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Collaborative Sensemaking in Crisis : Designing Practices and Platforms for Resilience

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Abstract

The COVID-19 pandemic exemplified the complexity of the field of crisis communication, with multiple channels and streams of information and misinformation causing new challenges for the authorities and general public alike. This complexity requires better addressing the situated and interrelated aspects of sensemaking practices and platforms, and how different disciplines and organisations collaborate during a crisis to turn ambiguity into resilience, and complexity into comprehension. We use design research and participatory design methodology to draw on learnings from the Finnish context and response to COVID-19 and other crises. These insights are then used to create design principles that bridge crisis informatics theory with HCI knowledge to create speculative, diegetic artefacts, which embody new practices and platforms that can be used to encourage collaborative sensemaking to tackle complex, large-scale crises and therefore have a positive impact on the resilience of the society.

Authors Keywords

Crisis; Design Research; Collaborative; Sensemaking; Digital platforms

CSS Concepts

•Human-centered computing~Collaborative and social computing~Collaborative and social computing theory, concepts and paradigms~Computer supported cooperative work

INTRODUCTION

The COVID-19 pandemic shaped an all pervasive crisis that affected every minute aspect of our lives; a novel period where sensemaking was as critical as it was difficult to achieve [5]. It revealed how complex crisis communication can be, navigating the seemingly infinite digital realm of multiple websites of the authorities, media companies and social media platforms. Various channels of information, misinformation and disinformation, combined with the timely nature of the matter causes new challenges for the general public and civic authorities, among others, especially in the public health domain.

Public authorities and elected leaders are looked to by the general public for situational information, policy guidance, resource availability, and mitigation measures, especially in times of a crisis [29]. As a crisis evolves, public information demands often change dynamically [36]. This requires authorities to be able to adapt their communication strategies across different timeframes and contexts to consistently meet public demand for updated information [1]. Immediate access to information online as well as the widespread use of social media has increased citizens' expectation of the government to be flexible and dynamic in their crisis communication.

As online communication is by nature two-way communication, the authorities are often required to respond to discussions where the general public aims to understand the situation. Before communicating, however, the authorities themselves must understand and interpret the situation. This process can be called sensemaking, where sense is made at a particular point in time and space and therefore the people are mandated to anchor themselves in their histories and frameworks [10]. It is an important function of maintaining normality, especially in the context of health [14]. Collaborative sensemaking helps build resilience in uncertain situations such as crises, where communication forms the basis for reducing uncertainty in communities [27].

More social and ecological interpretations of resilience take into account interactions between individuals, their community, and their environment as developmental assets [31,32]. Dynamic interactions between the sources of risk and resilience in societal or institutional contexts of crisis are also affected by cultural and contextual factors; which adds to the complexity of the situation.

This paper makes two contributions to fields of designing and crisis informatics: Firstly, we present how participatory design methodology and research through design approach can lead to a greater understanding of practices and practices from complex fields such as crisis communication. Our second contribution comes in the form of speculative, diegetic artefacts that embody insights and principles from our research. These artefacts act as a speculative bridge between crisis informatics and management theory and HCI and service design concepts.

In the following, we start with a review of existing work related to designing for sensemaking in crisis. We look at the relevance of our research in the public health domain within the Finnish context. Subsequently, we present the insights from the participatory design workshops, which lead to design principles, which expand on the different facets of designing for collaborative sense-making. We conclude with the diegetic artefacts to manifest and concretize the ideas.

I. CONTEXT

How can we facilitate collaborative sensemaking in times of immense complexity; in a highly regulatory landscape of organisational complexity?

II. DESIGN RESEARCH

Will a collaborative, data-based platform allow health communication experts to more effectively make sense of the varied narratives that emerge during a crisis?

III. DESIGN PRINCIPLES

How can design methodology and crisis management theory combine to create more resilient public organisations?

IV. DIEGETIC ARTEFACTS

How can diegetic artefacts formed from design principles create new visions of sensemaking practices?

I. CONTEXT

## Public crisis leadership in Finland

International and national crisis communication can be conceptualised by looking at the roles of the authorities and citizens as senders and receivers of information. Operations in each field require different approaches and strategies but are also interlinked: action in one affects the situation in others.

