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# The fire-pandemic risk: fire management strategies and Internal Crisis Communication during Covid-19

Amber van den Broek  
Student Nr.: 1007295  
Msc Development and Rural Innovation (MDR)  
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CPT-81330

Supervisors:  
Marijn Poortvliet - CPT  
Cathelijne Stoof - SGL



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# 1. Introduction

Worldwide, over the last 18 years the amount of area burned by fire decreased by an estimate of 25% (Andela et al., 2017). However, even though globally less is burned, some areas (e.g. USA and Australia), have consistently been met with large, more intense and hotter fires that are harder to fight due to rising temperatures, drought and shifting precipitation patterns (BBC News, 2019; Halofsky et al., 2020). On top of managing these more intense fires, early 2020, the World Health Organization (WHO) declared Covid-19 a worldwide pandemic, providing difficulties for many job occupations, including fire management (WHO, 2020). In this research, 'fire management' of landscape fires, is defined in accordance with an ongoing research by Wageningen University & Research (WUR) and the FAO. Fire management considers the *"the inclusion of the entire disaster management cycle from risk reduction, readiness, to response, recovery and review"* (Moore et al., 2020, p.10). In pre-pandemic circumstances, fire management already didn't come without obstacles, such as fatigue from long shifts, causing difficulties within the organization behind fire management (Fleming et al., 2015; Vincent et al., 2016). Now, the occurrence of Covid-19 seems to add another dimension to existing obstacles, strategies, and risks within fire management, urging to once again take a closer look at fire management. This means that also well-functioning fire strategies need to be reevaluated in the context of Covid-19 as they might not be able to function as well as they did before. One example can be found in the inability to perform prescribed burning as fire managers can not perform them while social distancing (Fisher, 2021; Jlevans3, 2020). This combined risk of managing fire and the Covid-19 pandemic is better known as the fire-pandemic risk.

The pandemic not only affects practical implications for fire management, but also communicative aspects, as close-contact interactions are to be kept to a minimum. Communication is what usually enables understanding within an organization, enabling careful decision-making. In short, communication stands central in facilitating a risk management process, making it an important catalyst within fire management (IRGC, 2017; Moore et al., 2020; Stoof et al., 2020). However, in multiple countries, governments have ordered to work as much from home as possible, complicating and minimizing face-to-face communication between colleagues (BBC, 2020). Such restrictions may prove to hinder communication efforts in fire management as it is a fast-paced response profession where communication during crisis is already critical, especially if the risk is novel (Dwyer & Hardy, 2016). The fire-pandemic risk can be considered a novel risk that is becoming clearer over time. Therefore, its risk management is also constantly updated.

In this study, the objective is to contribute insights regarding the strategy management and communication efforts within the fire-pandemic risk context. As changes due to the virus within fire management become clearer, the question remains how strategies could be adjusted to address them. Not only may these adjustments in strategies address Covid-19 related changes and challenges, but it may also provide the opportunity to discover novel ways to benefit firefighting in the future. As such, insights into the adjustments made to existing strategies could reveal how to improve on organizing and executing fire management more effectively.

More insights can be provided in terms of internal communication among fire management professionals in the context of the pandemic. The eventual implementation of strategies externally is only possible when the unit of operation is able to initially cope with the object of crisis internally. Mutual understanding and sharing information among colleagues with regard to the problem improves implementation and organizational operation (Adamu & Mohamad, 2019; Salih & Doll, 2013). This requires healthy internal communication within an organization. However, it is unclear if communication between fire managers has been affected due to the pandemic, potentially hindering effective action-taking. Gaining insight in the Internal Crisis Communication (ICC) in fire management could reveal where

ICC is strong and were there may lie challenges affecting the operationality of fire management. In line with these objectives the following research questions have been posed:

1. How did fire management strategies develop and adjust over the course of the Covid-19 pandemic?
2. Could the development of fire management strategies during the Covid-19 pandemic benefit future, post-pandemic fire management?
3. What did Internal Crisis Communication (ICC) look like within fire management organizations during the Covid-19 pandemic?

To study these knowledge gaps, this research will analyze and contribute to a project initiated by the WUR in collaboration with the FAO who called upon the fire management community worldwide to answer surveys related to the implications of the coronavirus on their job activities (Moore et al., 2020; Stoof et al., 2020). This data will be descriptively displayed by the means of SPSS and be further analyzed using a theoretical framework applying the IRGC Risk Governance Framework and Internal Crisis Communication literature. At the time of this study, fire management professionals have been managing fire under the conditions of the Covid-19 pandemic. Therefore, they have gained personal experience in what or what not to do regarding the physical and communicative obstacles in fire management. It should be noted that as this study progressed, more information became certain regarding the Covid-19 pandemic and what it would mean for fire management. This research aims to be as up to date as possible and may therefore present a development of fire-pandemic information in certain sections to be transparent on the evolution of information in certain stages of the pandemic.

