Received: 23 April 2024 | Revised: 9 August 2024 | Accepted: 7 September 2024

DOI: 10.1111/1468-5973.12618

ORIGINAL ARTICLE

WILEY

A four-phase model and a mobile app for crisis preparedness and management in small and medium sized enterprises

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Funding information
None

Abstract

In this study, we present a new four-phase crisis model and the development and assessment of a mobile crisis management application. The model development was supported by a participatory process involving Finnish Small and Medium-sized Enterprises (SMEs). The four phases of the model are *preparedness*, *beginning of the crisis*, *during the crisis*, and *after the crisis*. The new model is incorporated into the mobile app to offer clear, actionable advice for different stages of crisis management. The mobile app, "Crisis Assistant", is designed to aid SMEs in managing a variety of crises, including infectious diseases, accidents, cyber security threats, personnel issues, and business changes. Recognizing the unique vulnerabilities of SMEs due to their size and resource constraints, and their critical role in the economy, the app aims to provide accessible, user-friendly crisis management guidance. In the mobile app, web analytics provide real-time insights into the content usage, which allows for updates to the crisis guidance content and authorities' instructions as well as the further development of the app. The app has been well-received, highlighting the importance of mobile-based solutions in enhancing SME resilience and preparedness for crises. This study suggests future research should evaluate the app's broader impact on SME crisis management capabilities and applicability to other crisis domains.

KEYWORDS
crisis guidance, mobile app, preparedness, SME

1 | INTRODUCTION

Crises are ambiguous events that disrupt the normal flow of activities in an organization (Pearson & Clair, 1998). Despite the importance of preparedness planning (Gates, 2015), the deficiency of personal experience in crisis often leads to these events being perceived as surprises (Ekengren, 2024). The COVID-19 pandemic caught many organizations unprepared for the ensuing disruptions and restrictions. Surprisingly, despite historical experiences with various crises, including natural disasters (Abu Samah et al., 2019; Bronfman et al., 2019; Hidalgo & Baez, 2019), major accidents (Rodrigues et al., 2021), and economic recessions (Brenner, 2021), preparedness for a pandemic of this scale was lacking. Even global indices measuring preparedness, such as the Global Health

Security Index, failed to align with responses to the pandemic (Abbey et al., 2020; Alhassan et al., 2023). Notably, pandemics have received less research attention compared to other crises (Karlsen & Antonsen, 2023).

In the context of Small and Medium-sized Enterprises (SMEs), there is a notable absence of user-friendly digital guidance tools suitable for both crisis specialists and non-professionals (Tan et al., 2017) emphasizing the need for a crisis-as-practice approach (Oscarsson, 2022) and digital solutions. SMEs form 99% of all businesses and employ two thirds of the European workforce (Di Bella et al., 2023). Due to 'the liability of smallness' (Freeman et al., 1983), SMEs are uniquely vulnerable in the face of crises due to their limited resources. SMEs often operate with fewer management skills and face challenges with managerial limitations. In today's globalized and technology-driven landscape, these issues become even more pressing, making SMEs susceptible to immediate economic repercussions during crises. While extensive research exists on crisis preparedness in large organizations (Adikaram & Surangi, 2020), SMEs have received relatively less attention (Herbane, 2013). However, due to the small size, SMEs also tend to be more flexible when threats arise (Eggers, 2020; Klein & Todesco, 2021).

In response to these challenges, a comprehensive crisis guidance document encompassing various crisis types was developed through collaboration among eight Finnish universities and universities of applied sciences. The development involved Finnish SMEs as well in a participatory process. Existing crisis models were evaluated and based on them, a model better suited for SMEs for preparedness and response was defined. This comprehensive guidance, covering infectious diseases, accidents, cyber security, personnel, and business changes, was made publicly available as a PDF (Portable Document Format) (FOKUS, 2020). In this study, we present a crisis model and the development and assessment of a mobile crisis management application that utilizes the model. It emphasizes the importance of preparedness and highlights both internal and external communication. The primary objective is the adaptation of crisis guidance into a mobile application framework, ensuring that it comprehensively covers the wide array of crisis scenarios pertinent to SMEs. This adaptation process is aimed at preserving the depth and detail of the original guidance while optimizing its presentation and functionality for mobile access. The goal is to create a mobile app that serves as an accessible, navigable, and user-friendly resource, enabling SMEs to swiftly locate and apply relevant crisis management guidance.

Secondly, this study provides an overview of the participatory design process and technical complexities in the development process. This entails investigating the application's User Interface (UI) and design, incorporation of authoritative news sources, and the integration of user engagement analytics. The aim is to offer insights into rapid application development methodologies that can be effectively leveraged in crisis situations, thereby contributing to the field of crisis management technology.

Thirdly, by analysing patterns of usage, feature engagement, and user feedback, the study aims to identify the most valued aspects of the app and areas that require refinement. This analysis is pivotal in ensuring that the application remains a highly effective tool for crisis management, continually adapted based on empirical user data to meet the evolving needs of SMEs. The goal is to leverage analytics for ongoing improvements, enhancing the app's usability, and thereby, its impact on SMEs' crisis preparedness and resilience.

2 | METHODS FOR CRISIS GUIDANCE DEVELOPMENT

In the midst of the COVID-19 pandemic, which triggered a cascade of crises in workplaces, including business changes and personnel-related issues, a nuanced approach to crisis management was conceived. Originally intended to address solely the pandemic, the scope of the crisis guidance broadened to include a variety of crises such as infectious diseases, accidents, cyber security threats, personnel crises, and business changes. The diversity and complexity of these crises necessitated a tailored approach; hence, it was decided to develop specific guidelines for each type of crisis, consolidated within a single guidance. Additionally, a section was introduced to guide immediate actions in the unexpected onset of a crisis, underlining the importance of swift response. This underscored the necessity of a four-phase framework for crisis management.

The guidance was crafted remotely by small groups in the fall of 2020, comprising specialists in occupational health, workplace culture, management, and the work environment. Written in a directive manner, the guidelines provided clear, action-oriented instructions. Checklists for managers, executive teams, and preparedness groups were also developed to ensure comprehensive preparedness. Upon compilation, feedback from businesses was solicited and integrated into the final guidelines. This feedback was overwhelmingly positive, affirming the guidelines' significance and comprehensiveness in addressing a wide array of crises.

