic proved unsuccessful and survey direction shifted to the perspectives of the public.

Additionally, due to the method of the outreach to the general public, (conducted via social media), participants tended to sit in the younger age demographic. Fortunately, additional outreach methods across multiple media platforms ensured recruitment over a wider demographic however, it is still important to note that this factor may have contributed to the outcome of the data.

SURVEY 1

Drones in Emergencies. ..... *Public Perception*

30 Responses - General Public

Implementation Concerns

Survey data from Question 6, (*"What is your main concern with drones operating in your local area?"*), highlighted privacy as the most frequent response, consisting of almost two-thirds of all answers (see Figure 4). Other notable concerns consisted of, safety, misuse, and no concern, however, these consisted of significantly smaller responses within the sample.

An analysis of the age distribution of participants who responded to this question, indicated that privacy was the consistent concern within the 18-24 age demographic. Whereas, responses on other concerns were mixed across the age demographic, including responses from the 55-64 and 65+ age group.

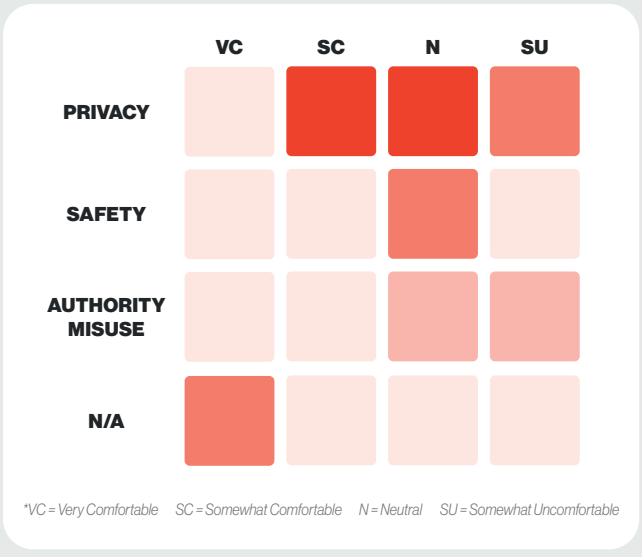


Figure 5 - Heat Map of Drone Concern vs Comfort

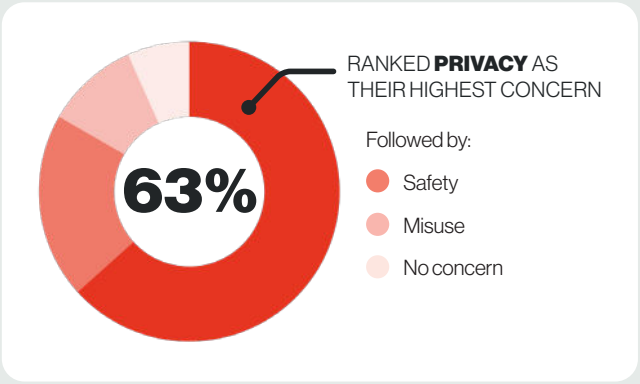


Figure 4 - Drone Implementation Main Concerns

Implementation & Comfort of Use

Bivariate cross-analysis of questions 5 and 6 were conducted:

5. *"How would you describe your comfort with drone use in public spaces?"*
6. *"What is your main concern with drones operating in your local area?"*

Gathered data showcased the following distinct distributions (see Figure 5):

- **"Very Comfortable"** respondents most often indicated no concerns with drone use.
- **"Somewhat Comfortable"** respondents vocalised their concerns entirely around the issue of privacy with drone use.
- **"Neutral"** respondents, voiced their main concerns around privacy, safety and misuse
- **"Somewhat Uncomfortable"** respondents again showcased privacy as their most common concern, alongside authority misuse

Comfort & Perceived Value

The cross-analysis of participant's comfort around drones against their perceived value of within the EMS system uncovered that 100% of participants believed that their implementation would at least offer some value to the response system, indicating an overall acceptance regarding their potential integration. From these response, those who were generally more comfortable with drones had a higher perceived value, whereas those less comfortable sat lower however still recognised their potential to aid the EMS response process (see Figure 6).