This research has been structured as followed: chapter 2 introduces both the IRGC Risk Governance Framework and the ICC literature framework that will provide focus to the eventual results gathered. Chapter 3 provides a methodological explanation on how the research questions will be answered. Chapter 4 shows IRGC Risk Governance Framework (partly) applied in support of how strategy development has come to be. Chapter 5 presents the survey results both concerning strategy development and ICC. Chapter 6 combines and discusses both the results found in chapter 4 and 5 with regard to the research questions. Chapter 7 concludes this research.

## 2. Theoretical Framework

This research will make use of the IRGC Risk Governance Framework. This framework leads to understanding about the risks before it proceeds to conclude on the management of organizations. Therefore, this framework is appropriate for this research: it does not only show that strategies have adapted but it also shows what information, values, concerns and context have been considered which have led to the adjustment in strategies. This chapter described the steps of the framework which will later on be applied.

Additionally, Internal Crisis Communication literature is reviewed and gathered in a framework, to add to the communication subchapter of the IRGC Risk Governance Framework, as it did not specifically mention concepts of ICC. Therefore, this ICC framework is relevant for this research as it will show 1) the concepts that make ICC and 2) how these concepts are in their optimal state, reflecting effective ICC. These concepts can than again be measured among fire management professionals and compared with the framework to describe its status within fire management organizations (see Methodology).

### 2.1 The IRGC Risk Governance Framework

The IRGC Risk Governance Framework is a framework meant to help raise relevant questions when confronted with uncertain situations. The framework was made by the International Risk Governance Council (IRGC), a non-profit organization consisting out of different perspectives from policy makers, risk managers and more including societal context into risk assessment. Next to conventional risk analysis tools, it incorporates risk perception, social values, and different stakeholder perspective to induce more effective risk management strategies. As such, the framework can locate current and/or possible pitfalls in fire management within the process of managing the risk and provides direction in order to be able to manage these pitfalls. The framework is compiled out of five elements that are used to analyze and understand the risk management process (Figure 1)(IRGC, 2017):

1. Pre-assessment: Identification and framing; setting the boundaries of the risk
2. Appraisal: Assessing the technical and perceives causes and consequences of risk
3. Characterization and evaluation: Making a judgement about the risk and the need to manage it
4. Management: Deciding on risk implementation options
5. Cross-cutting aspects: Communicating, engaging with stakeholders, context.

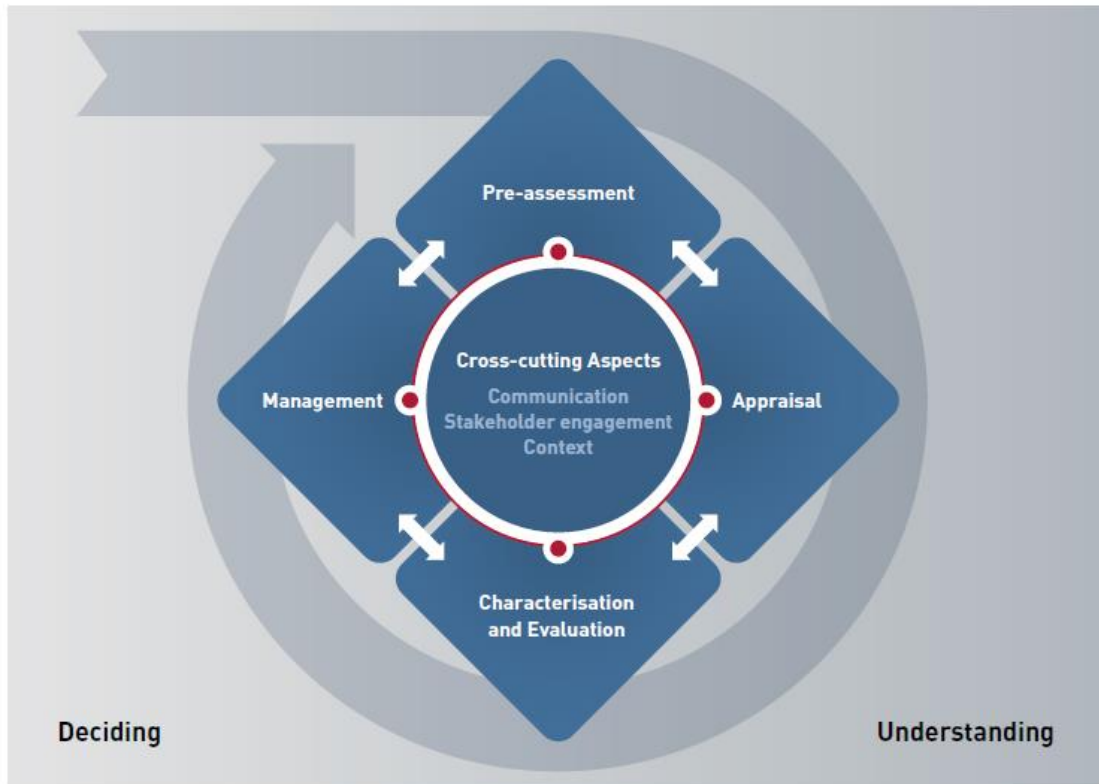


Figure 1 The IRGC Risk Governance Framework (IRGC, 2017).