Finland, as a result of its geopolitical location, has historically been in the forefront of preparedness due to both environmental and military threats. The National Emergency Supply Agency [37] is responsible for maintaining strategic reserves and preparedness. Resilience, the capacity to stand crises is broadly discussed and followed in the Finnish national policy-making and the authorities with other organisations of the society are regularly exercising ways to respond to different kinds of crises, from nuclear accidents to environmental disasters such as an oil spill in the Baltic Sea. It can be said that in Finland there is a strong safety and emergency preparedness culture and existing organisations and infrastructure for crisis management constructed around a comprehensive security model (CSM) [33].

The strategies for crisis management and communication, however, are in large part designed for a world with a more centralised media landscape, where media companies in collaboration with the authorities were able to share information with the citizens/public (A2C). According to the 2019 statistics, about 70 percent of the Finnish population aged 18 to 64 participated in social networks [6]. This means that today the weight in crisis communication is more in the fields of Citizens to Citizens (C2C) and Citizens to Authorities (C2A) than ever before. Simultaneously, this causes challenges in the Authorities to Authorities (A2A) communications. For this research we identified as one of the main research gaps the A2A communication, but also recognized its connections to other fields of crisis communications. Therefore we recruited health care communication experts and journalists to take part in the participatory design workshops. The communication experts came from different organisations with different practices, experiences and responsibilities related to communication in crises. The journalists, as the servants of the public, were representing the common interest.

Within the COVID-19 pandemic many people in Finland felt that the instructions and regulations set by the authorities were unclear. The situation was further complicated by the ongoing reform of social welfare and rescue services. The authorities were also arguing on the legality of each other's decisions. For instance, in the early stage of the pandemic the government decided to lock out the southern region from all travelling in and out from the other parts of the country. Later the Ministry of Justice found the closure of southern Finland to be against the constitutional right of people's free movement. This resulted in the ending of the lock out.
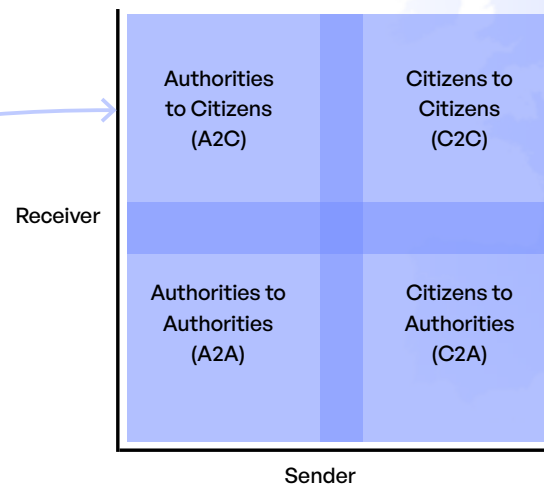
Classification matrix for social software use in crisis management [1]

Sensemaking and Design

Pirolli and Card [24] describe sensemaking as broadly involving two interconnected loops of activity. The first involves information foraging, which seeks, filters and extracts information, while the second concerns sensemaking, which involves the construction of the mental model that best fits the evidence. Many information visualisation tools are designed to address the information filtration and extraction aspect, but don't provide enough support or context for sensemaking activities [4].

A research gap related to sensemaking in Finland we focus on unpacks the increasing number of digital tools designed for crisis management and communication, which seek to aid in access to data and information, but don't account for what the user should do with the data and the information. We see this gap further affecting the resilience of people, organisations and nations during a crisis. Sensemaking creates the context for greater resilience [18], whereby the conditions to "bounce back" are created due to a more holistic understanding of the situation.

We follow a research-based design approach [21] to conduct contextual inquiry, participatory design, and product design in the field of crisis communication and sensemaking. The aim in the research is to understand the people who are considered to be the primary beneficiary of the designed service and/or tool(s) [12]. We aim to understand these people's needs, why they behave as they do, to explore possible computational tools and services and to find meaningful interaction for people with the service and the tools. We carry out this exploration with participants from different domains of expertise and stakes in crisis communication/action in the tradition of Scandinavian participatory design [3]. This way the design research aims not only to make improvements in the existing designs, concepts, products or services but to present new concepts, ways of working and services.

Sensemaking and Crises

While sensemaking as an activity is important, given the complexity of a crisis, collaborative sensemaking is imperative for cross-disciplinary understanding of a crisis [19]. Crisis such as COVID-19 showed the complexity of information collected and narratives formed led to calls for better addressing the situated and interrelated aspects of sensemaking practices and platforms [5]. Collaborative sensemaking requires not only multiple, complex sources of information, but also varied perspectives and expertise to make sense of this data [23]. Design of systems that facilitate collaborative sensemaking requires attributes such as creating common ground, communication, hand-offs and coordination [23].

