Using Automatic Speech Recognition for Documenting Work in Municipal Emergency Operations Centers

Erik Borglund
Mid Sweden University
erik.borglund@miun.se

Martina Granholm
Mid Sweden University
martina.granholm@miun.se

Catrin Johansson
Mid Sweden University
catrin.johansson@miun.se

Peter Jonriksson
Mid Sweden University
peter.jonriksson@miun.se

ABSTRACT

Automatic speech recognition (ASR) and automatic documentation have not been widely explored in crisis management, despite their potential utility in facilitating the transcription of speech recordings. Although documentation is widely recognized as essential for creating a common operational picture, there is often a lack of such documentation, which can hinder understanding of events during and after a crisis. The novelty of the research is to apply existing technology and evaluate the potential of ASR technology in the domain of crisis management. We present preliminary results of using OpenAI Whisper for automatic transcription and documentation. In Phase 1, the ASR software was tested with existing recordings from previous research. In Phase 2, data was collected from recorded meetings during a tabletop exercise. The results indicate that transcripts, combined with other AI technologies, can provide valuable information and support for crisis and emergency management in Emergency Operation Centers.

Keywords

Automatic speech recognition, Crisis and emergency management, Command and control, Documentation, Document, Emergency operation center, documents

INTRODUCTION

During a crisis, the governmental authorities responsible will often activate temporal organizations, i.e. an Emergency Operation Centre (EOC) for emergency and crisis management and response. According to the Federal Emergency Management Agency (FEMA), an EOC is a physical or virtual location from which leaders of a jurisdiction or organization coordinate information and resources to support incident management activities (on-scene operations). An EOC serves as a coordination structure to collect, analyze, and share information; support resource needs and requests, including allocation and tracking; coordinate plans and determine current and future needs; and provide coordination and policy direction (FEMA - Emergency Management Institute, 2022). In this article, the concept EOC is used. However, we acknowledge that situation rooms, control rooms and operation rooms are often used as synonyms for EOC, sharing common characteristics due to their shared focus on maintaining an overview, supporting management, and responding to crises. Command and control work in EOC is meticulously documented in various forms. These documents and records, some of which are more fragile and temporal, while others are rather legally required, play a pivotal role in creating the common operational picture (COP) (Borglund, 2020). However, numerous instances highlight how the absence of documents obstructs understanding of what transpired during and after a crisis, emphasizing the critical need for comprehensive documentation. Previous research in this field has focused on the role that documents and records play in creating a common operational picture (Borglund et al., 2014; Borglund, 2011), showing that records from both internal and external organizations play a crucial role in establishing a common operational picture. The

common operational picture, on the other hand, is essential for decision-making during a crisis. Too often, no records are found after a major crisis. E.g. after Covid-19, in one large Swedish region, almost no records from command and control or similar work in emergency operation centers were found resulting in severe institutional amnesia (Borglund, 2024). During crisis, command and control work was documented similarly to street level-bureaucracy (Buvik, 2016), i.e. each actor in the EOC documented at their discretion, reflecting their individual interpretation of the legal room or space for action (Borglund, 2020).

The Swedish Civil Contingencies Agency (MSB) is the authority responsible for establishing the operational procedures that should be followed during a major crisis. They are also responsible for the robust radio network for emergency workers, as well as for two systems able to support documentation (RIB Lupp and WIS). Fourteen years ago, they published a research report on the need for documentation during large crises (Landgren, 2011). However, few public authorities adequately document their work during large crises and emergencies. Institutional amnesia during crisis management is particularly serious, especially if future decisions rely on historical knowledge (Stark, 2019). In Sweden, several major crises have been heavily criticized for a lack of documentation, making it nearly impossible to evaluate the work and analyze what transpired. In 2014, a large forest fire resulted in a significant aftermath where documents were found to be missing (Myndigheten för samhällsskydd och beredskap, 2016). For example, there was no evidence of all the volunteers who worked during the most intense weeks of the fire (Sperens, 2016). Four years later, another hot summer brought a total of 90 fires in Sweden, yet documentation remained insufficient (Statens offentliga utredningar, 2019). According to Stark (2024), some memory loss or amnesia may be beneficial, but it is still best to remember the past in order to reduce errors in the future.

Our research explores the possibility to use technology during crisis management to support agencies in their work with documentation. In this case we focus on Automated Speech Recognition (ASR). ASR is not a new technology, but in recent years, it has become more accessible to the public. The SIRI assistant on iPhone, Google assistant on Android, and Amazon Alexa all use different ASR technologies. O365 from Microsoft now includes Copilot as AI support in some of its distributions, but ASR has been embedded in O365 for many years. The accuracy of ASR has improved in recent years with the application of AI-based technologies like deep neural networks, and models have been trained on large volumes of text and spoken language[1]. In many commercial applications of ASR, voice is transformed into text, such as in research where transcribing interviews can be time-consuming (Draxler et al., 2020). Another application area is the police, where police interviews also take time to transcribe. More automated transcription saves significant effort (Harrington, 2023) as they use Google, Amazon and REV commercial ASR services. It has also been used in healthcare for automated transcription of hospital letters using 3M M*Modal speech-recognition software (Byrne, 2023).