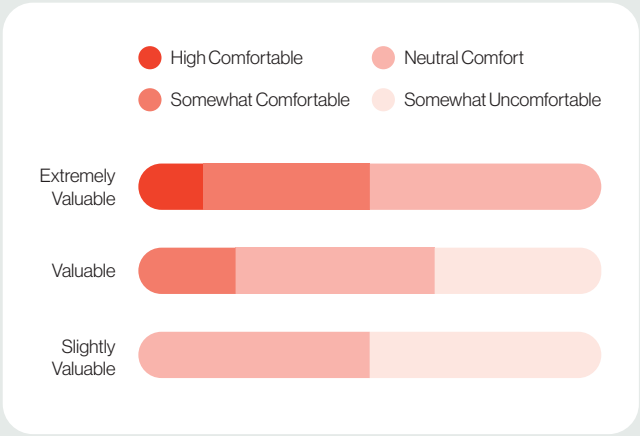
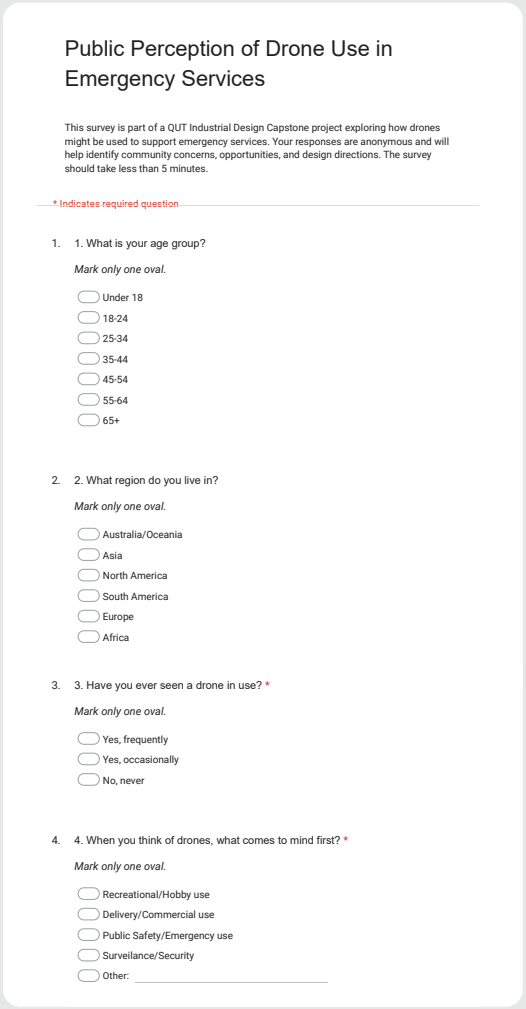


Figure 6 - Comfort Vs Perceived Value of Drones in EMS


Public Perception of Drone Use in Emergency Services

This survey is part of a QUT Industrial Design Capstone project exploring how drones might be used to support emergency services. Your responses are anonymous and will help identify community concerns, opportunities, and design directions. The survey should take less than 5 minutes.

* Indicates required question

1. 1. What is your age group?

Mark only one oval.

- Under 18
- 18-24
- 25-34
- 35-44
- 45-54
- 55-64
- 65+

2. 2. What region do you live in?

Mark only one oval.

- Australia/Oceania
- Asia
- North America
- South America
- Europe
- Africa

3. 3. Have you ever seen a drone in use? *

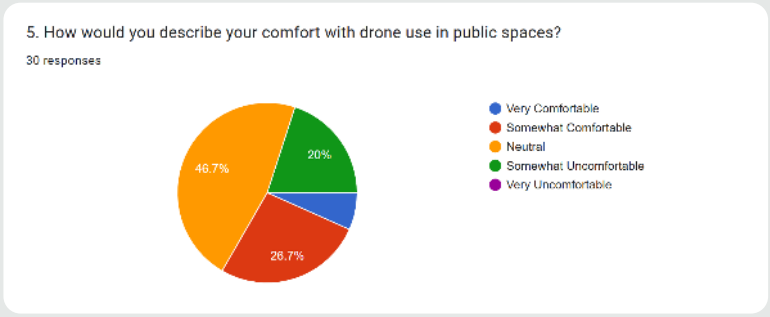
Mark only one oval.

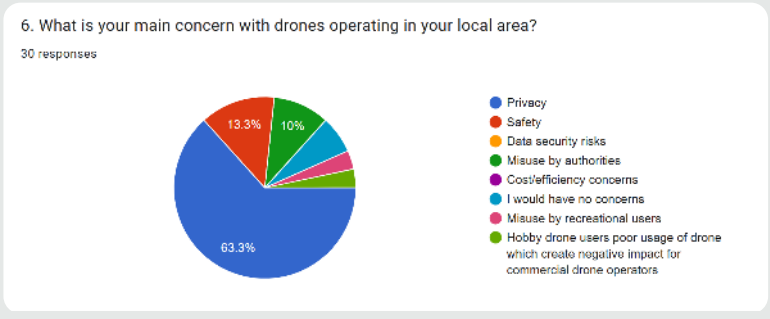
- Yes, frequently
- Yes, occasionally
- No, never

4. 4. When you think of drones, what comes to mind first? *

Mark only one oval.