Crisis Informatics (CI) refers to a branch of human-computer interaction research that is informed by crisis and disaster sociology [8], which looks at how information systems and socio-behavioral phenomena are interconnected with disasters [28]. Crisis informatics as a field offers an opportunity to utilise the sheer amount of information required for crisis management for more appropriate decision making. However, an overload of data in crisis situations can lead to information overload by decision makers [16]. Given the time constraints in an emergency situation, communication experts and decision makers are left paralysed, rather than empowered with the information. Systematically integrating news and social media into crisis awareness, communication and sensemaking presents many challenges, in particular due to the massive volume, speed and diverse sources of social media streams emerging during disaster events across multiple platforms such as Twitter, Facebook, Snapchat, Instagram and WhatsApp [25]. Many researchers have been developing computational techniques to automatically process such high-volume social media streams, identify relevant information, and prioritize credible alerts to disseminate in real-time, using machine learning [17]. Most of these systems have not currently been incorporated into the work practices of emergency responders or crisis communication professionals as they don't critically handle the context and complexity of the unfolding crisis events nor allow stakeholders to transform situational awareness into collaborative sensemaking [26].

The aim of combining sensemaking and crisis informatics is to ensure that the information can become an actionable resource [34]. In the context of Finland, we noticed that there is a research gap in understanding how sensemaking could be a democratic and a collective process.

HCI and CSCW have a long history of using participatory, critical, speculative, and values-sensitive design to create a strong foundation on which we process and communicate information about a crisis [28]. Previous work in related fields reveal the differences between interfaces for individual and collaborative sensemaking [22], with the challenges in designing for asynchronous information contextualisation across different groups of people causing a lack of common ground of understanding.

Designing for sensemaking can create the conditions for greater resilience in times of crisis.

II. DESIGN RESEARCH

In the design research we have generally followed the research-based design approach [21]. At first, based on literature and interviews we have mapped the landscape we are doing research on and designing for. In the contextual inquiry stage we defined the main beneficiaries to be the communication experts in the public sector responsible for communicating on the crises related topics. In the participatory design workshops we gained deeper understanding of the people and their work and were able to present our early and then more elaborated ideas and prototypes developed in the Product Design stage. This way in the following workshops we were looping back from the Product Design phase back to Participatory Design. Naturally, we were also looping back to contextual inquiry, as both phases were providing us with a better understanding of the broader context.

In our contextual inquiry we recognized trends indicating that the current pandemic is not the last health crisis and we must be well prepared for future pandemics. Another trend highlighted that in managing crises, collaborative digital tools and services may play a more important role. Furthermore, we observed that engaging with social media interactions plays a growing role in crisis communications; hence in part related to this communication professionals working in local healthcare municipalities are crucial actors. We also engaged other stakeholders involved in public sensemaking processes. As a preliminary design challenge we examined the current communication practices of healthcare professionals working on the frontline. We noticed that they were rather alone in their work, struggling to make sense of the situation in different times of crises.

CONTEXTUAL INQUIRY

PARTICIPATORY DESIGN

We conducted 4 participatory design workshops and multiple interviews with communication experts across regional and national health agencies across Finland. Based on them, a platform was conceptualised with the coronavirus pandemic as its primary "crisis" or scenario of use.

PRODUCT DESIGN

The platform was designed as a "mental prototype" or artefact based on the earlier research conducted in the form of interviews and workshops. The aim was to better define and visualise the use cases and basic interaction. The prototype was intended as a manifestation of the user stories, and needs, rather than an actual solution. A complete look at the prototype can be found on the next page.