The framework differentiates in understanding (appraisal) the risk and deciding what to do regarding the risk (management) to highlight the division of responsibility. For this study, especially step 4 and 5 are of great importance, since they link directly to the research questions. To create a full understanding of this framework, the steps will be discussed briefly in the context of fire-pandemic risk management. This will be done to show how much is already known about this risk (Figure 1) (IRGC, 2017).

### 2.1.1 Pre-assessment

Pre-assessing the risk is the first step within the IRGC framework, creating the baseline on how to approach and manage risks. It essentially frames the risk and uncovers how to prepare for the risk. It requires the involvement of relevant and affected stakeholders including their different perspectives on the risk. The stakeholders may reveal different angles and dimensions in relation to the risk and in turn provide different strategies to prepare for it. In short, the pre-assessment main goals are to: 1) map the different perspectives on the risk offered by relevant stakeholders and 2) to uncover what is to be determined as the risk, as well as how to handle it by the means of already available practices, indicators and routines (IRGC, 2017).

Potential obstacles in performing the pre-assessment may lie with the scope of the risk as well as the framing. Various stakeholders may have conflicting views on the risk which again may lead to a different perspective on the severity and impact of the risk; thinking it is only local but in fact could be affecting a wider scope. There is also the issue of potential 'black swan' events where there was no initial awareness regarding the risk and the hazard and is experienced as a surprise. On the other hand, a risk can be known but no warning signals in relation to the risk have been noticed or detected (IRGC, 2017).

## 2.1.2 Appraisal

The appraisal or assessment of the risk is the second element within the IRGC governance framework. The risk appraisal is meant to gather knowledge to inform the most effective and appropriate way of managing the risk. It further investigates the possible options to prevent, mitigate or adapt to the risk. This knowledge is gathered by conducting two assessments: the risk assessment and the concern assessment (IRGC, 2017). Only the concern assessment will be discussed as it says something about the concerns of those involved which can be taken into account while considering adjustments for strategies. The risk assessment measures the potential severity of the risk and is for the fire-pandemic risk mainly connected to the number of people at fire camps, the number of people having the virus in the area and the mitigation practices available, not necessarily contributing to how strategies have been developed, only stating the status of the risk (Dilliot et al., 2020; IRGC, 2017).

### The concern assessment

The concern assessment focusses on the social aspect of the risk, incorporating different views and concerns from relevant stakeholders to assess the risk. The perception of risks is influenced by several factors such as previous experience with the risk, people's values, culture, age and more. All these factors construct the same risk differently for individual people leading to a different response to the risk induced by these differences. The concern assessment takes all these values, factors, and socio-emotional aspect into account to approach the risk with all concerns in mind. When a risk becomes more complex, it becomes difficult for people to give meaning to their concerns, affecting their attitude to the risk. Therefore, it is important to incorporate the concerns and collaborate with stakeholders as it can make a difference in how to (individually) deal with the risk and create situational awareness.

Obstacles within the concern assessment could be the lack of attention to some of the stakeholders or the misinterpretation of the situation leading to inadequate confidence in the data or models. There is also the risk of misunderstanding viewpoints creating a misinformed perception of the risk (IRGC, 2017).

## 2.1.3 Characterization and evaluation

To evaluate the risk, the outcomes of the appraisal are compared to criteria regarding the acceptability of the risk. The characterization of the risk can help to determine the acceptability of the risk and advise what kind of management strategies to take. Evaluating the risk shows whether risk reduction is needed.

### 2.1.3.1 Characterization of a risk

Risks can differ from each other in terms of character. During the appraisal, knowledge has been gathered regarding the risk which may determine if the risk is relatively simple or more complex, uncertain, or ambiguous. Depending on the characteristics of the risk, decisions can be made to address the severity of the risk. For relatively simple risks, the course of action could be already known and straightforward. However, when risks are not that simple, other approaches must be considered to manage the risk safely. Different characteristics of a risk would require a different approach regarding the assessment, evaluation, and management of the risk, considering the values and concerns of several stakeholders. Risks can be characterized as complex, uncertain and ambiguous (IRGC, 2017).