- Recreational/Hobby use
- Delivery/Commercial use
- Public Safety/Emergency use
- Surveilance/Security
- Other: _____





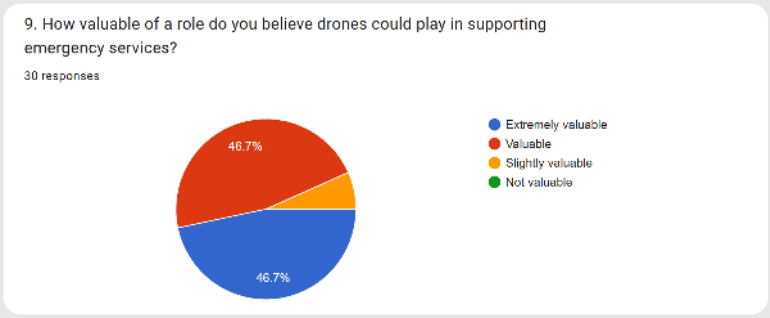


Figure 7 - Extract of Google Forms Survey Questions & Responses

SURVEY 2

Triple Zero Emergency Calls ..... *Public Experience*

11 Responses - General Public

Survey data across interview 2, focusing on gaining insight on difficulties during the communication phase of dispatch, (*"What do you believe would be most difficult to communicate in an emergency call?"*), indicated that the nature of the emergency was the most difficult to communicate, followed by the location of the emergency (see Figure 8). This highlights that communication difficulties lie within two out of the five main critical points of data for an EMS dispatcher, (*what* and *where*).

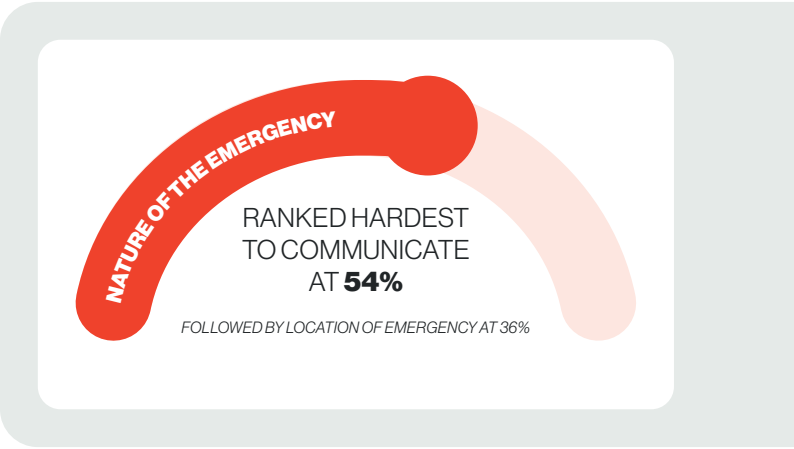


Figure 8 - Information Exchange Concern

Patient confidence surrounding experiences or perspectives on emergency calls, (*"If I were making an emergency call, I would feel most confident knowing..."*), demonstrated varied responses regarding systems to reduce caller stress. The most commonly indicated response surrounded additional systems being put in place to help aleviate caller stress (see Figure 9).

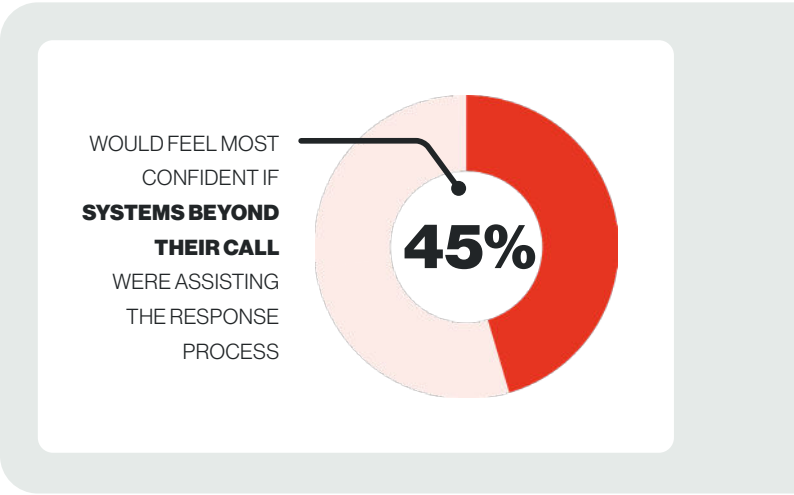


Figure 9 - Emergency Call Confidence

Out of the survey data analysed, 100% of respondents agreed that stress would have a strong or very strong effect on the quality of information exchanged. Those with prior experience making emergency calls indicated that providing key details within emergencies had some factor of stress which may have affected their ability to provide key information.

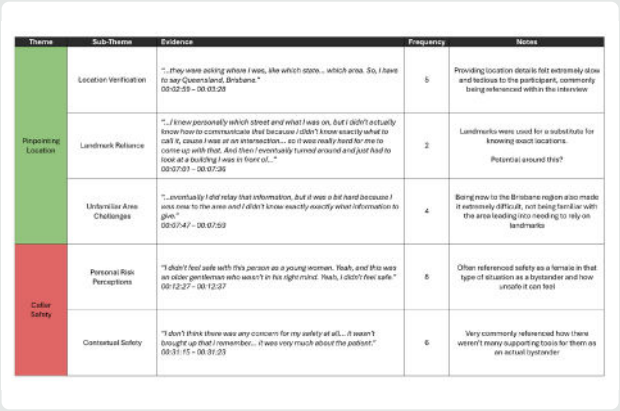
Throughout this interview's open structure, additional concerns regarding privacy were raised. Participants mentioned, *"...not wanting to feel like they're being tracked..."*, and worries around their *"...privacy and personal details being breached by the wrong people."*

Privacy is a very commonly recurring theme throughout each stage of primary research.