This iterative dialogue and refinement process was crucial to formulating the final crisis guidance document employed in this study. Notably, discussions with SMEs focused on adopting more accessible and nontechnical terminology instead of scientific terms, which had posed comprehension difficulties for a significant portion of participants. This participatory approach underscored the importance of ensuring the guidance's applicability and practicality in the real-world contexts of the companies involved.

The mobile app's usability for crisis guidance was evaluated through test user interviews in the pilot phase, employing a participatory development methodology. This allowed for both open-ended comments and structured responses via a questionnaire-based survey, which was also accessible through the mobile app. Google Universal Analytics (UA) was integrated into the app to provide deeper insights into its usage. The insights gleaned from this questionnaire are discussed in detail in the chapter on User Feedback.

3 | CRISIS GUIDANCE STRUCTURE

Crisis types can be categorized based on the nature of the precipitating events, which are broadly classified into external and internal origins. External events encompass a variety of triggers including natural disasters, accidents, political decisions, economic fluctuations, pandemics, and wars. Internal events that lead to crises typically involve leadership failures, financial instabilities, operational malfunctions, information technology challenges, human resource dilemmas, and cultural conflicts. Furthermore, factors such as financing, suppliers, customers, and competitors may serve as intermediary causes contributing to the crisis.

Another categorization can be made to sudden and smouldering crises. Accidents are typical sudden crises SMEs need to cope with. Smouldering crises start as minor internal problems but escalate because of management's inattention (Institute for Crisis Management, 2014). Bernstein (2011) further differentiates the smouldering crises to creeping crises and slow-burn crises. A creeping crisis is series of events where a pattern is not seen, and a slow-burn crisis has some advance warning signs as in smouldering crisis (Institute for Crisis Management, 2004). Infectious disease crisis like COVID-19 can be seen both smouldering and sudden crisis from a national and global level. There were warning signs, but the crisis suddenly escalated to an unprecedented level. An example of early warning signs is study (Zhao et al., 2023) where machine learning is used for warning signs of a financial crisis in SMEs.

In addition to early warning signals, megatrends such as nature, well-being challenges, geopolicy, technology, and economy should be taken into account (SITRA, 2023). In the guidance, warning signs and megatrends did not have specific emphasis. However, in the app, the news from Finnish Cyber Security Center, Finnish Institute for Health and Welfare, Occupational Safety and Health Administration, and Finnish Institute of Occupational Health were added. This feature offers the app users the opportunity to recognize early warning signs and learn from the insights derived from the experiences of others.

In a systematic literature research for crisis management (Bundy et al., 2017), two primary perspectives in the literature were identified, one focused on the internal dynamics of a crisis and one focused on managing external stakeholders. The internal dynamics perspective focuses on prevention, reducing the impact, and learning from a crisis. The external perspective involves shaping perceptions and coordinating with stakeholders to prevent, solve, and grow from a crisis. The guidance places greater emphasis on the internal perspective, while also acknowledging the significance of the external perspective.

The crises selected to the guidance and are identified as sudden and primarily caused by external events and not directly resultant from SMEs' decisions to strategic, product, reputation, or liquidity problems. Personnel crises and business change crises were considered to be sudden crises as well, although they can be caused by internal company decisions. It is noteworthy that reputation crises, while singled out as a separate type in this study, are implicit in all types of crises. Effective communication was identified as a key strategy in mitigating reputation crises, negating the need to classify it as a distinct type.

In response to dynamically evolving threat landscape, the inclusion of cyber crises in the guidance constitutes an important update. The pronounced reliance of contemporary business operations on information technology, identified as a substantial technological risk (Asgary et al., 2020), further accentuates the concern regarding the inadequate proficiency in cyber crisis management within SMEs (Hoppe et al., 2021). This concern is exacerbated by the rapid and continuous evolution of cyber threats.

The PDF document for the crisis guidance for SMEs offers detailed action instructions in total of 266 pages. It covers the following five crisis types: infectious diseases (64 pages), accidents (53 pages), cyber security (43 pages), personnel (46 pages), and business changes (53 pages).

3.1 | Crisis phases

A crisis can be divided into different phases and there are many definitions for a crisis lifecycle. Smith (1990), in Figure 1, and Richardson (1994) identified three phases for the crises: (1) the period leading to crisis (precrisis), (2) the operational crisis situation (trans-crisis), and (3) the postcrisis situation. In an integrative framework from Bundy et al. (2017) three phases were also used: (1) the precrisis prevention, (2) the crisis management, and (3) the postcrisis outcomes. In addition, each of these three phases had internal and external perspective. Internal perspective is the technical and structural aspects, and the external perspective is oriented toward stakeholder relationships. Palttala and Vos (2011) defined a crisis communication scorecard which has five phases: (1) preparation, (2) warning, (3) crisis response, (4) reconstruction, and (5) evaluation. Each of the phases contains multiple actions to different stakeholder groups like citizens, news media, and response networks.

Pearson and Mitroff (1993) identified five phases for crisis management: (1) signal detection, (2) preparation and prevention, (3) containment and damage control, (4) business recovery, and (5) learning. In that model, there is emphasis in the signal detection before preparation and prevention. Similar emphasis can also be noticed from the four-phase model from Federal Emergency Management Agency (FEMA, 2016), in Figure 1, where mitigation is the first phase. The emergency management cycle has four phases: (1) mitigation, (2) preparedness, (3) response, and (4) recovery.

United Nations Office for Disaster Risk Reduction defines four phases in the Sendai Framework (UNDRR, 2015): (1) understanding disaster risk, (2) strengthening disaster risk governance to manage disaster risk, (3) investing in disaster risk reduction for resilience, (4) and enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation, and reconstruction.