Given the lack of documentation from crisis and emergency management in EOCs, we argue that ASR could serve as an alternative, providing automatic transcription and minutes for meetings and crisis and emergency management work in EOCs. For example, O365, using MS Teams and MS Copilot, can provide meeting summaries and minutes for meetings held in MS Teams[2]. We searched for research on the use of ASR technologies to automatically create documents during temporal crisis and emergency management, but the results were not relevant. We found research focusing on the use of ASR for automatic documentation during medical interviews (Falcetta et el., 2023). However, their systematic review also found that this field had almost no research, with a lack of clinical data on usability and benefits.

This research explores how OpenAI Whisper ASR technologies, together with OpenAI ChatGPT-4, can be used in crisis and emergency management work in Emergency Operation Centers, and whether these technologies can also provide documentation or other text-based resources. Noticeable is that the research is not aiming to develop and train a new model, rather to explore, use and evaluate technology freely available.

This paper presents preliminary findings from ongoing research aiming to evaluate the quality achievable using OpenAI Whisper for automatic transcription of crisis and emergency management work in EOC meetings. It also examines the quality of using ChatGPT-4 for summarizing large transcripts into usable documents based on discussions from the C2 meeting. I.e., the research is exploratory with an aim to contribute to crisis and emergency management work in Emergency Operation Centers. The novelty of the research is to apply existing technology and evaluate the potential of the ASR technology in the domain of emergency and crisis management in an exploratory way.

RELATED RESEARCH

[1] https://sonix.ai/resources/what-asr/
[2] https://learn.microsoft.com/en-us/microsoft-sales-copilot/generate-meeting-summary

This "work in progress" paper presents a brief summary of related research.

Speech recognition has a history dating back to the 1952, when Bell Labs made it possible to recognize digits over the phone. The models evolved, and in the 1970s, the Hidden Markov Model was introduced, using small sound pieces and statistics to determine the probability of a certain word. The next major step was using neural networks, followed by deep learning (O'Shaughnessy, 2008), machine learning, and, more recently, deep neural networks (Nassif et al., 2019). Automatic speech recognition also faces several challenges, including the vast number of languages and the difficulty of finding datasets suitable for training models (Malik et al., 2021).

In a study of ASR transcriptions, it was found that they differ dramatically from human transcriptions. When used for classification, performance results between ASR and human transcriptions are similar (Pentland et al., 2023) An example of this is in different interviews carried out by the police (Komter, 2022). In police work, ASR can be supportive but also present challenges in many cases, such as converting recordings (Gilbert & Heydon, 2021) and translating without the use of an interpreter (Lai, 2023). However, there are still challenges in performance (Harrington, 2023), and police interviews are sometimes conducted under noisy conditions (Mølnvik, 2024). Bajaj (2023) used ASR in combination with machine translation (MT) to reduce the risk of misunderstandings during pilot-controller communication. In firefighting, there is research where automatic speech translation has been used and tested on multinational first responders (Cambara et al.). Another example is when emergency calls are transcribed automatically (Thuestad & Grutle, 2023). The list of application areas in the field of emergency agencies is extensive, but the common theme in the literature is that voice-to-text technologies are used to save time and increase quality. An example is Tsujiguchi et al. (2023), who compared the time it took to create chronological records (CR) from handwritten information versus with recorded information. They found that the time difference was minimal for the trained staff, while the time savings were notable for untrained staff. This was partly due to the unfamiliarity with documenting CRs in the given format, but also a result of handwriting being difficult to decipher. Their experiment shows that AI can be used to create records, however, they did not evaluate automated documentation.

Outside the ASR field, Large Language Models (LLM) are still relatively new in crisis management. Some research has explored how LLM can be applied in emergency management (Jiang, 2024), while other studies argue that LLMs can improve emergency management (Otal & Canbaz, 2024). But Whisper has been applied as an ASR and tested on Swedish, showing potential time savings potential but also challenges with accuracy (Helin, 2024). The quality of transcriptions using Whisper can be improved by reducing noise in the original recording (Trabelsi et al., 2024). However, a major challenge for transcription quality is that Whisper has not been trained on languages of certain origins (Fuckner et al., 2023).

METHOD

In this paper, the overall design of the research is explained, including the data collection and the technologies used, though as a work in progress, the paper does not cover everything. The preliminary findings are presented as results. The research consists of two phases, which are described in chronological order. Both phases apply a qualitative research approach (Creswell, 2013) as the result is not measured using metrics, and the quality of the transcripts will not be analyzed quantitatively, such as with mathematical measures. The research is carried out by four researchers with expertise in information management, command and control, and crisis communication.