INTERVIEW ANALYSIS

Following the completion of the interview process, recordings were uploaded from transcription softwares, (*Apple Voice Memo* and *Microsoft Teams),* to *Microsoft Word* for the analysis and coding of key themes, sub-themes and their frequency of mention (see Figure 10). From this analysis, a Thematic Coding Matrix (see Figure 11) was created, in order to analyse the frequency of recurring themes and/or ideas.

Figure 10 - Transcript Analysis
**Data redacted for privacy protection*



Theme	Sub-Theme	Evidence	Frequency	Notes
Pinpointing Location	Location Verification	"...they were asking where I was, like which state... which area. So, I have to say Queensland, Brisbane." 00:02:59 – 00:03:28	5	Providing location details felt extremely slow and tedious to the participant, commonly being referenced within the interview
	Landmark Reliance	"...I knew personally which street and what I was on, but I didn't actually know how to communicate that because I didn't know exactly what to call it, cause I was at an intersection... so it was really hard for me to come up with that. And then I eventually turned around and just had to look at a building I was in front of..." 00:07:07 – 00:07:39	2	Landmarks were used for a substitute for knowing exact locations. Potential around this?
	Unfamiliar Area Challenges	"...eventually I did relay that information, but it was a bit hard because I was new to the area and I didn't know exactly exactly what information to give." 00:07:47 – 00:07:53	4	Being new to the Brisbane region also made it extremely difficult, not being familiar with the area leading into needing to rely on landmarks
Caller Safety	Personal Risk Perceptions	"I didn't feel safe with this person as a young women. Yeah, and this was an older gentleman who wasn't in his right mind. Yeah, I didn't feel safe." 00:12:27 – 00:12:37	8	Often referenced safety as a female in that type of situation as a bystander and how unsafe it can feel
	Contextual Safety	"I don't think there was any concern for my safety at all... it wasn't brought up that I remember... it was very much about the patient." 00:31:15 – 00:31:23	6	Very commonly referenced how there weren't many supporting tools for them as an actual bystander

Figure 11 - Thematic Coding Matrix

Limitations

As mentioned previously, one of the initial aims of the primary research was to capture the perspectives of individuals directly employed within the EMS industry. Despite outreach efforts, the recruitment of this primary stakeholder group proved unsuccessful. As a result, the interviews conducted within this stage of the report instead reflect the perspectives of general members of the public, regarding their direct involvement in emergency scenarios.

It is also important to note that participant responses were retrospective in nature. As both interview instances involved the individual's reflection on their experience, which had occurred one to three years prior. While reflections of the experience still provide extremely valuable insights, time passed since the scenario may influence the accuracy of provided data. Additionally, due to the time gap from participants' experiences, it is possible that EMS practices have since evolved and developed. This does not diminish any relevance of data collected however, highlights an important factor to consider moving forward in the analysis process.

INTERVIEW 1

Information Flow in EMS Calls ..... *Bystander Perspective*

55 Minutes 43 Seconds

This interview explored a bystander caller's perspective during a Triple Zero (000) emergency call. Via thematic analysis (see Appendix 6), the following two compelling themes of *Caller Safety* and *Privacy & Trust* emerged (see Figures 12 & 13).

Caller safety was a new emerging theme that was not considered in earlier stages of primary research, where responses centered mainly around the safety and condition of the patient themeslves. Privacy and trust on the other hand, is a recurring theme throughout the entire primary research process. It is important to analyse these key themes from a bystander caller's perspective to better inform a wider user centered design that can aim to assist a broader range of users within the emergency response system.

Figure 12 - Alluvial: Caller Safety

Personal risk was the most common sub-themes within the caller safety context. Where the interview participant commonly vocalised their concerns around their personal safety within the call process, (see Figure 12). What became noticeably apparent was the caller's perception of the dispatcher's limited consideration of their safety as a bystander.

"I don't think there was any concern for my safety... it was very much involving the patient." *31:15–31:23*

"...once I had given all the information, the operator said I was free to leave. So I left because I didn't feel safe..." *13:28–13:49*

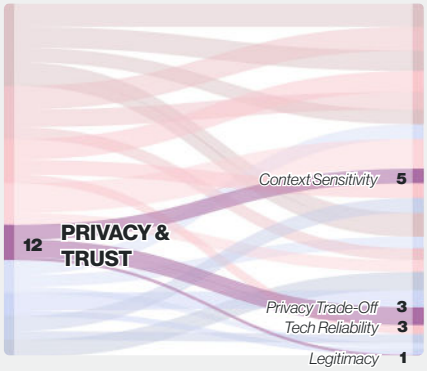


Figure 13 - Alluvial: Privacy & Trust

It became very clear that the participant's acceptability of monitoring/observational tools assisting in emergencies was extremely context driven, (see Figure 13). The participant regularly mentioned how this trade-off of help vs privacy was an exchange they were willing to make, given that it was made clear as to what and how these technologies would be utilised.