SOFTWARE PROTOTYPE AS HYPOTHESIS

The prototype also served as a "hypothesis", whereby we asked the question; **"Will a collaborative, data-based platform allow health communication experts to more effectively make sense of the varied narratives that emerge during a crisis?".**
The fourth participatory design workshop that followed the "software prototype as hypothesis" stage of the research-based design process aimed to use the prototype as a probe, to better understand the approach taken by crisis management and communication experts in sensemaking during crises. A scenario based workshop, the prototype was intended to actualise concepts around sensemaking in a familiar setting of a crisis, which might have otherwise been abstract or vague to those unfamiliar with the term.
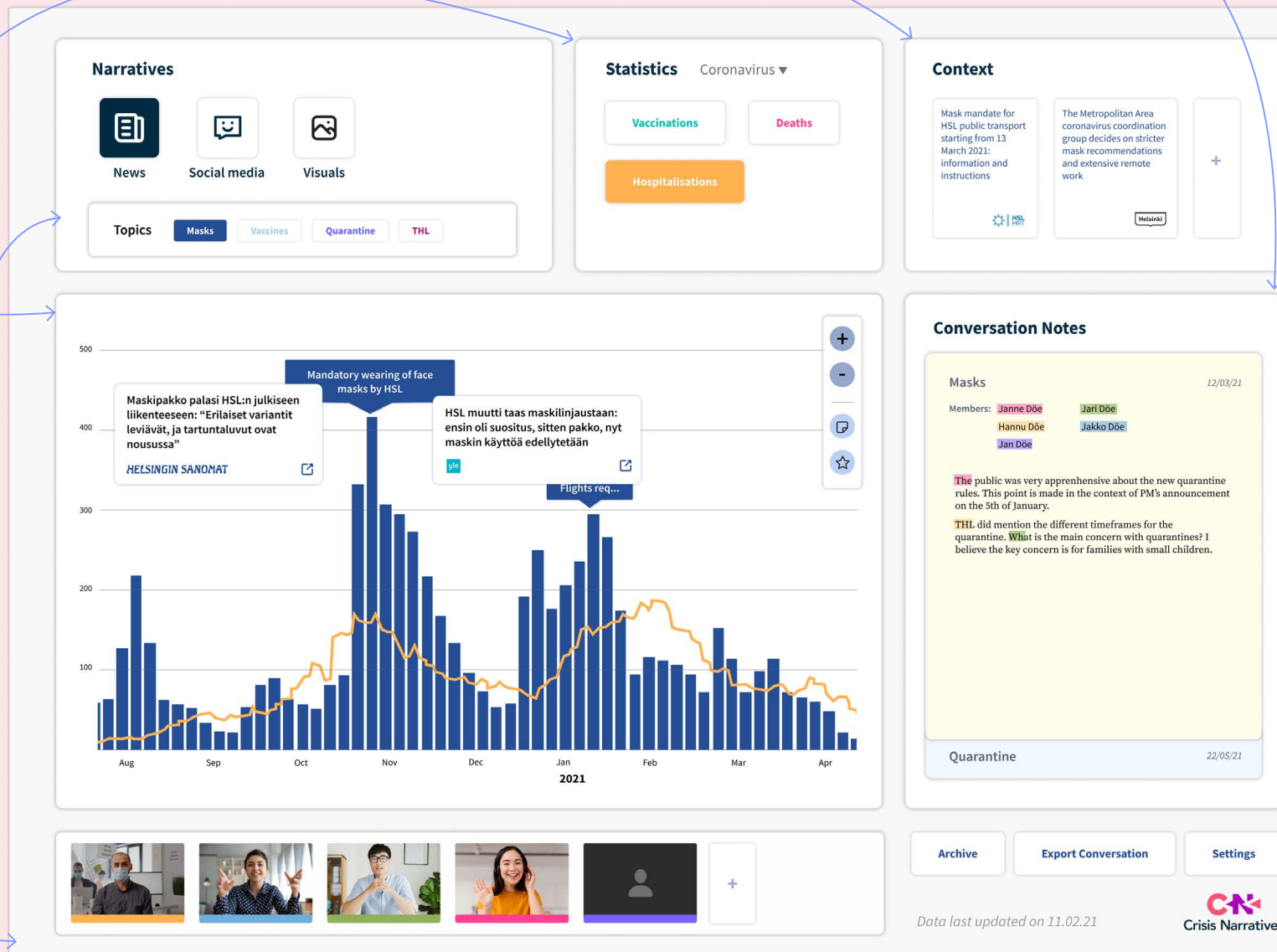
Prototype

The prototype was used as a probe in a scenario-based workshop, where the participants were asked to use the tool to navigate a fictional crisis of a nuclear meltdown. The workshop was conducted primarily online over Zoom. Additionally, Miro was used as a presentation/whiteboarding platform, to allow the facilitators and participants to take notes and record any information. Useberry was used to record participants' interaction with the platform over Figma.

The largest area of the interface was devoted to a "timeline", where the expert could view a temporal overlay of the qualitative narratives and the quantitative statistics relating to the crisis. The narratives included data from news media and social media, while statistics were relevant numbers that gave a layer of context to the narratives. Both types of information could be controlled with various options to overlay different topics, figures, and graphs on the timeline, allowing the expert to easily find correlations between the quantitative and qualitative. Key moments were chosen on the timeline to represent various "hot topics" during different periods of the crisis. For example, news media coverage of public transport authorities mandating the wearing of masks. Being a tool for collaborative sensemaking, inbuilt video conferencing was considered as well.