Phase 1

Phase 1 involves an initial test of the technology, including the installation of the Automated Speech Recognition transcription software. We have used OpenAI Whisper, which has been installed as a standalone application on a Windows PC. Instructions for installing Whisper are available in many versions, and we used this tutorial to install whisper locally[3]. Whisper has been trained on more than 680,000 hours of speech[4]. Phase 1 also includes the design of Phase 2. To test OpenAI Whisper on a Windows PC, we first used short recordings from meetings in our university department. OpenAI Whisper transcribed the recordings, and then ChatGPT-4 was used to summarize the transcription, identify the key points, and learn how to best draft the meeting minutes. The ChatGPT-4 service used in this research was the service provided by Mid Sweden University. Both the transcriptions and the output from ChatGPT were analyzed with a focus on the following: a) the quality of the transcript, i.e. how well the transcription matched the recording of the meeting; b) how well ChatGPT captured the essence of the meeting and produce a credible record. The transcript and how well ChatGPT was capturing the essence was not measured or analyzed statistically. The primary purpose of the analysis was to determine whether the setup would be worth testing in Phase 2. During step b, the goal was also to test different ways of

[3] https://youtu.be/ABFqbY_rmEk?si=opP52W4oSmLBnWPn
[4] https://openai.com/index/whisper/

writing GPT prompts for our research purposes.

Secondly, we used recordings previously collected from the Tetra[5] radio communication during the large international collaborative exercise Barents Rescue 2019. During Barents Rescue 2019, the Swedish (Rakel), Norwegian (Nødnett), and Finish (Virve) Tetra networks were connected, which we studied. These recordings were selected because they contain language and vocabulary commonly used in a command-and-control situation. Both the transcriptions and the output from ChatGPT were analyzed similarly to step 1, i.e. without measuring the quality of the transcript, rather if the transcript could be understood. One criterion was to see whether OpenAI Whisper, and ChatGPT were trained to understand communication from an emergency and crisis management domain.

The purpose of Phase 1 was primarily to gather insights and inform the design of Phase 2. The findings from Phase 1 are summarized briefly below for clarity.

Phase 2

Phase 2 consists of a series of activities, some of which some have been completed, while others will be finalized in spring 2025. All activities are presented here.

First, based on the input from Phase 1, we decided on the technical setup and approach, i.e. we used OpenAI Whisper as an open-source automatic speech recognition (ASR) system to transcribe recordings from crisis and emergency management work in EOCs into different text files. Whisper was installed locally on computers used by the researchers. The text files were later uploaded to different AI chatbots, primarily OpenAI ChatGPT-4, but also Llama 3, which is a Large Language Model from Meta that can be used on standalone computers. One aim of this research is to explore what can be achieved with publicly available solutions without developing a custom solution. This means that the research was designed to use recordings, rather than a solution where Whisper transcribes the speech in real time.

Second, data was collected, which included a total of six recordings from two tabletop exercises for three municipalities, which we organized. In December, three municipalities were invited to MSB's Sandö[6] training facility. The three municipalities have a crisis organization that is activated during a large crisis, and, if needed, they will organize themselves and establish command and control. They were offered to participate in two shorter tabletop exercises (FEMA - Emergency Management Institute, 2003) in which we were going to record their work in the fictional EOC. When designing the research, we initially planned to use ChatGPT-4 but wanted to minimize the risk of sharing sensitive data, which is why we created a fully fictional scenario. An advantage of this was that we could use the same scenario for the three municipalities. The scenario was about a suspected sabotage on a water tower in the municipality *Allmänsta.* The representatives from the three municipalities were expected to act according to their roles in their municipality crisis organization. Each crisis organization was responsible for providing a basis for decision to the fictive head of Allmänsta municipality. The representatives were also asked to maintain their own documentation for use in Activity 4.

The scenario was divided into two parts, Part 1 started before lunch, and Part 2 after lunch. Each scenario lasted 90 minutes, during which we, as researchers, acted as participants and introduced new information throughout the duration. The representatives from the three municipalities were placed in separate rooms, each equipped with whiteboards, and large computer screens. When they started their work a voice recorder started recording all voice activity in the room and stored it in a raw format. After the two exercises, the recordings were processed in Audacity to minimize noise and other unwanted sounds[7].

Third, the recordings were transcribed using Whisper, and the files generated were shared amongst all researchers to accelerate the testing process and explore the potential of various generative AI tools. In this paper only preliminary findings from the use of ChatGPT-4 and other generative AI chatbots are presented.

Fourth, when the research has completed the explorative third step, the findings and documents produced will be presented to all three municipalities and the staff participating in the exercise. A longer group interview with each municipality will be carried out to capture the end-user perspective and the usability of the different documents that can be generated by this technology.

[5] Terrestrial Trunked Radio (TETRA) a European standard for trunked radio system. Originally designed for government agencies and emergency services (police, fire, ambulance)
[6] MSB Sandö refers to a training and education facility operated by Myndigheten för samhällsskydd och beredskap (MSB), which is the Swedish Civil Contingencies Agency. https://www.msb.se/sv/utbildning--ovning/msbs-utbildningsorter/sando/
[7] https://www.audacityteam.org/

RESULTS

The results will be presented thematically and contain descriptive parts to show what the researchers did and how the results were identified.