"If it was providing medical assistance, I think I would be OK with it... very context driven." *26:45–26:55*

"Surveillance... people might think, 'I'm being watched all the time.' If it was very clear it was emergency response, that might put people's minds at ease." *23:52–24:06*

INTERVIEW 2

Wearable Tech in Emergencies ..... *Patient Perspective*

33 Minutes 4 Seconds

Interview 2 focused on first hand experience of a patient's involvement with EMS response. From thematic analysis conducted over the 33 minute of interview, 8 relevant key themes emerged (see Figure 13). Of these, the most frequently mentioned theme regarded the Role of Technology in first response. More specifically, the participant felt the implementation of technology, (their Apple Watch), in EMS response helped bridge the communication gap by automating the transfer of critical data and improved the first response efficiency and workflow.

*"...everything went quite smoothly and quick... it was very good to have this, (**Apple Watch**), because it helped everything, (**Personal Data**) being organised when you're dazed..."* *18:10*

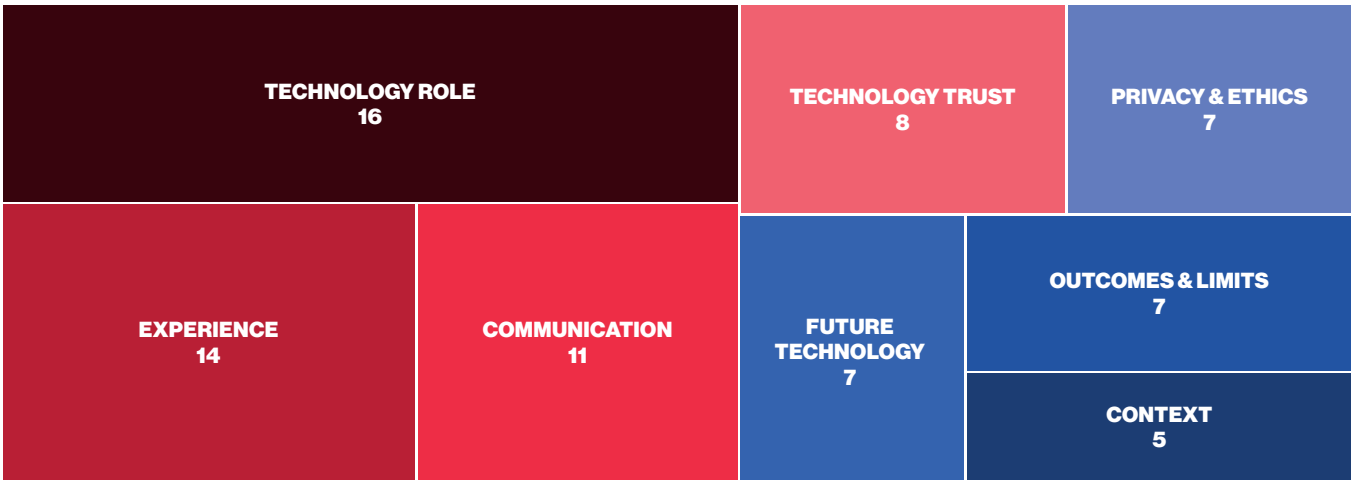
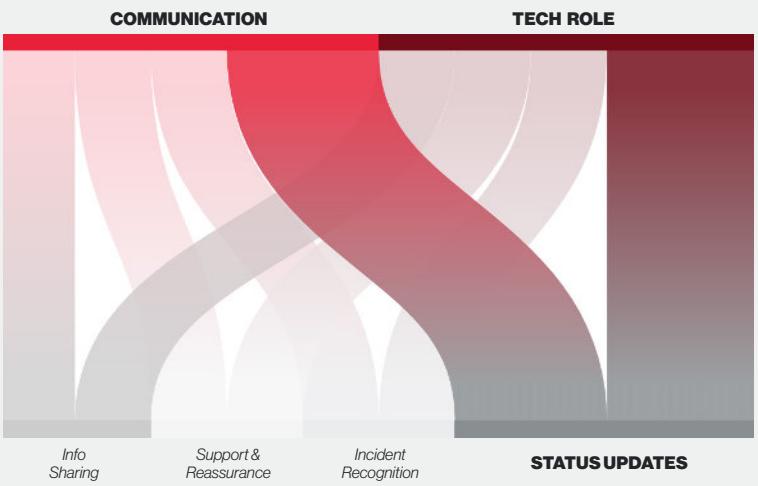


Figure 13 - Tree Map: Emerging Themes



The themes of Technology Role and Communication were closely compared to explore the potential for hardware based technologies within EMS response (see Figure 14). By analysing recurring sub-themes between the two themes, it became apparent that there was a desire for status based updates to aid patient comfort.