History and context of a situation is vital to well informed sensemaking; thus a section for related documentation and press releases by public organisations provides context to news coverage and social media trends.

Finally, conversation notes as a means of annotating the data and recording important insights that experts from different sectors using the platform come up with together. These can then be exported and shared.

Narratives

| News | Social media | Visuals |

Topics: Masks | Vaccines | Quarantine | THL

Statistics Coronavirus ▾

Vaccinations | Deaths | Hospitalisations

Context

Mask mandate for HSL public transport starting from 13 March 2021: information and instructions

The Metropolitan Area coronavirus coordination group decides on stricter mask recommendations and extensive remote work

Mandatory wearing of face masks by HSL

Maskipakko palasi HSL:n julkiseen liikenteeseen: "Erilaiset variantit leviävät, ja tartuntaluvut ovat nousussa"
HELSINGIN SANOMAT

HSL muutti taas maskilinjaustaan: ensin oli suositus, sitten pakko, nyt maskin käyttöä edellytetään
yle

Flights req...

Aug — Sep — Oct — Nov — Dec — Jan — Feb — Mar — Apr
2021

Conversation Notes

Masks   12/03/21

Members: Janne Döe | Jari Döe | Hannu Döe | Jakko Döe | Jan Döe

The public was very apprehensive about the new quarantine rules. This point is made in the context of PM's announcement on the 5th of January.

THL did mention the different timeframes for the quarantine. What is the main concern with quarantines? I believe the key concern is for families with small children.

Quarantine   22/05/21

Archive | Export Conversation | Settings

Data last updated on 11.02.21

Crisis Narratives

Workshops

The participants were public servants (primarily health communication experts) from regional administrative and state health agencies that were directly involved in COVID-19 pandemic. We also engaged other stakeholders in public sensemaking processes such as journalists, and people working in the media.

In the first two workshops, we tried to understand the major pain points of the stakeholders, with regards to their context, practices and tools. This helped us define the problem better, and we used the third workshop as a means of ideating solutions together with our stakeholders. In the fourth workshop, we presented a prototype that represented the ideas shared in the previous workshops in a scenario based workshop.

4 total workshops   16 workshop participants

1	**Contextual Inquiry Workshop**	Participants from **YLE, THL, AVI, Regional Hospital**
2	**Contextual Inquiry Workshop**	Participants from **Head of communications at southern Finland's AVI, communications at Social Services, SOTE, Journalist / TV-host**
3	**Participatory Design Workshop**	Participants from **Social media analyst, communications at TRAFI, AVI, THL**
4	**Participatory Design Workshop**	Participants from **communications at AVI, THL, LVM**

YLE- Finnish Broadcasting Company

THL- Finnish institute for Health and Welfare

AVI- Regional State Administrative Agency

LVM- Ministry of Transport and communications

SOTE- Health Care and Rescue Services Division

TRAFI- Finnish Transport Safety Agency

Analysis

From our workshops and interviews, the varied perspectives from participants allowed us to understand different aspects of the crisis management in public sector organisations. Some key insights from our research included:

Secure Intranet for cross-organisational communication: During an all encompassing crisis like COVID-19, several different national and regional organisations were involved. Security being an important aspect of communication and sharing data, these organisations usually worked in silo's due to a lack of a compatible cross-organisational tool. There was a clear need for a secure platform for sharing data.

Informal, accessible tools for communication: The medium of email as the primary form of communication presented a level of formality that prevented sensemaking as an engaging, collaborative activity. Several suggestions for 'chat groups' on secure platforms such as Signal were noted, with the possibility of sharing trusted news, questions and best practices. It was noted that the participants spoke of the importance of this 'community of communication experts' that predated a crisis, such that these channels were already thriving during a crisis.

Movement of actionable information: A severe gap during the COVID crisis was the lack of good, presentable data for communication experts which could be used for influencing decision makers higher up in the organisational hierarchy.

Regular Feedback Mechanisms: Communication experts are unable to zoom out from day to day activities and evaluate their own practices and understanding often enough. While our interviews reflect that retrospective work is important, the daily demands restrict it to a few moments per year.

Sensemaking of the government, by the government: Another recurring theme was of the need for analysis and sensemaking, not only of social media and news discourses, but also of other authorities' decisions and press releases. This was important due to the lack of a common platform for communication.