Phase 1 Results

OpenAI Whisper provides the following files after processing a sound file in the version we installed and used: Transcription Text File (.txt) – a plain text file containing the transcribed speech without timestamps; SubRip Subtitle File (.srt) – a subtitle file with timestamps, commonly used for video captions; WebVTT File (.vtt) – another subtitle format similar to .srt, but often used in web applications; JSON File (.json) – a structured file containing timestamps, confidence scores, and segment details.

From Phase 1, we found that the text file from Whisper was better than expected and that it was not difficult to understand the content of the recording using the text file. By using GPT-4, the raw text file served as the basis for summarizing the content. By using the *.SRT file we could prompt questions such as "how much time passed before this happened"? A crucial lesson from Phase 1 was the time aspect when using a standalone computer on which Whisper was running locally. It took at least as long as the recording itself when using Whisper. Noticeable was also that computers with separate graphic cards and a powerful GPU was quicker than if the GPU was embedded on the motherboard.

Phase 2 Results

The thematic headings represent the content and are not related to any analysis.

Speed, manual work, and quality of the raw material

The manual work involved removing noise and unwanted background sounds, along with the transcription using Whisper, took more time than the actual time of the recording. A factor of 1.5 x recording time is realistic. As this research aims to work with standard products and available ASR technologies the time needed for the preparation of the recording and producing the Whisper output files was expected.

At no point did the transcription process malfunction, nor did Whisper ever misidentify the language being spoken. This can be added manually, but it was never done. In emergency and crisis management work and in EOC settings, concepts and special words are used, and all recordings show that the majority of such words were detected by Whisper. The raw unmanipulated transcript in the text file from Whisper was readable. However, the structure of the document was less so, as can be seen in the example in Figure 1 from one of the text files (in Swedish). The transcripts need to be manually formatted to accurately represent what was actually said in the room.

```
1  Som kontinuiteter på den här salen.
2  Så är det någon som har strömmat någon annan dag?
3  Ja, det är en dator som har strömmat.
4  Nu är det [redacted] som fortsätter med spelet efter lunch.
5  Det nya inriktningsbeslutet.
6  Tretton av noll.
7  Vi vet fortfarande inte om och när vi får veta.
8  Så vi utgår ifrån att vi inte kan använda vattnet överhuvudtaget.
9  Klockan är tretton.
10 Och för tio minuter så meddelade polisen att förundersökningen och inbrottet i vattentornet har tagit sig över.
11 Säkerhetspolisen.
12 Så då pågår ju deras förundersökning.
13 Och sen får vi av uppdrag, fast det har vi redan fått i vårt första inriktningsbeslut.
14 Att planera för mer långsiktigt.
15 Men nu är det tydligt att vi i alla fall måste jobba i stab under helgen.
16 Och till 14.30 så har vi presenterat nytt reviderat inriktningsbeslut över kommunens arbete över helgen.
17 Inriktningsbeslut över kommunens arbete över helgen.
```

Figure 1. Raw text file from the Whisper transcription

What happened

All six raw text files were input into ChatGPT-4 asking what the transcript was about. The result was very interesting. As the recording of the exercise covered all that was spoken in the room from when the exercise started until it ended, this summary could also be used to analyze if the municipalities did what we expected in the exercise. In Figure 2 there is an example where the question is in English, but the transcript remained in Swedish.

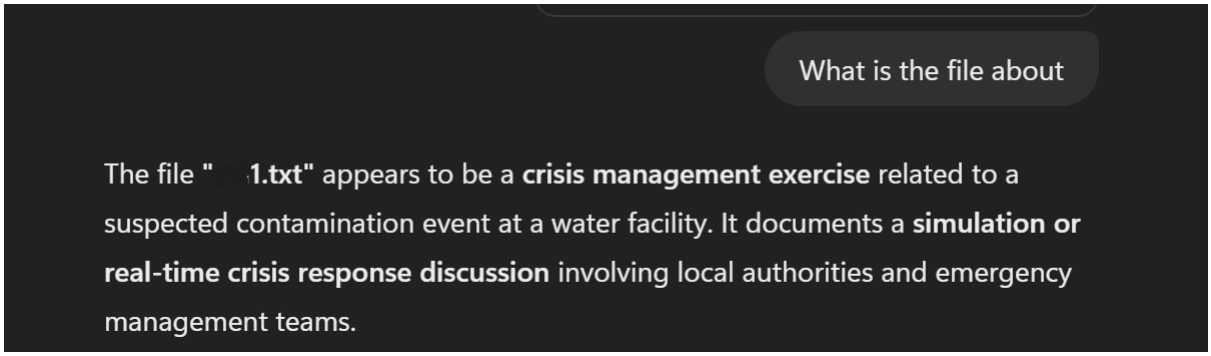

Figure 2. Example of the question "what is the file about"

The transcript could therefore help us understand and evaluate whether the municipalities actually did what was expected of them, without the need to be physically in the room observing. This finding was not expected and can be seen as a bonus.