"...that could provide alot of comfort... knowing that help is on the way" *21:15*

Figure 14 - Alluvial Diagram: Communication & Tech Role

SECTION THREE:

DISCUSSION

This study aimed to identify communication and decision-making gaps within the EMS system, focusing on how multimodal innovative technology could be implemented to best support the early moments of critical response.

Desktop Research Findings

The implemented system providing urgent response in life-threatening scenarios, relies heavily on the ability of callers to relay the critical information pieces to help inform dispatcher decision-making. However, desktop research showcased how the effect of intense emergency situations can affect a caller's cognitive abilities to relay reliable, complete, and accurate information. This delay in information exchange ultimately slows dispatch times, significantly affecting a responder's ability to effectively prepare for a scene.

Human limitations around currently implemented technologies are only compounded via the existing weakness in EMS infrastructure. Where call overload and understaffing affect the ability for triple zero to respond to calls. Throughout disaster and extreme events, this major weakness in infrastructure has only been highlighted, showcasing the major flaws which revolve around the current fragile, caller reliant system, underlining the dire need for hardware to provide reliant and independent streams of data.

Benchmarking Findings

Via benchmarking and primary research analysis, this gap was reinforced. Existing software and hardware analysis revealed that the earlier stages of EMS were almost entirely software dominant, with technologies such as Computer Aided Dispatch (CAD), depending entirely on caller input. Although hardware driven solutions do exist within the EMS realm, the current innovations are almost entirely experimental, showing tremendous promise in pilot programs but remaining almost entirely conceptual due to regulations, infrastructure demands, and public perceptions. This technology imbalance deprives dispatchers of effective tools that provide additional receiving points of information to help verify or supplement caller data.

Photo by Pixabay: https://www.pexels.com/photo/grayscale-photo-of-firemen-266403/

Primary Research Findings

Primary research revealed the most common human concerns regarding the EMS system and implementations of new public technologies. This was achieved via the use of surveys and interviews. Survey data highlighted the main difficulties within an EMS call, showcasing the caller's lack of confidence in providing critical data in emergencies, (Nature and Location), and how their ability to relay this data is only diminished in stressful scenarios. Additionally, this data explored how plausible the implementation of new technologies was, focused on the primary concerns of the public with the integration of emerging products. The primary concern raised throughout this survey research regarded the privacy and safety surrounding these new technologies, where the majority of demographics expressed their unease around surveillance and data misuse.

Interview data reinforced these findings, where the role of technology and importance of data trust became very apparent. Patient interviews showcased how data communication devices, such as Apple Watches, assisted tremendously in the transfer of critical information, reducing confusion and improving overall response efficiency. At the same time, concerns were raised regarding privacy and transparency of this data use. Both interviews described their acceptance in sacrificing privacy for improved emergency assistance however highlighted how the use of these technologies were extremely context driven and required careful considerations to protect the public from misuse.

DESIGN IMPLICATIONS

1.

Enhanced Communication & Situational Awareness

Callers often fail in clearly communicating the nature and location of emergencies due to multiple cognitive factors such as stress, confusion and panic. The current process of dispatch relies heavily on this ability for callers to provide verbal descriptions, which when combined with severe mental load, can prove to be unreliable and open to mistakes or misinterpretations. Inputs from multimodal data sources, (such as video, photo, sensors or wearables), can alleviate this over-reliance by providing contextual clues and external validation to help dispatchers infer and reference missing, or unclear information.

Trust, Privacy & Transparency

Privacy concerns were commonly brought up throughout interviews and surveys. The consensus showed that even if new technologies were able to improve communication on scene, adoption of these innovations would be difficult if no systems are put in place for the clarification of data collection and how the system would operate outside of an emergency scenario. To best accommodate for public comfort surrounding the use of technologies that could be perceived as potentially invasive, clear consent mechanisms, non-invasive sensors and visible privacy indicators should be implemented to build public confidence. Trust and transparency are non-negotiable criteria within future designs, but a requirement for appropriate EMS tech adoption.

2.

3.

Data & Feedback Loops

The public experience commonly describes the EMS communication flow as one-directional, flowing from caller to dispatcher with little return on information. This lack of clear communication exchange can leave callers anxious and unsure if the information provided to dispatchers was correct and being acted upon. A major design opportunity lies within this communication gap, where tools can be implemented to provided callers with reassurance indicators that establish bidirectional communication, showcasing that they are being responded to. Drones and other potential multimodal tools can be effectively implemented to provide communicative data and interactions with callers.

4.

Intelligent Automation

Manual processes add unnecessary delays and risk of human error in the EMS system. In emergencies, the inefficient reliance on reporting key personal details and incident conditions via outdated phone operated systems poses a critical risk to the ability for EMS to quickly respond to a scene. Intelligent automation should be a key factor in the design of multimodal tools to assist in the information flow of relevant data to guide faster emergency dispatch. By implementing these automated systems, analysing location, emergency nature and key details surrounding the people involved, the design can aim to deliver faster care on scene.