III. DESIGN PRINCIPLES

The insights from the participants were then combined with Crisis Management theory to create design principles. Design principles can be thought of as codified knowledge that aids the design process in reaching a successful solution [13]. We use design principles as a mechanism for creating bridging concepts [9] between crisis management and HCI theory with our design-based practice and research. These concepts were domain agnostic, so as to not influence the solution towards a technological or organisational solution; but rather allowing it to emerge on its own. These design principles expand existing concepts of usability, accessibility etc, within the context of collaborative sensemaking in crisis.

In the following section, we present three diegetic artefacts as a means of manifesting the design principles. While we present these principles as

grounded concepts that can be used to develop platforms for collaborative sensemaking that facilitate more resilient crisis communication, we also use them as entry points for presenting more speculative outcomes. These speculative outcomes do not necessarily "solve" the issues [11], but rather provide examples for collaborative action that engage the civil society in the different elements of sensemaking. The outcomes presented are a blend of participant and designer views; seemingly mundane articulations, ideas and speculations in workshops and interviews have been delved into and converted into visions for alternative practices which utilise existing and near future technologies in different ideologies or configurations [2] to current ways of sensemaking. The quotes are not real, but rather an amalgamated representation of different voices we heard during the participatory design phase of our research.

DESIGN PRINCIPLES

DESIGN PRINCIPLES		DIEGETIC ARTEFACTS
Focus on situational awareness Holistic design of ancillary services	**Sensemaking as a tool**	Platforms for collaborative sensemaking
Technology/Solution should leverage existing, pre-crisis tools or practices Solution must be cross-departmental	**Sensemaking as a practice**	Sensemaking hackathons
Addressing actionable information The solution must have a public facing component	**Sensemaking as public engagement**	Citizen-centred collaborative sensemaking

IV. ARTEFACTS

DESIGN PRINCIPLE #1
Focus on situational awareness

In the field of Crisis Informatics and management, Situational awareness refers to the perception and understanding of a crisis situation in real-time. It helps decision-makers to understand the nature of the crisis and respond to it in an effective and timely manner [7]. By having accurate and up-to-date information about the situation, crisis managers can make informed decisions on how to allocate resources, mobilise response teams, and communicate with the public. Thus, a key aspect of any crisis management tool should be to increase SA. This could be done by gathering information from various sources such as social media and news outlets, and then filtering out which information is accurate and actionable.

DESIGN PRINCIPLE #2
Holistic design of ancillary services

An effective crisis management tool or practice is rendered useless if ancillary tools are not user-friendly. For example, during the pandemic, recommended working practices and organisational duties, while documented, were not easily accessible and understood. While the tools and practices existed, the lack of accessibility and poor design of the same caused the relevant tools and practices to be neglected. They should be easily searchable, indexed and understandable for even a new employee to hit the ground running.

"Now we know why there's a rise in cases in Helsinki; it was a combination of Finnair's new policy and the nurses' strike"

DIEGETIC ARTEFACT #1

Sensemaking as a tool

Platforms for collaborative sensemaking

More than a database or dashboard, the platform becomes part of the key tool for crisis communication experts, being a bridge between different forms of information, contexts and competencies for greater situational awareness. The redesign of the ancillary legal and policy documents to more graspable and available forms of documentation allows for greater sensemaking of the organisational capabilities within context. The platform is a key step in moving from linear forms of understanding crises to incorporating complexity in sensemaking.

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Technology/Solution should leverage existing, pre-crisis tools or practices

The solution must be an existing practice or tool, which can be used before, during and post crisis. Sensemaking as a practice requires regular practice; it cannot be forced onto communication experts during a crisis. When working during a crisis, the pressure of the role results in the crisis managers or communication experts being likely to revert to using practices and tools that they are familiar with [15]. The use of existing daily tools reduces additional cognitive load from having to learn and use a new tool, as well as builds the sensemaking capability of the experts. Thus, the design of the tool must incorporate the users everyday working practices, not just a crisis.

Solution must be cross-departmental

Crises usually affect a wide range of public services. This was seen during the pandemic which was primarily a health crisis, but also affected every other sector of public and private service. Data, and insights from one department can be valuable when shared across the rest, as a multi-disciplinary approach to sensemaking can aid in creating more holistic and effective solutions during the crisis. This also helps in reducing redundant efforts of different organisations processing the same data and information multiple times, especially in high intensity situations such as a crisis.

"Here we go, just like we practiced last month."