Search for certain information

One important use of the documentation from the crisis and emergency management work in EOCs is to help find and recall important information discussed or raised during the work in the EOC. Many document what happens in a notebook, but without a common and shared documentation smaller information pieces could get lost. In this research, the story in the scenario included a witness living close to the water tower seeing a car driving away at high speed, the car was likely a Sedan. This detail is an example of information that can get lost in highly stressful situations.

Figure 3 presents a summary of how ChatGPT-4 can easily find and summarize this type of information. ChatGPT-4 has only analyzed the transcript from one of the municipalities in this excerpt. It is only the voice transcript from the EOC work that resulted in this text. The excerpt is in English as the prompting for this paper was in English. However, the original transcript was in Swedish, and the results were the same, based on the unaltered transcript provided by Whisper.

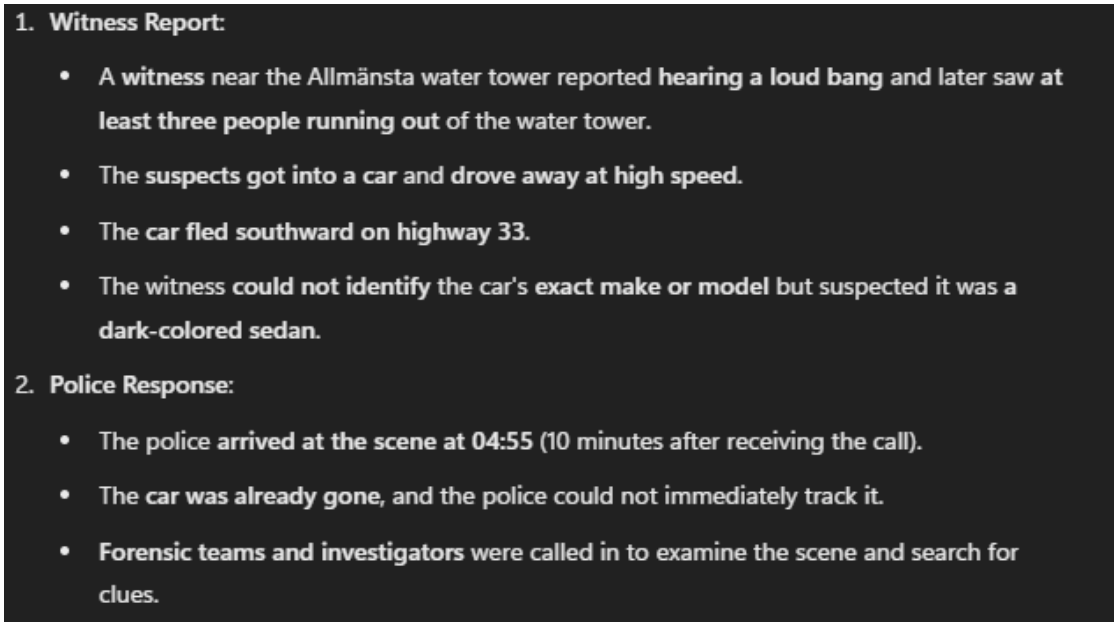

Figure 3. An excerpt from ChatGPT-4's response to the question about whether there was any information about a vehicle.

When, Where, and What

During large crises, knowledge of what happened and when specific tasks were carried out can be crucial for effective crisis management. Some of the output files from Whisper contain details about when certain information was mentioned and discussed in the recording. Originally these files were designed for subtitles, but they are also

useful for this purpose. Figure 4 shows excerpts of the results after prompting the question "after how long time did the municipality activate the "nödvatten" solution. "Nödvatten" is an emergency water solution, as the exercise scenario included a risk that the drinking water had been contaminated with harmful chemicals.

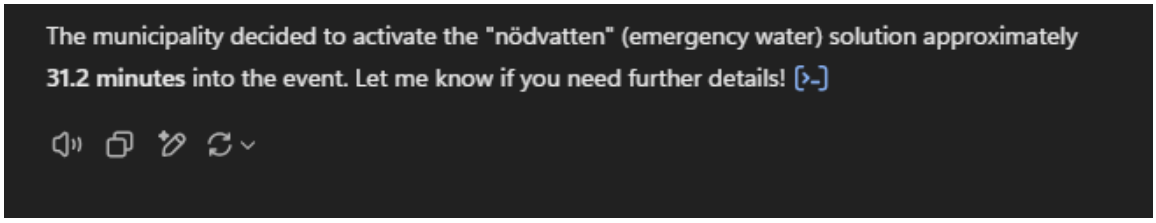

Figure 4. An excerpt from ChatGPT-4's response to a question about when something happened

Summary of the event

The quality of the transcription in all six exercises was such that ChatGPT-4 was able to summarize each one. It summarized what happened, decisions made, and identified questions raised. The summary of the six exercises contained all information that was given to the municipalities in writing during the exercise. The summary based on the transcript, closely matched what happened during the exercise and what the municipalities presented in the after-action review. As exercise leaders, we could see to what extent the municipalities had done what we expected of them. We could also very easily compare the three municipalities' different solutions based on the same scenario.