Crandall et al. (2014) defined a four-phase model: (1) landscape survey, (2) strategic planning, (3) crisis management, and (4) organizational learning. This model emphasizes the importance of continuous improvement in crisis management. By learning from each crisis

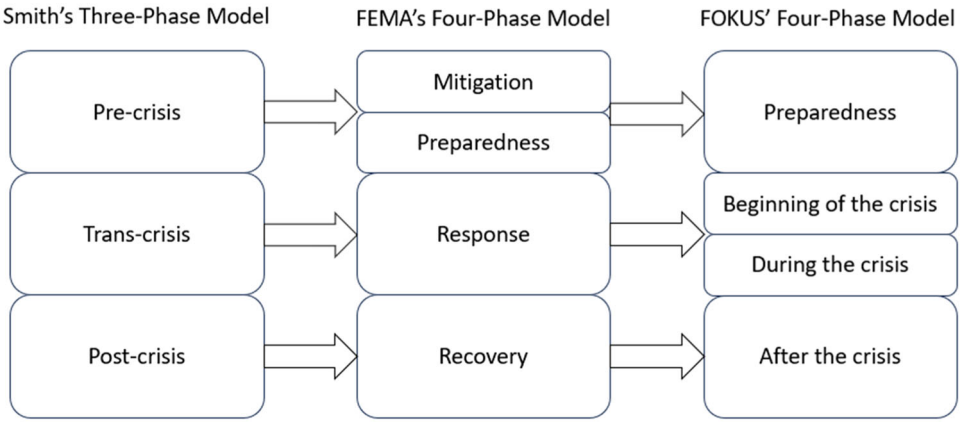

FIGURE 1 Smith's three-phase model, FEMA's four-phase model and the four-phase crisis model developed in the study. FEMA, Federal Emergency Management Agency.

and adjusting strategies and plans accordingly, organizations can enhance their resilience and be better prepared for future crises.

These linear models have also been criticized (Jaques, 2007) since clear boundaries for different phases might be missing. The phases can overlap as in the Recovery Continuum model from the FEMA's National Disaster Recovery Framework. Especially the COVID-19 crisis was prolonged and did not have a clear start and end.

In light of the various models and with the participatory process with Finnish SMEs a cohesive four-phase model was formulated that integrates core elements from existing frameworks and addresses the criticism regarding distinct boundaries. This model was named the FOKUS model. In all phases of the model, the internal and external communication is emphasized, crucial not only for effective crisis management but also for addressing potential reputation crises.

In the FOKUS model, the first phase, preparedness, serves as the singular precrisis phase. While many models, such as those by FEMA (2016) and Pearson and Mitroff (1993), emphasize mitigation and early warning signs as pivotal, this model places a reduced emphasis on mitigation due to the unpredictable nature of crises and the limited resources of SMEs. The emphasis here is on the preparedness and setting up an organizational structure for crisis management, for response activities and communication.

Second phase, beginning of the crisis, is characterized by the immediate activation and implementation of prepared crisis management protocols. This phase is crucial as it involves the initial actions that can significantly influence the outcome of the crisis (Saarelma-Thiel, 2009). The emphasis is on operational management and setting up initial response teams, including the management of communication and safety protocols of the current crisis type while ensuring the continuity of work.

The third phase in the model, during the crisis, involves sustained management and operational responses aimed at effectively managing the crisis as it unfolds, either as an acute or a prolonged crisis. There is strong emphasis on continuous communication keeping all stakeholders including employees, the public, and media informed about the situation like Palttala and Vos (2011) highlight. Employing a singular trans-crisis phase was deemed inadequate for accommodating the diverse array of crisis types (Jaques, 2007). This division into two trans-crisis phases offers a more fitting framework for managing both acute crises, such as accidents, and more prolonged crises, including infectious diseases and cyber security incidents.

After the crisis phase is crucially recognized as a distinct stage essential for learning from the crisis and enhancing effective behaviour (Haneberg, 2021). This phase focuses on recovery and rebuilding efforts, essential for restoring normal operations, supporting affected individuals, and enhancing overall resilience against future crises as emphasized by Crandall et al. (2014).

The FOKUS four-phase crisis model and its differences to Smith's and FEMA's models are presented in Figure 1.

3.2 | Crisis actions

The nature of a crisis inherently involves a personal dimension (Saarelma-Thiel, 2009) that poses significant challenges even for individuals within high readiness organizations, who possess specialized training (Bechky & Okhuysen, 2011). These challenges are even more acute for leaders of small businesses. Puumalainen et al. (2023) highlight that during a crisis, decision-making often becomes fraught with indecision, particularly when circumstances necessitate swift and adaptive actions, such as pivoting strategies for enhanced financial performance, over a strategy of perseverance. Moreover, the individual emotional responses to crises play a significant role in shaping managerial responses, potentially leading to an increased tendency towards retrenchment, as noted by Miocevic (2022).

In light of the observations in the studies discussed above, the development of action instructions has been intentionally oriented towards simplicity and clear directives as per study (Pearson & Mitroff, 1993). This approach aims to facilitate immediate and effective action by eschewing the complex terminology typical of

crisis management professionals, thereby making the guidelines more accessible and actionable for those at the helm of SMEs.

The structure in the PDF for all five crisis types is similar: the phase of the crisis, and the actions in that specific phase. Depending on the crisis type the order of the actions differs as also their amount between 14 and 22. Each action contains instructions, and they are applicable to multiple crisis types, for example, communication during a crisis or debriefing after the crisis. The significance of communication, both internally and externally, has been underscored in the guidelines.

In the PDF, the actions' instructions in each phase for each type needed to be repeated since the user might be reading only one printed type. The phases and their actions can be seen in Table 1.

4 | DESIGN OF THE MOBILE CRISIS ASSISTANT

The process of mobile app development can be both costly and requires specialized technological expertise. In response to these challenges, low-code development platforms, such as Online Application Generators (OAGs), offer a promising solution. They have several advantages, such as facilitating rapid app development and delivery (Sanchis et al., 2020; Vikebø & Sydvold, 2019), as well as enabling development without extensive programming experience (Woo, 2020).

The choice of development platform emerged as a critical consideration in this study. Without any pre-existing infrastructure for software development or database maintenance, the necessity for a ready-to-use development environment was paramount, allowing work to commence immediately upon logging into an OAG, which itself could represent a crisis scenario.

For this study, we compared various OAGs. One of the characteristics of low-code development environments is their rapid evolution. Some of the considered platforms were discontinued and some had significant development user interface modifications. Tablet and desktop support, Google Analytics integration, custom domain, and easy data storage were the features that swayed the decision to choose Glide for this project. All the candidates can be seen in (Luo et al., 2021).

The generated application from Glide is not a native application to mobile operating systems but it is a PWA (Progressive Web Application) similar to a web page. That limits some functionality but simplifies development, since there is only one distribution platform to target. Sharing of a PWA only requires the URL rather than a developer account and submission to a proprietary app store. In a study (Sharma et al., 2019) the PWA was considered a one stop solution for all application development across all platforms, but we found out that the OAG used was not able to fulfil all the capabilities of a PWA. Due to technical constraints, there are limitations related to privacy and localization, with a detailed discussion in Chapter 5 and the content is solely in Finnish.