Sensemaking as a practice

Sensemaking hackathons

Rather than building software, the aim of this hackathon is to create a cooperative social context within which a common understanding of sensemaking practices in times of crisis. Finnish authorities take pride in their exhaustive crisis management and emergency preparedness exercises; a collaborative operation that brings together different agencies as they review the practices and documentation required for a potential crisis. The act of "practising" sensemaking as a collaborative activity should also be given its due importance, a skill and habit worth practising and developing. As crises become more intertwined across different factions of society, making sensemaking a well understood set of tools and practices in the communication experts arsenal creates the conditions for collaborative sensemaking.

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Addressing actionable information

The designed solution must result in information that is actionable, and movable up and down the hierarchy through easily accessible channels. This is evident as interviews have shown that there is a surplus of information available during a crisis, but current tools and practices do not account for "sensemaking" as an activity, where information and data can become insights. This results in important insights falling through the gaps, as data cannot be made actionable. Communicating actionable information is key for authorities and citizens alike to develop community resilience and a citizen response [20].

Public facing component

Transparency is a key theme when it comes to public services and crisis management. Use of public facing components for sharing information, and practices helps increase transparency and, in turn, trust between the public and crisis management experts. Sharing of data, challenges and processes also allows for sensemaking to become a form of public engagement, and also allows for citizens to self-organise.
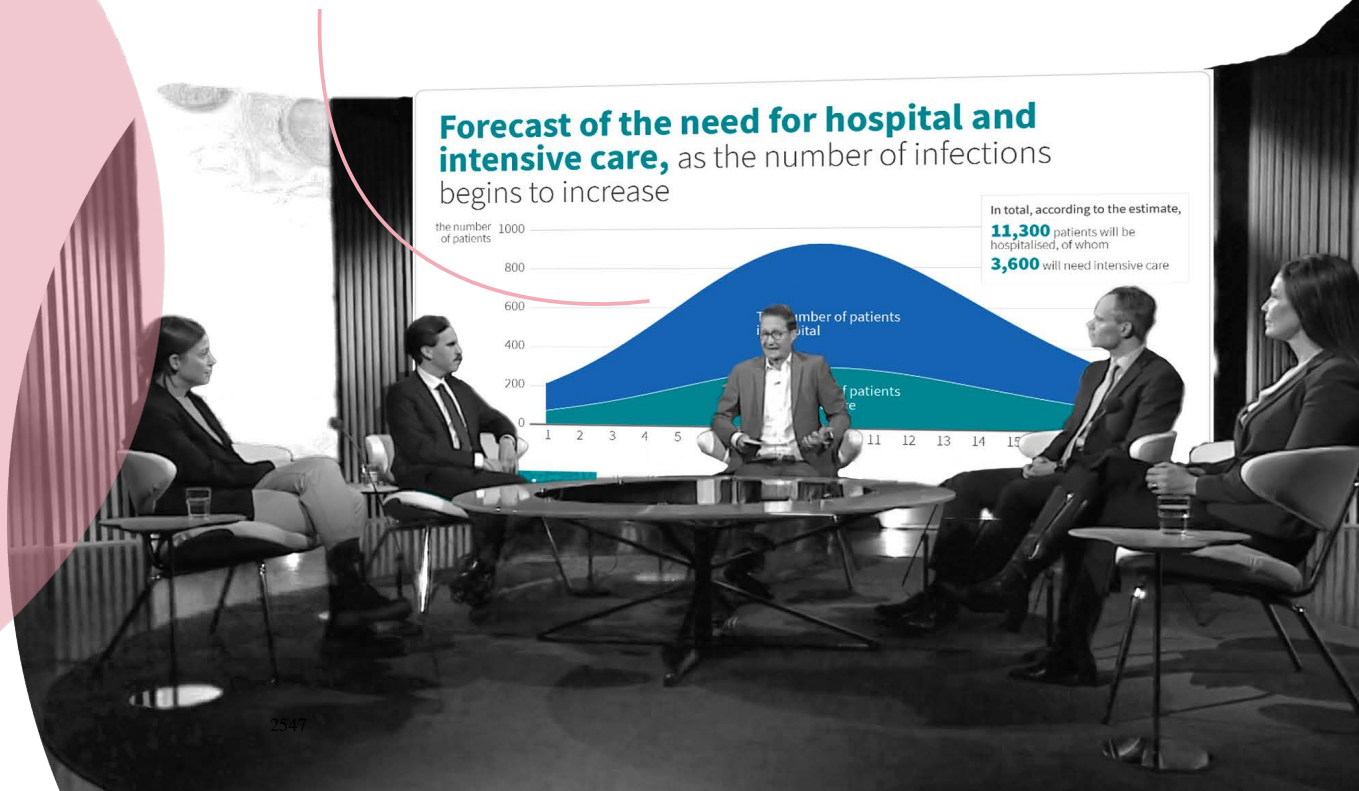
DIEGETIC ARTEFACT #3