Contradictions and tracing changes in decisions

As the scenarios for the two exercises were based on each other, it was also a goal that the municipalities could change their decisions. By prompting questions about contradictions between documents and whether any decisions made in the documentation from Exercise One were changed in the document from Exercise Two, these changes could be detected. The excerpt in Figure 5 shows how ChatGPT-4 identified decisions that were made during the first exercise, and then changed in the second exercise.

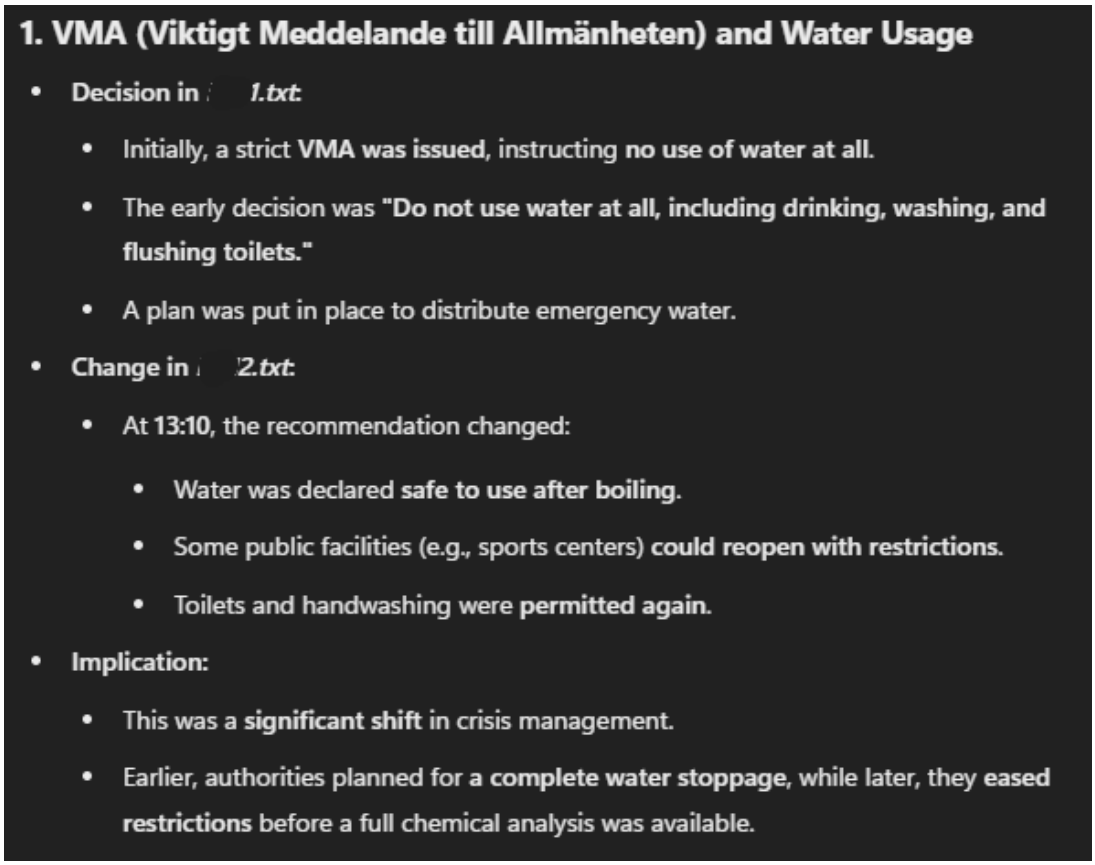

Figure 5. Excerpt where changes in decision are detected

DISCUSSIONS OF PRELIMINARY FINDINGS OF THIS RESEARCH

At this stage of the research, the only findings are the researchers' perspectives and an evaluation of how the outputs from a) Whisper and b) ChatGPT, along with similar chatbots, could enhance crisis and emergency management work in Emergency Operation Centers.

Details and quality

The transcription quality in its raw form exceed expectations. Compared to existing transcription tools available in O365 and in MS Word, the quality and Whisper's ability to detect even difficult Swedish words were surprisingly impressive. The raw text file contained all details of the conversation during the exercise and in the simulated command and control environment, making it possible to search the document for various purposes. The excerpt above, which shows a search for information about a car and how the municipality managed that information, is one such example of detail.

The need for minutes

Since everything said during the exercise was recorded, the raw text file could be challenging to format into something more readable. A transcript is just a transcript and not a set of minutes. Since the scenario in the tabletop exercises did not require the participating municipal EOCs to organize a formal meeting, there was no situation in which minutes would have been a natural outcome. ChatGPT-4, and Google Notebook summarized the raw transcripts with high precision and also presented the summaries in a structured format. As shown above, ChatGPT-4 could be prompted with questions to identify contradictions, and the results appeared promising.