A PDF does have some interactive features, like hyperlinks within the content and to external web sites. However, the functionality depends on the PDF reader software. Most browsers support PDF with Adobe PDF plug-in but the implementation of the features differs. Therefore, the PDF guidance is considered as a static document in this study. The mobile app's implementation initially followed the PDF guidance's structure as much as possible. After initial testing with the test users, the different usage logic of an app forced a change in the app structure to enhance its practicality.

4.1 | Mobile application content design

The content text in Finnish from the PDF guidance was directly incorporated into the mobile app where applicable. Some instructions contained lengthy textual context that posed challenges for display on mobile devices. Shortening the text was not feasible without omitting critical information. To address this, the instructions were presented as separate items, reducing the amount of content visible on the mobile device screen. Also, due to the instructions' numerous one-to-many relations, the instructions were put in a separate tab in the app to avoid repeating them in individual crisis actions in the mobile device screen. This reduced the number of actions between 6 and 11. This strategic simplification contributed to a more cohesive and efficient crisis guidance. The mobile app structure for actions can be seen in Table 2. The instructions in the separate tab can be seen from Table 3.

4.2 | Guidance presentation in the mobile app

Gestalt visual theory (Graham, 2008) is a psychological theory of perception that explains how the human brain organizes visual information. The theory emphasizes how the brain organizes visual information into meaningful patterns or wholes. Based on the Gestalt visual theory's core principles of proximity and similarity the following visualisations were used for illustrative purposes and to help users perceive and interpret the content:

- In the PDF document and in the app, *each crisis type has a different picture* to separate them from each other.
- In the PDF document, *each crisis type has its own colour bar* at the bottom of the page to separate the crisis types more visually than text alone. To avoid confusing the app user with too many colours, the type specific colour was not used in the app. Instead, the app has a tab for each crisis type to keep the focus on one type at a time while scrolling up and down.
- In the PDF document and in the app, *actions have different colours on the phase* they belong to. Preparedness is blue; the beginning of the crisis is red; during the crisis is yellow; and after the crisis is green. In the PDF document, actions are in a list, but in the app, actions are box elements which the user can click.

TABLE 1 The five crisis types of the PDF guidance documentation and the actions in different phases. Each crisis type has a separate colour that was used in the PDF but not in the app. The colours of the four phases were used both in the static PDF document and in the interactive app.

Infectious diseases	Accidents	Cyber	Personnel	Business changes
Preparedness				
1. Ensure the resilience of your business 2. Preparedness for infectious diseases 3. Communication readiness	1. Ensure the resilience of your business 2. Preparedness for accidents 3. Communication readiness	1. Ensure the resilience of your business 2. Management responsibility 3. Preparedness for cyber crisis 4. Communication readiness	1. Ensure the resilience of your business 2. Preparedness for personnel crisis 3. Communication readiness	1. Ensure the resilience of your business 2. Preparedness for business changes 3. Communication readiness
Beginning				
4. Checklist for operational management 5. Checklist for management team 6. Setting up a preparedness team 7. Communication 8. Continuity of work 9. Local management 10. Ensuring the occupational safety of personnel 11. Occupational health co-operation 12. Customer safety	4. Checklist for operational management 5. Actions in accident situation 6. Ensuring the occupational safety of personnel 7. Security at the accident location 8. Setting up a crisis group 9. Communication	5. First actions for cyber crisis 6. Checklist for operational management 7. Checklist for company 8. Instructions for employees and customers 9. Communication	4. First actions for personnel crisis 5. Checklist for operational management 6. Continuity of work 7. Setting up a crisis group 8. Communication	4. Checklist for operational management 5. Setting up a crisis group 6. Continuity of work 7. Communication 8. Management actions
During				
13. Safety instructions compliance monitoring 14. Ensuring adequacy personal protective equipment 15. Continuity of work 16. Supporting local management 17. Local management practises 18. Personnel management 19. Evaluation and learnings from the crisis 20. Personal protective equipment	10. Continuity of work 11. Communication after the accident 12. Local management practises 13. Meeting practises 14. Occupational health co-operation 15. Employee wellbeing 16. Injuries and death	10. Communication after the accident 11. Continuity of work	9. Local management practises 10. Communication during the crisis 11. Management actions 12. Support for personnel	9. Communication during the business change 10. Local management practises 11. Personnel changes 12. Support for personnel
After				
21. Returning from crisis to normal 22. Occupational health co-operation	17. Returning from crisis to normal 18. Communication readiness 19. Accident debriefing	12. Returning from crisis to normal 13. Cyber crisis debriefing	13. Returning from crisis to normal 14. Personnel crisis debriefing	13. Returning from crisis to normal 14. Towards a new workplace well-being culture

Note: Each crisis type has a separate colour that was used in the PDF but not in the app. The colours of the four phases were used both in the static PDF document and in the interactive app.

TABLE 2 The five crisis types and the actions in different phases in the mobile app. The numbering in this table reflects the corresponding actions in the PDF document.

Infectious diseases	Accidents	Cyber	Personnel	Business changes
Preparedness				
1. Ensure the resilience of your business 2. Preparedness for infectious diseases	1. Ensure the resilience of your business 2. Preparedness for accidents	1. Ensure the resilience of your business 2. Preparedness for cyber crisis	1. Ensure the resilience of your business 2. Preparedness for personnel crisis	1. Ensure the resilience of your business 2. Preparedness for business changes
Beginning				
3. Checklist for operational management 4. Setting up a preparedness team 5. Occupational health co-operation 6. Customer safety	3. Checklist for operational management 4. Actions in accident situation 5. Ensuring the occupational safety of personnel 6. Setting up a crisis group	3. Checklist for operational management 4. Instructions for employees and customers	3. Checklist for operational management 4. Continuity of work 5. Setting up a crisis group 6. Communication	3. Checklist for operational management 4. Continuity of work 5. Management actions
During				
7. Ensuring adequacy personal protective equipment 8. Continuity of work 9. Personnel management	7. Continuity of work 8. Employee wellbeing 9. Injuries and death	5. Continuity of work	7. Management actions	6. Local management practises 7. Personnel changes
After				
10. Returning from crisis to normal 11. Occupational health co-operation	10. Accident debriefing	6. Cyber crisis debriefing	8. Personnel crisis debriefing	8. Towards a new workplace well-being culture

Note: The numbering in this table reflects the corresponding actions in the PDF document.