Current System Integration

Emerging technologies such as wearables, drones and smart sensors often show promise within experimental pilot implementations, however lack proper integration with current EMS systems to effectively bridge the workflow gap. Tools that are seperate to the existing services and technologies implemented by the EMS, (Such as CAD and communication platforms), risk creating more work for dispatcher and responders. This in turn has the complete opposite intended effect on the workflow process of first response, slowing down rather than aiding in its efficiency. Designs should aim to reduce workload, via ensuring seamless integration with existing response platforms.

5.

CONCLUSION

This report examined the gaps in communication and decision-making within EMS, identifying how multi-modal technologies could aim to help support early stages of urgent response. Key research findings demonstrated how patient outcome directly links to the speed and efficiency of response, and how communication breakdowns between callers/dispatchers significantly disrupt the flow of response.

Five key implications were derived from these insights, centred around: enhancing communication and situational awareness, embedding trust and transparency in emerging technologies, creating secure caller/dispatcher feedback loops, integrating intelligent automation, and ensuring smooth alignment with existing systems. Implementing these implications as the foundation of design criteria in emerging ideation will help reduce caller burden, strengthen response preparedness and build confidence surrounding emerging EMS technologies.

In summary, the improvement of EMS communication requires more than incremental adjustments within implemented software and hardware. It demands the development of innovative, human centred technologies that consider the EMS system, patient trust, privacy and safety at its core. Ultimately advancing first response capabilities and improving patient outcomes in life threatening situations.

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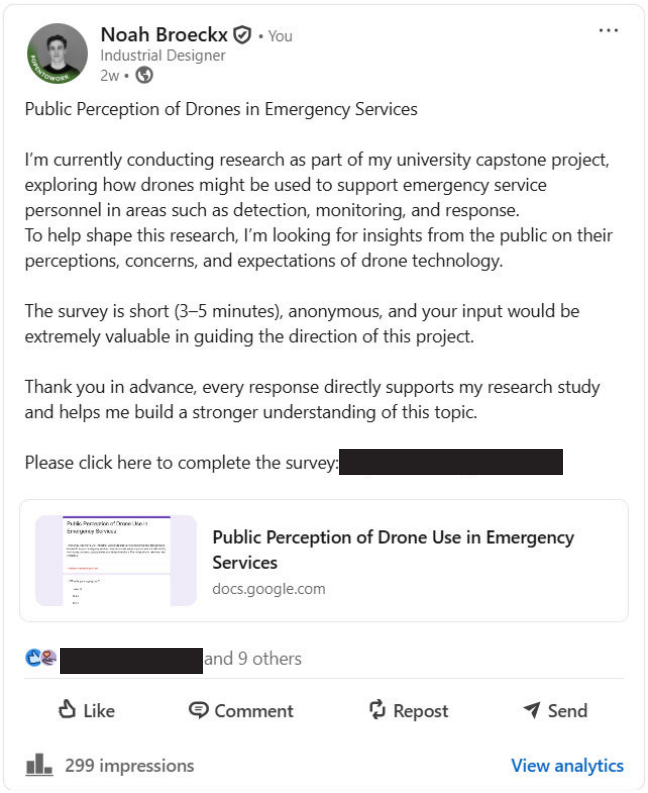
APPENDIX

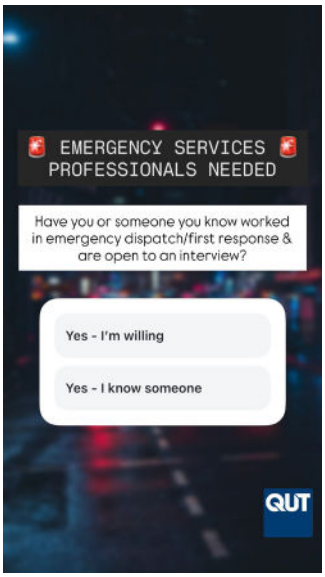
Appendix 1:
Drone Survey Recruitment - Instagram/Facebook

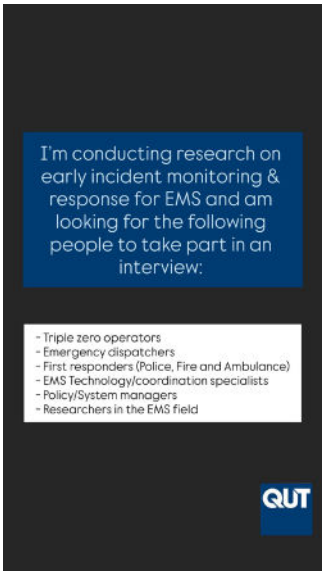
Appendix 2:
Drone Survey Recruitment - LinkedIn

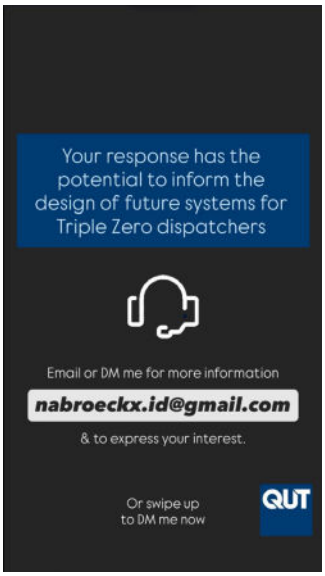


Appendix 3:

EMS Recruitment Post - Instagram/Facebook

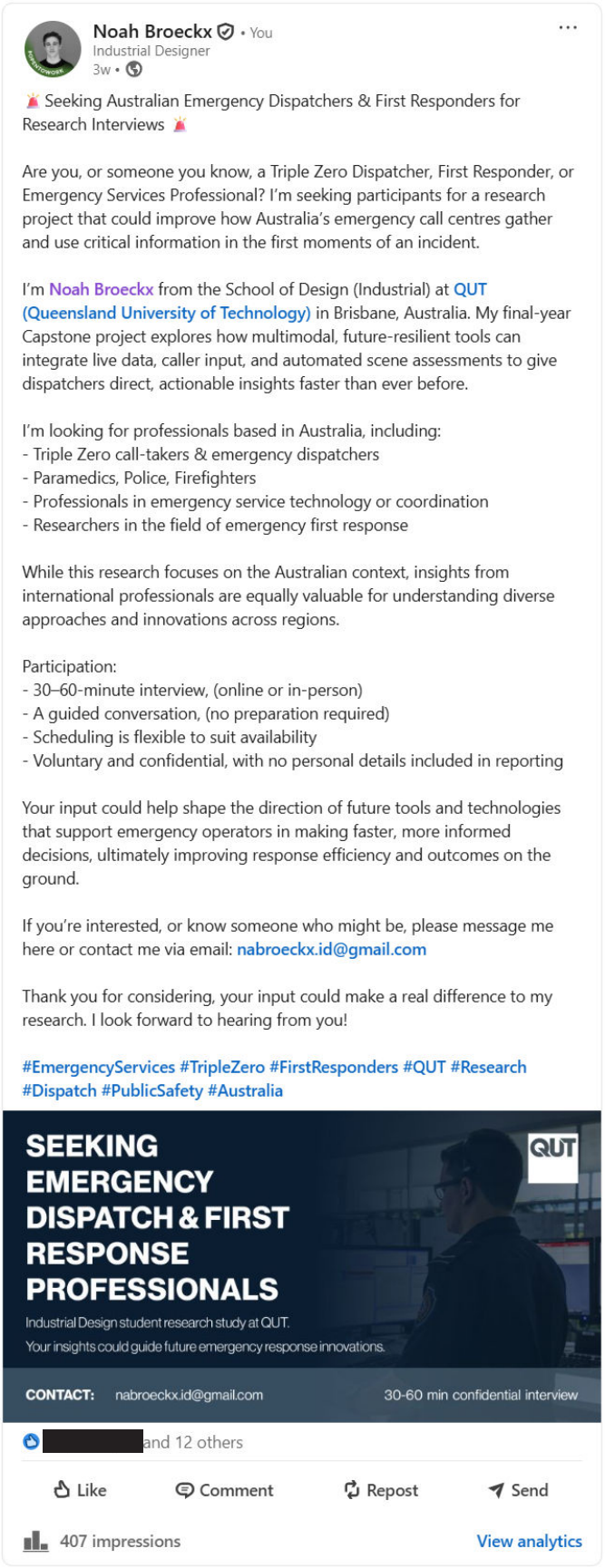






Appendix 4:

EMS Recruitment Post - LinkedIn



Noah Broeckx • You
Industrial Designer
3w •

🚨 Seeking Australian Emergency Dispatchers & First Responders for Research Interviews 🚨

Are you, or someone you know, a Triple Zero Dispatcher, First Responder, or Emergency Services Professional? I'm seeking participants for a research project that could improve how Australia's emergency call centres gather and use critical information in the first moments of an incident.

I'm Noah Broeckx from the School of Design (Industrial) at QUT (Queensland University of Technology) in Brisbane, Australia. My final-year Capstone project explores how multimodal, future-resilient tools can integrate live data, caller input, and automated scene assessments to give dispatchers direct, actionable insights faster than ever before.

I'm looking for professionals based in Australia, including:
- Triple Zero call-takers & emergency dispatchers
- Paramedics, Police, Firefighters
- Professionals in emergency service technology or coordination
- Researchers in the field of emergency first response

While this research focuses on the Australian context, insights from international professionals are equally valuable for understanding diverse approaches and innovations across regions.

Participation:
- 30–60-minute interview, (online or in-person)
- A guided conversation, (no preparation required)
- Scheduling is flexible to suit availability
- Voluntary and confidential, with no personal details included in reporting

Your input could help shape the direction of future tools and technologies that support emergency operators in making faster, more informed decisions, ultimately improving response efficiency and outcomes on the ground.

If you're interested, or know someone who might be, please message me here or contact me via email: nabroeckx.id@gmail.com

Thank you for considering, your input could make a real difference to my research. I look forward to hearing from you!

#EmergencyServices #TripleZero #FirstResponders #QUT #Research #Dispatch #PublicSafety #Australia

[redacted] and 12 others

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