To sum up, the need for minutes from this kind of work can be questioned. After discussions with the participating municipalities, we can assess whether the need is more for a summary of the event, help to detect anomalies, or assurance that the raw transcript from the event can be used when needed.

As a tool for tabletop exercises

The original purpose of this research was not to test the usefulness of the technology tested as support for running exercises. However, this research revealed the valuable insight of easily comparing different approaches taken by the three municipalities. As an educator and exercise facilitator, one challenge is that you can only be in one place at a time. Recording everything that was said during the exercise gave us a unique opportunity to compare different approaches as well as compare how differently the municipalities could interpret the same information. This is something that will be discussed with the municipalities later in this research and will be developed further.

Security and Risk Issues

It is, of course, highly relevant to discuss the potential risks of using open services for documenting crisis situations in an Emergency Operation Centre. In this specific research we have minimized the risk by providing the municipalities with a case where they acted as if they worked in the fictional municipality "Allmänsta", a fictive municipality that The Swedish Civil Contingencies Agency (MSB) have been using in their own training. It was important during this research that no municipality felt hesitant to share information about their own organization while using ChatGPT. OpenAI, on the other hand, was installed locally on a computer, so the risk of sharing sensitive information using Whisper was minimized. An alternative to ChatGPT is custom-developed chatbots, or another option is to use META Llama 3, an LLM, that can be downloaded and installed manually.

However, if this technology becomes widespread and standard in EOCs, it will likely be necessary to develop locally installed ASR systems and an internally developed chatbot.

SUMMARY AND NEXT STEP

These are the first results from ongoing research using publicly available ASR technologies alongside open AI chatbots to explore how these technologies could enhance the crisis and emergency management work in Emergency Operation Centers. The research includes a planned in-depth assessment of the usability of the technology tested with the end users, which is the three municipalities in this research. This step will be carried out in spring 2025, and the research will be completed in fall 2025.

The research shows that although the transcripts are far from perfect, they can, when combined with other AI technologies, provide valuable information and documentation for crisis and emergency management work in

Emergency Operation Centers.

REFERENCES

Bajaj, B. (2023). Risk communication: Experimenting with automatic speech recognition as the first step of a combined speech-to-text and machine translation tool for risk reduction during pilot–controller communications. In *The Routledge Handbook of Translation, Interpreting and Crisis* (pp. 403-417). Routledge.

Borglund, E. (2024). Institutional amnesia during large crisis: Effects of poor documentation. *ISCRAM Proceedings*, *21*.

Borglund, E., Landgren, J., & Lintzen, M. (2014). *Lägesbilder: Att skapa och analysera lägesbilder vid samhällsstörning [Common operational pictures: To create and analyze common operational pictures during large crisis]*. Myndigheten för samhällsskydd och beredskap.

Borglund, E. A. M. (2011). Records Role in Creating a Common Cperational Picture. In Judith Molka-Danielsen, H. W. Nicolajsen, & J. S. Persson (Eds.), *Selected Papers of the Information Systems Research Seminar in Scandinavia Nr. 1 (2010): IRIS 33 Engaged Scandinavian Research*. Tapir Academic Press

Borglund, E. A. M. (2020). Records-Making During Crisis Management – Rule Based or Discretion Driven? In A. Sundqvist, G. Berget, J. Nolin, & K. I. Skjerdingstad, *Sustainable Digital Communities* International Conference on Information, iConference 2020, Borås, Sweden.

Buvik, K. (2016). The hole in the doughnut: a study of police discretion in a nightlife setting. *Policing and Society*, *26*(7), 771-788. https://doi.org/10.1080/10439463.2014.989157

Byrne, A. (2023). Case study: automated transcription of hospital letters with 3M M*Modal speech-recognition software. *British Journal of Nursing*, *32*(Sup16b), S10-S15. https://doi.org/10.12968/bjon.2023.32.Sup16b.S10

Cambara, G., Grivolla, J., Farrus, M., & Wanner, L. Automatic Speech Translation for Multinational First Responder Teams.

Creswell, J. W. (2013). *Qualitative inquiry and research design : choosing among five approaches*. SAGE Publications.

Draxler, C., Van den Heuvel, H., Van Hessen, A., Calamai, S., & Corti, L. (2020). A CLARIN Transcription Portal for Interview Data. Proceedings of the Twelfth Language Resources and Evaluation Conference,

FEMA - Emergency Management Institute. (2003). *IS-139, Exercise Design*. Retrieved from http://training.fema.gov/EMIWeb/IS/is139.asp

FEMA - Emergency Management Institute. (2022). *Emergency Operations Center How-to Quick Reference Guide*. Retrieved from https://www.fema.gov/sites/default/files/documents/fema_eoc-quick-reference-guide.pdf

Fuckner, M., Horsman, S., Wiggers, P., & Janssen, I. (2023, 25-27 Oct. 2023). Uncovering Bias in ASR Systems: Evaluating Wav2vec2 and Whisper for Dutch speakers. 2023 International Conference on Speech Technology and Human-Computer Dialogue (SpeD),