TABLE 3 The instructions taken from the actions in the PDF and made as a separate list in the mobile app.

Instructions tab in app
Communication readiness
Communication in the beginning of the crisis
First notification
Crisis diary
Remote work
Local management
Personnel illness
Communication during the crisis
Notification
Press conference
Interview
Reduction of uncertainty
Personnel support
Occupational healthcare co-operation
Employee well-being
Support in work negotiations
Debriefing
Work wellbeing culture

- In the app, *instructions have a uniquely shaped colour coded box* with a different shape than action boxes to distinguish them from each other. All the instructions do not apply to all crisis types, and the applicable types are expressed with a text since crisis type colours were not used in the app. It would have been possible to add type colour(s) as smaller additional boxes, but that was considered too confusing to have up to five different sub-colours for types in addition to four phase colours in an instruction box.

The structure and colours can be seen in Figure 2. The final version of the app is shown in Figure 3. Figure 4 has a comparison of the PDF content and the app screen for one action.

5 | TECHNICAL FEATURES OF THE MOBILE CRISIS ASSISTANT

The PWA technique falls short compared to native mobile implementations on IOS and Android, primarily due to the absence of mobile push notifications at the operating system level. A straightforward and universally applicable solution within PWAs is lacking. As a replacement, SMS messages tend to be more obtrusive compared to mobile application notifications but could be used in a crisis. Consequently, the decision was made not to implement any notifications in this study.

In the app, the News tab has Really Simple Syndication (RSS) feeds from different authorities: Finnish Cyber Security Center, Finnish Institute for Health and Welfare, Occupational Safety and Health Administration, and Finnish Institute of Occupational Health. This is a definite addition to a static PDF document. RSS updates the information when the configured page has new information and enables the latest news from various authorities to be viewed. Depending on the authority, they publish information from 1 to 10 times a month, Occupational Safety and Health Administration and Cyber Security Centre being most active. One of the deficiencies of Glide is the absence of a mechanism for dynamically adjusting the content text language in accordance with user preferences. Although standard interface components, such as buttons, are subject to translation, the platform does not support language selection for content text on a user-specific basis. The ability to translate the app content into multiple languages would enhance its utility. With the advent of artificial intelligence the process of language translation has become both accessible and swift. However, the task of localization extends beyond mere translation to encompass content adaptation, particularly vital in crisis management contexts. This adaptation is crucial as procedures and recommended actions for crisis situations vary significantly across different countries; methods deemed effective in one sociocultural environment may not necessarily apply universally (Arlikatti et al., 2014; Harro-Loit et al., 2012).

5.1 | Privacy

In the study's context, compliance with the General Data Protection Regulation (GDPR) legislation needed to be considered in the implementation.

This application did not fall under the Public Protection and Disaster Relief directive, but the same principles were followed: Define narrowly the purpose and limit usage of personal data to the identified purpose, define an appropriate legal base, comply with other data protection principles especially with minimum data needed, and ensure respect to for data subjects' rights.

If the data is stored outside of the EU, the developer needs to define the data transfer mechanism as a contract with the end user. Unknown storage has an impact in the end user's possibility to request data correction and erasure. Glide as a company for the developers fulfils the GDPR legislation, but that cannot be extended to the apps from the developer to the end users. Glide highlights that restricting data visibility or using hiding conditions in the User Interface (UI) elements are not security features, but creating a GDPR compliant implementation is not explained.

Google UA has privacy issues as well. According to the EU's ePrivacy directive, the end user needs to be informed and consent is required. It is insufficient to merely assume that the user gives consent by continuing to use the website. The guidelines stipulate that the agreement must be expressed through some form of affirmative

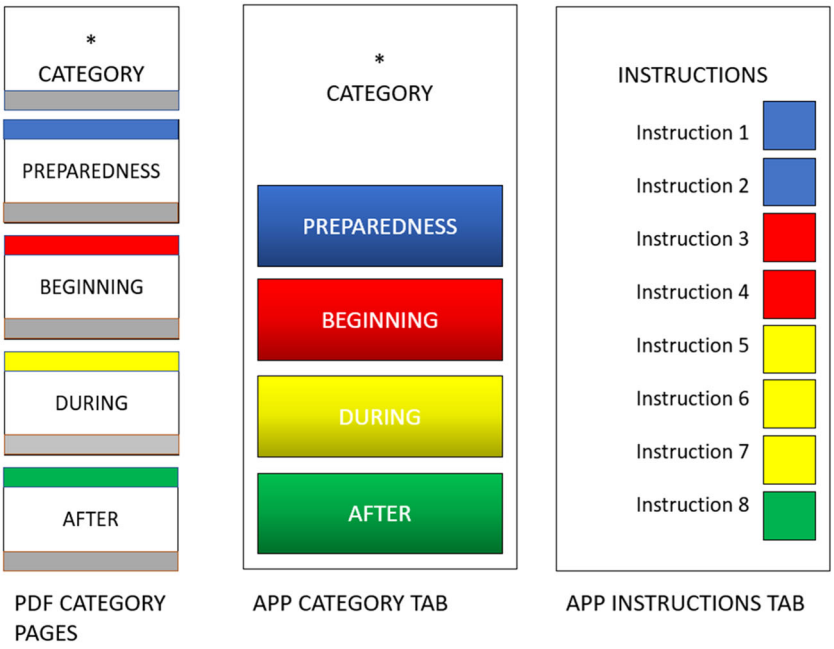

FIGURE 2 Structure of the content and color-coding in the static PDF document and in the interactive mobile app. Each crisis type has four phases. In the PDF, grey marks the type colour. An asterisk *denotes a crisis type icon in the PDF and in the app. The app's crisis type tab holds the different action boxes specific for the selected crisis type. The app instructions tab has the instructions separately unlike in the PDF.