Sensemaking as a public engagement

Citizen-Centred Collaborative Sensemaking

Sensemaking needs to happen not only behind the closed doors of the crisis management experts, but in the everyday life of citizens. High rates of trust and education in Finnish society can be leveraged to create self-organising citizen communities for sensemaking. The process of collaboration between different disciplines in itself can produce contextual and actionable information.

Analysis of the crises and the underlying data as a televised public forum between experts, journalists and citizens can create shared trust in the decision making capabilities of the experts and the organisations they represent. The speculative, crisis equivalent of sports analytics show, the aim is to build shared understanding of the crisis, and get ahead of any potential misinformation that might spread.

"Have you seen the latest forecast from Lapland? It makes so much more sense why there are mask recommendations now"

Forecast of the need for hospital and intensive care, as the number of infections begins to increase

In total, according to the estimate, **11,300** patients will be hospitalised, of whom **3,600** will need intensive care

DISCUSSION

During our design research we were able to pinpoint several challenges in the Finnish public crises management and communication and further examine them as more critical issues related to collaborative sensemaking. With a participatory design approach we explored the issues with several stakeholders and were able to recognize several design principles and provide speculative, diegetic artefacts that embody insights from our research. These are (1) sensemaking as a tool, (2) sensemaking as a practice and (3) sensemaking as public engagement.

The results indicate that because of the changing media landscape there is a need to reconsider public crises management and communication practice in all the fields of crisis communication. With the diegetic artefacts we propose how crisis-related sensemaking between Authorities to Authorities (A2A), Citizens to Citizens (C2C) and Citizens to Authorities (C2A) could be enhanced with digital tools and practices. While these diegetic artefacts may or may not be technically feasible, we believe they provoke meaningful insights into how we can reimagine current forms of crisis communication and sensemaking. Rather than framing the need for data-driven dashboards to address crisis awareness and decision-making, we examined a broader need for facilitating and empowering crisis communication professionals and citizens towards sensemaking as a platform and practice. We believe that this empowerment can create more resilient societies in not only short and medium term crises such as an earthquake or a pandemic, but even in long term crises such as climate change.

There are several shortcomings in the research. At the moment the artefacts are only conceptual prototypes and visions; and more research is needed to evaluate how a feasible version of these visions can be developed. Also, a number of ethical issues such as privacy and national security were not deeply considered. We, however, see that our results may lead all the stakeholders to discuss the possible futures in a constructive way.

Future Directions

Valuing the experience and agency of emergency responders, crisis communication experts, journalists, and seasoned crisis managers must be central to introducing new technologies, platforms and practices for situational awareness, crisis management or sensemaking. The challenge is designing how such systems are not only well integrated into existing individual and cooperative work practices, but also offer new forms of information flow, sensemaking and decision-making across stakeholders and organisational silos for complex emerging crises.

As mentioned in the literature, collaborative sensemaking is a crucial but challenging process amidst complex crises. In recent years, specialised ICT systems have been developed to assist public authorities to respond to crises [15]. However, research indicates that there is a gap between the ecology of ICT tools designed for crisis management and communication, and the everyday digital tools that are more widely adopted and used for crisis response by Finnish public authorities during the COVID-19 pandemic [30]. We found that Finnish public authorities rely mainly on pre-existing digital tools and platforms that are designed to support governance and communication in times of non-crisis; this offers possibilities for organisation-based crisis response but have significant shortcomings when it comes to ICTs that would afford multi-actor sensemaking and collaboration. The current tools and processes do not adequately address the fragmentation of communication flows or the barriers between organisations, rather adding "noise" to a hectic situation instead of adding the "right" information that is actually needed by the authorities [7,35]. Hence, there's a need to develop new holistic platforms and practices that enable public authorities to better adapt and make sense of the crisis by creating suitable socio-technical practices that are better adapted for demanding situations.

There is a risk that over-reliance on technologies can de-emphasize the experiences and complex challenges encountered in crises, hence the use of speculative and participatory design strategies provide crucial insights into more effective practices for crisis response and sensemaking.

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