Gilbert, D., & Heydon, G. (2021). Translated Transcripts From Covert Recordings Used for Evidence in Court: Issues of Reliability [Original Research]. *Frontiers in Communication*, *6*. https://doi.org/10.3389/fcomm.2021.779227

Harrington, L. (2023). Incorporating automatic speech recognition methods into the transcription of police-suspect interviews: factors affecting automatic performance [Original Research]. *Frontiers in Communication*, *8*. https://doi.org/10.3389/fcomm.2023.1165233

Helin, M. (2024). *Evaluating the Accuracy of Automated Transcription using Open AI's Whisper Model for Swedish IT-Related Interviews : A Comparative Analysis with Manual Transcription* [Student thesis, DiVA. http://urn.kb.se/resolve?urn=urn:nbn:se:du-49741

Jiang, Y. (2024, 24-26 May 2024). The Applications of Large Language Models in Emergency Management. 2024 IEEE 6th Advanced Information Management, Communicates, Electronic and Automation Control Conference (IMCEC),

Komter, M. (2022). Institutional and Academic Transcripts of Police Interrogations [Original Research]. *Frontiers in Communication*, *7*. https://doi.org/10.3389/fcomm.2022.797145

Lai, M. (2023). Transcribing and translating forensic speech evidence containing foreign languages—An Australian perspective [Original Research]. *Frontiers in Communication*, *8*. https://doi.org/10.3389/fcomm.2023.1096639

Landgren, J. (2011). *"Glöm inte dokumentera!" Hantering av dokumentation vid krishantering*. (MSB 315). MSB

Malik, M., Malik, M. K., Mehmood, K., & Makhdoom, I. (2021). Automatic speech recognition: a survey. *Multimedia Tools and Applications*, *80*(6), 9411-9457. https://doi.org/10.1007/s11042-020-10073-7

Myndigheten för samhällsskydd och beredskap. (2016). *Ansvar, samverkan, handling : åtgärder för stärkt krisberedskap utifrån erfarenheterna från skogsbranden i Västmanland 2014 [Responsibility, collaboration, action: measures for enhanced crisis preparedness based on the experience of the forest fire in Västmanland 2014]*. Myndigheten för samhällsskydd och beredskap.

Mølnvik, K. (2024). *Automatic Speech Recognition (ASR) Performance in Noisy Conditions; A Study on Norwegian Police Interviews* NTNU].

Nassif, A. B., Shahin, I., Attili, I., Azzeh, M., & Shaalan, K. (2019). Speech Recognition Using Deep Neural Networks: A Systematic Review. *IEEE Access*, *7*, 19143-19165. https://doi.org/10.1109/ACCESS.2019.2896880

O'Shaughnessy, D. (2008). Invited paper: Automatic speech recognition: History, methods and challenges. *Pattern Recognition*, *41*(10), 2965-2979. https://doi.org/https://doi.org/10.1016/j.patcog.2008.05.008

Otal, H. T., & Canbaz, M. A. (2024, 14-15 May 2024). AI-Powered Crisis Response: Streamlining Emergency Management with LLMs. 2024 IEEE World Forum on Public Safety Technology (WFPST),

Pentland, S. J., Fuller, C. M., Spitzley, L. A., & Twitchell, D. P. (2023). Does accuracy matter? Methodological considerations when using automated speech-to-text for social science research. *International Journal of Social Research Methodology*, *26*(6), 661-677. https://doi.org/10.1080/13645579.2022.2087849

Sperens, H. (2016). *Dokumenthantering gällande frivilligpersonals insatser vid extraordinära händelser. : Vilka problem fanns med dokumenthantering vid skogsbranden i Västmanland 2014 och finns det lösningar?* [Student thesis, DiVA. http://urn.kb.se/resolve?urn=urn:nbn:se:miun:diva-28671

Stark, A. (2019). Institutional Amnesia and Crisis Management Analysis. In: Oxford University Press.

Stark, A. (2024). Institutional Amnesia in Government: How much is enough? *Policy Quarterly*, *20*(1), 3-9.

Statens offentliga utredningar. (2019). *Skogsbränderna sommaren 2018:Betänkande av 2018 års skogsbrandsutredning SOU 2019:7*. Stockholm Statens offentliga utredningar

Thuestad, J. A., & Grutle, Ø. (2023). *Speech-to-text models to transcribe emergency calls* The University of Bergen].

Trabelsi, A., Werey, L., Warichet, S., & Helbert, E. (2024). Is Noise Reduction Improving Open-Source ASR Transcription Engines Quality? ICAART (3),

Tsujiguchi, T., Imai, M., Kimura, S., Koiwa, T., Naraoka, M., Hanada, H., Yamanouchi, K., Kashiwakura, I., & Ito, K. (2023). Development of an Automatic Chronological Record Creation System Using Voice AI to Facilitate Information Aggregation and Sharing in the Event of a Disaster. *Disaster Medicine and Public Health Preparedness*, *17*, e560, Article e560. https://doi.org/10.1017/dmp.2023.216