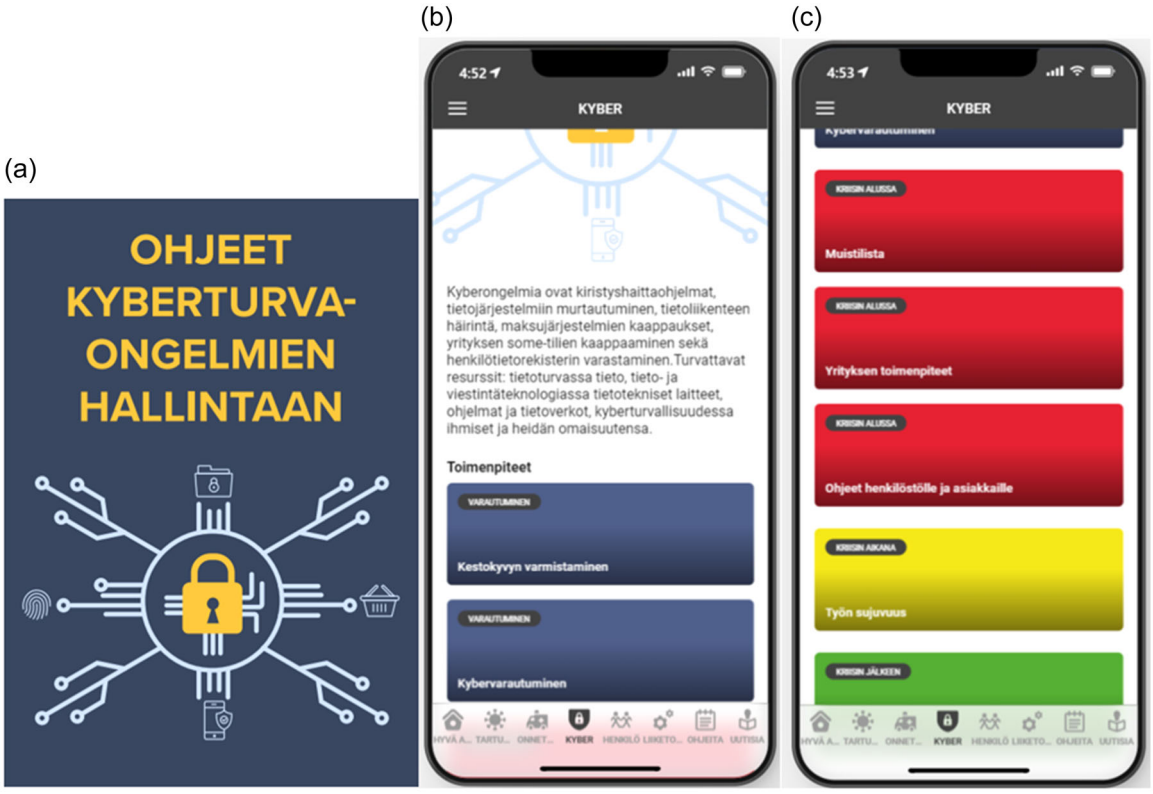

FIGURE 3 Example for cyber crisis guidance from the PDF (picture a) and the published app (pictures b and c). Picture A is the first image page of the cyber crisis guidance in the PDF. In picture B is the published app without the crisis type specific colour as image background. It is followed by description and two visible action boxes for preparedness (blue). Picture (c) shows the actions in different phases with colour coding. The cyber crisis type in picture B can be swiped more down by the users to reveal more actions.

action, that is checking a tick box or clicking a button. In the app, an approval tick box for approving analytics tracking was added on the login screen. Unfortunately, there was not a possibility to create a way to continue without checking the tick box. Therefore, it was estimated that a few privacy-conscious users may not have used the app. On the other hand, the study required information about the usage, hence the analytics tracking was necessary. Additionally, it provided a better insight as to which features were most frequently

FIGURE 4 Comparison of an action between the PDF (on the left) and an app screen (on the right). An app screen has the phase-specific color (red) but does not have a crisis-specific color (bluegray). The screen on the right is an example of one red action box clicked with more information than a static PDF page; guidance, share button ("JAA" in Finnish), and hyperlinks to sites of official authorities for more information. The Back button is not translated to Finnish since it is shown in English based on mobile device language settings, highlighting the problems with localization.

used across different crisis types. Cookieless tracking was introduced with Google Analytics 4 in October 2020, but because there was insufficient experience with it, the older UA was used in the study.

The privacy issues caused two features to be abandoned from the final release of the app: a crisis action diary and a personal favourites task list. They would have been used to store information about what had been done, and what instructions had been found interesting and saved. They would have not been a direct violation of GDPR but a privacy issue, nevertheless. In addition, geo-location and chat could be useful but they would require strict privacy.

6 | USAGE OF THE MOBILE CRISIS ASSISTANT

After the IOS version 14.5 privacy change in April 2021, Apple offered the feature App Tracking Transparency for users to limit apps' access to Advertising Identifier (IDFA). The IDFA enables the UA to track users' activities on the iOS, and it is impossible to estimate how much it has affected the statistics for iOS and Safari browser users. Looking at the UA statistics for browsers in half year periods, the number of Safari users has been 24, 21, 33, 25, and 28%. This would indicate that one quarter of the usage statistics data could be missing or not trust-worthy.

The app was released in February 2021. From the statistics, it can be seen that during the two-and-a-half-year period from January 1, 2021 to June 30, 2023, there were 1231 users with 19000 page views. The average user activation length was 2 min 30 s. The decline in the usage can be explained with stronger marketing in the beginning of the project.

Based on users' average activation length during the two-and-a-half-year period, INFECTIOUS DISEASE (1 min 25 s) and CYBER (1 min 21 s) were the most interesting crisis types. Other types were PERSONNEL 81 min 5 s), ACCIDENT (43 s), and BUSINESS CHANGE (51 s).

Based on page view count, the most popular tab was naturally the starting tab, with 2036 views. Compared between the crisis types, INFECTIOUS DISEASE was the most popular, with 1807

views. After that were CYBER (1460), PERSONNEL (1318), ACCIDENT (989), and BUSINESS CHANGE (795). The INSTRUCTIONS tab had 797 views and the NEWS tab had 389 views.

Figure 5 shows the number of page views of the crisis type tabs in five 6-month periods: January 1 to June 30, 2021, July 1 to December 31, 2021, January 1 to June 30, 2022, July 1 to December 31, 2022 and January 1 to June 30, 2023. An interesting and notable change in Figure 5 is that in the first half of 2022, the cyber crisis became more popular, unlike the trend in other types. This can be explained by the situation in Ukraine. In the last year of the period, the interest was notably less.

Instructions' view counts in Figure 6 show a relation to the COVID-19 situation when usage of remote work instructions first decreased in the second half of 2021 but increased again in the first half of 2022, reflecting the rise of active COVID-19 cases. However, interest in work well-being steadily decreased. There is also a counter-intuitive observation that interest in cyber crisis in Figure 4 and password instruction in Figure 5 are opposite of each other. Probably the users only wanted to have simple instructions instead of wider guidance. The communication plan instruction had more users in the second half, similarly to the password instruction. In general, the interest in the latter half of 2022 was low but increased again in the first half of the 2023.

6.1 | User feedback

Interviews were conducted, and the test users found the software to be user-friendly during the usability testing on various platforms. The only nonintuitive technical feature was that running the app in the laptop's browser needed two fingers to scroll on the touchpad, similar to the mobile phone swiping up and down. The navigation was found to be simple to follow, and the guidance instructions were easily accessible. The instruction texts were found useful in different situations. There were no major issues reported by the testers.

As a PWA technology issue, many users did not realise it was possible to install the application to the home screen since the app was opened from a URL instead of downloaded from the application store. Only one fifth of the users installed it and only half knew it was possible. The application was then updated to have instructions for the installation.

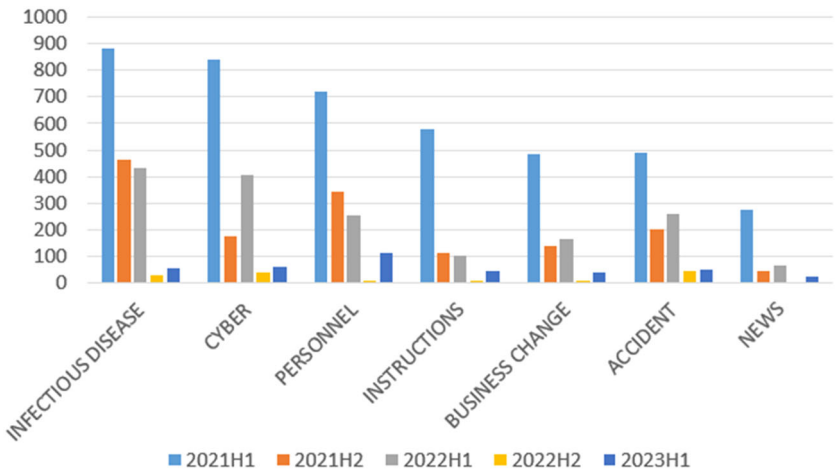

FIGURE 5 Views of the tabs of five crisis types, instructions, and news tabs. H1 is the first half of the year, H2 is the second half of the year.

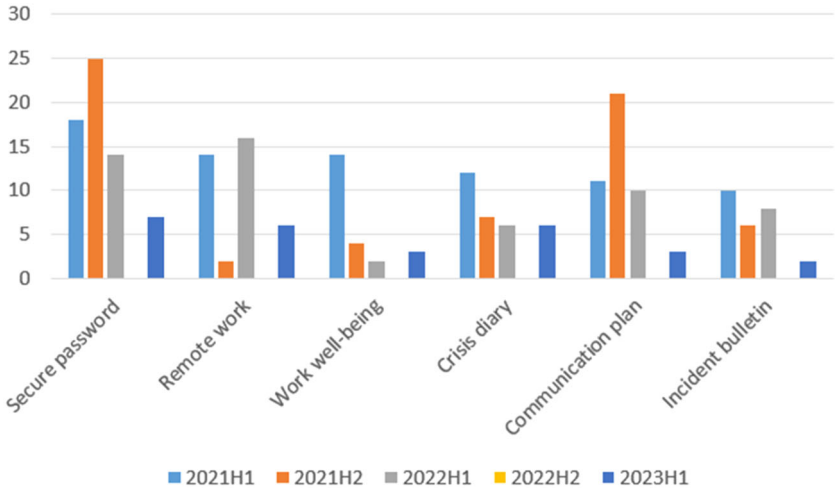

FIGURE 6 Views of the six most popular instructions from a total of 19 instructions.

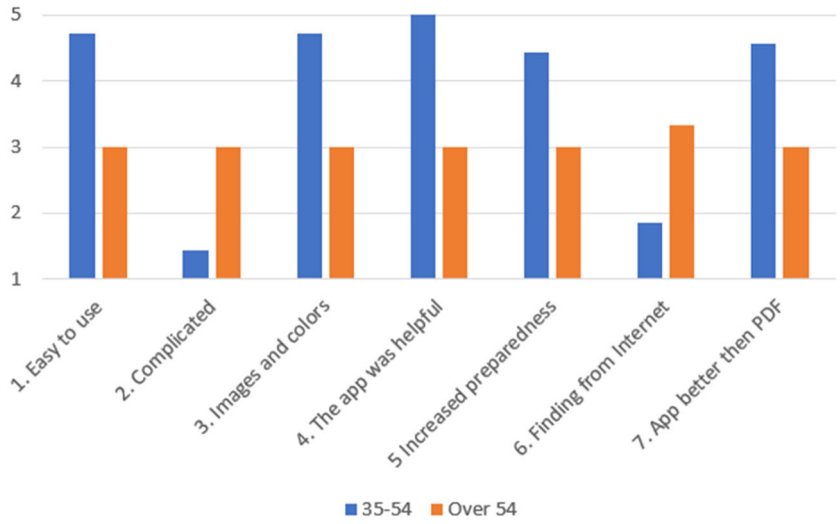

FIGURE 7 Results from the usability of the guidance in the app by age groups. Answers in question 2 are reverse to question 1. In question 6 lower value indicates finding information from Internet is harder.

After the release of the mobile app, a questionnaire was added to the app. It included two parts: (1) questions for the user's digital proficiency, and (2) questions from the usability of the guidance in the app. The questionnaire for the digital proficiency included background inquiries encompassing age, educational background, the number of supervisees, and proficiency with various applications. Proficiency was assessed using a 5-point Likert scale, estimating ease of use in mobile devices for activities such as email usage, social media, photography, calendar management, online payments, and video streaming. Age was the sole differentiating factor in these assessments, with respondents categorized into three age groups: 35−44, 45−54, and over 54 years. The combined average proficiency score for the first two age groups approached 5, while the age group over 54 reported an average score of only 3. Notably, social media proficiency received the lowest average score of 2 at the age group over 54.

These trends were also evident in the findings related to the usability of the guidance in the app. The ease of use received a rating of 5 from the combined age group 35−54 but only 3 from users over 54. Intriguingly, older participants reported that they found information on the internet more easily and they preferred PDF document over the mobile app. Additionally, the mobile app did not significantly enhance older users' preparedness. These observations are likely attributed to their greater experience but could also signal potential gaps in preparedness education or the presence of overly complex terminology. These results can be seen from Figure 7.

7 | RESULTS AND DISCUSSION

In this study, the successful transformation of guidance from a static PDF document to a mobile application was achieved. The mobile app, Crisis Assistant, proved to be well received by the users and provided real-time usage information from hundreds of users. We discovered that, in appropriate cases, an OAG is a rapid way to implement applications. However, the necessity for trade-offs between requirements and technology capabilities is substantially more than in web development. The amount of development work and complexity are significantly reduced for the OAG development, but this is partially attributable to OAG's technological deficiencies.

In a participatory process with Finnish SMEs and drawing on previous models, we devised a comprehensive four-phase model to address various crisis scenarios, encompassing: (1) preparedness, (2) beginning of the crisis, (3) during the crisis, and (4) postcrisis recovery. This model garnered positive reception and demonstrated its adaptability, effectively accommodating various types of crises, from prolonged crises like the COVID-19 pandemic to shorter-term crisis situations.

In the field of medicine, the utilisation of Personal Digital Assistants (PDAs) for guidance was adopted at an early stage (Lu et al., 2005; Malter & Davis, 2003), and the results for web-based guidance have been positive (Bochicchio et al., 2006; Lapinsky et al., 2004). One of the earliest examples outside medical use is the Work Environment Profile survey (Naumanen et al., 2008), which used a PDA device with custom software to conduct a survey. In education, mobile apps are widely used (Muslimin et al., 2017) and the International Labor Organization (International Labour Organization, 2018) released a series of mobile apps intended for improving occupational safety and health at workplaces, for ergonomics and stress prevention.

Using a mobile app for guidance has number of advantages over a static PDF document. The most prominent results were on the guidance provider's side. Analytics that were added to the mobile app provided the opportunity to examine the usage in greater detail and update the guidance to keep it current. When compared to a PDF file, where only download statistics were available, using analytics is a clear improvement. We saw how global events like the COVID-19 pandemic and the situation in Ukraine affected mobile app usage. For instance, more cyber crisis instructions were added to the mobile app in 2022 when officials released new clear-text guidance.

The users were satisfied with the guidance content both in the PDF and in the mobile app. Mobile app users particularly appreciated

the simplicity and clear advice tailored to their specific problems, presented through actionable steps and instructions. McGonigal's work (2022) underscores the crucial role of crisis simulations in enhancing mental preparedness, demonstrating how such exercises improve the ability to effectively navigate real-world crises. This study's app not only prepares SMEs for the practical aspects of crisis response but also strengthens their mental resilience.

However, we observed a difference in mobile app acceptance related to usability and guidance among users over 54 years old; they preferred sourcing information from the Internet, and the app did not enhance their preparedness. This variance in user experience and preference could be attributed to their extensive experience but also underscores potential gaps in preparedness education or the use of complex technical terminology in crisis management for those under 55.

A comparable application is the Estonian Women's Voluntary Defence Organisation's "Be prepared!" mobile app for citizens for preparedness (Naiskodukaitse, 2018). It was observed that they had implemented separately a similar approach as in this study's implementation maintaining simplicity in its guidance. Being implemented as a native mobile platform web application, it incorporates translations and notifications, where the municipality can be selected.

The lack of centralized, easily accessible crisis management guidance for SMEs is notable (Adikaram & Surangi, 2020). While there are numerous guidelines covering general topics, there is a noticeable absence of a systematized process designed to be applicable across various crises. It's impractical for all SMEs to invest in developing bespoke processes for every conceivable situation. In Europe, micro-enterprises constitute 93.5% of all companies and account for 29.4% of the workforce, whereas all SMEs combined represent 99.8 of companies and employ 64.4% of the workforce (Di Bella et al., 2023). Considering the SME's significant role in the economy, it is crucial for these enterprises to have a comprehensive and actionable crisis management guidance.

This study proposes a novel mobile app as a potent solution capable of providing SMEs with instant access to crucial resources and updates from authorities, even in scenarios of minimal internet connectivity. Using participatory approach with companies and applying the Gestalt visual theory improved the app's content and visual appearance, making the guidance more perceptible. Nevertheless, the inclusion of advanced functionalities like geolocation and chat is constrained by privacy considerations, underlining the need to balance features with user privacy.

The study also highlights the risks associated with relying on OAGs, including potential discontinuity and data loss, and emphasizes the need for regular data backups and consideration of vendor continuity. Furthermore, the study touches on the legal challenges, particularly in the EU, posed by GDPR restrictions, and the technical limitations of OAGs in terms of content localization, which in addition requires cultural sensitivity in crisis communication.

8 | CONCLUSION

This study has successfully demonstrated the development and assessment of the "Crisis Assistant" mobile app (KriisiApuri, 2021), which integrates a novel four-phase crisis management model specifically designed to support Finnish SMEs. Drawing on previous models and through a participatory development process, the app addresses the unique needs and vulnerabilities of SMEs by offering structured and actionable guidance for each phase of crisis management; preparedness, beginning of the crisis, during the crisis, and after the crisis.

The inclusion of web analytics allows for continuous improvement of the app based on real-time user engagement and evolving crisis scenarios, as evidenced by heightened interest in infectious diseases and cyber security threats during global events such as the COVID-19 pandemic and the conflict in Ukraine. The app's user-friendly interface and dynamic content update capability have marked a significant improvement over traditional methods, such as PDF guides, enhancing SME resilience and preparedness for diverse crisis situations.

The study acknowledges the low-code platform's efficiency in app development but also recognizes the necessity of addressing legal and privacy considerations. It suggests that future research should focus on evaluating the app's impact on SME crisis management capabilities, with an eye toward expanding its applicability to a broader range of crisis situations, thereby contributing to general resilience and preparedness.

ACKNOWLEDGEMENTS

The authors wish to thank the FOKUS project working group.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The data sets generated and/or analysed during the current study are available from the corresponding author on reasonable request.

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How to cite this article: Kiiveri, K., Naumanen, P., Liesivuori, J., Virtanen, S., & Isoaho, J. (2024). A four-phase model and a mobile app for crisis preparedness and management in small and medium sized enterprises. *Journal of Contingencies and Crisis Management*, *32*, e12618. https://doi.org/10.1111/1468-5973.12618