- More complex risk – experience the difficulty of determining the causes regarding the negative effects occurring and understanding the sociotechnical system. Can mostly be handled with scientific research and expertise on the issue.



- Uncertain risks – are uncertain due to lack of technical or scientific data or the lack of clarity regarding the data.
- Ambiguous risks – are the result of different views on the risk. Stakeholders may reach a disagreement on the severity or probability and can also contain economic and ethical sentiments. This type of risk is heavily influenced by people’s values (IRGC, 2017).

### 2.1.3.2 Risk evaluation

The evaluation of the risk is based on all the information gathered in the previous steps of the framework. Based on this knowledge, a risk can be evaluated as:

- Acceptable → when risk reduction is perceived not to be necessary
- Tolerable → when the risk can be beneficial if appropriate risk reduction measures are taken
- Intolerable → when it must not happen, and it can’t become tolerable with risk reduction measures

There could be a few issues in evaluating a risk. As the evaluation of a risk takes an abundance of information in consideration, it could be that some groups of stakeholders are overlooked in the process, voluntarily or involuntarily. Not only stakeholders can be overlooked, but it could also be that some information that is relevant for decision-making is missing (e.g., environmental consequences or economic trade-offs). On the other hand, the excessive involvement of stakeholder could also lead to indecision regarding the evaluation of the risk. Other issues could be inadequate transparency on the trade-offs or the lack of a sustainable long-term decision with regard to the risk (IRGC, 2017).

## 2.1.4 Management

### 2.1.4.1 Risk management

As the risk has been evaluated, the next step is to take appropriate measures to address it. Risk management is the process of designing and implementing the appropriate and effective measures to address the risk. It requires assessment, evaluation, selecting strategies and options, decision-making and implementation. There are several strategies when dealing with differently characterized risks. As they are different in nature, they require different risk management measures tailored to their needs (IRGC, 2017).

- Simple risks can be handled using routine-based strategies and can possibly be managed using conventional risk management frameworks, the law, or other regulations.
- Complex risks could be managed using internal or external scientific expertise, advice and models using a risk-informed strategy. A robustness-focused strategy may also be used that would focus on the strength of the risk reduction methods to withstand the effects of an unanticipated disaster event.
- Uncertain risks need to be managed by precaution-based and resilience-based strategies. Pre-caution-based strategies will minimize the exposure to the source of risk and strengthen the capacity to cope with the risk in case of an unexpected event. Resilience-based strategies will decrease the vulnerability of the exposed people and capital. Furthermore, they aim to prepare, cope, and recover from unexpected consequences caused by the risk.
- Ambiguous risks can be managed by discourse-based decision-making in order to create mutual understanding between relevant stakeholders and to address conflicting perspectives and values surrounding the risk (IRGC, 2017).

Some problems risk management may face are linked to decision-making. There is no general organization/person responsible for possible failures in risk management, making it hard to implement regulations. Furthermore, decisions may be made to only benefit short-term issues instead of long-term issues if decisions can be made at all due to conflicting perspectives. Measures taken may also not equally affect everyone; some may suffer more problems than benefits. As such, the general public can put pressure on decision-making, resulting in short-time quick decisions that may not be beneficial (IRGC, 2017).

#### 2.1.4.2 Implementation, monitoring and review

As the measures are decided, they are implemented by the appointed agencies to apply, monitor, and review them to track their performance. Effective implementation is achieved through clear leadership and authority, communication, responsibility, a clear role division and more. Often problems arise as there is no regulatory framework is available, or structure in the process. As such, implementation can fail or the review of implemented measures is lacking (IRGC, 2017).

#### 2.1.5 Cross-cutting aspects

The fifth element of the framework is an element that occurs in every step during the framework, ensuring crucial communication, the involvement of stakeholders and the consideration of societal context regarding the risk and the measures to address it. This research only discusses the communication aspect as it is relevant for its research aim. The other elements already discuss some of the context regarding the fire-pandemic risk. Regarding the stakeholder, this research focusses mainly on fire managers and those affected by the strategies of fire managers.

#### Communication

Communication is central in the process of risk management. Communication enables information sharing, the exchange of data and the access to a large network of stakeholders in interdisciplinary fields such as policy makers, citizen, researchers and more. It ensures mutual understanding on the responsibilities within the risk management process as well as the understanding of the risk and why certain measures are taken to address it. Clear and open communication enables people to see the rationality in decision-making, ensuring trust in the process and influencing their perception on the risk.

However, in the communicative process, there may be the occurrence of miscommunication. The use of scientific jargon could be misunderstood or confusing for stakeholders such as the general public, not addressing their concerns. Consequently, it could become a one-way information sharing process instead of two-way. Furthermore, the communication used to express the risk may not convey the characteristics of the risk. For example, an uncertain risk may be interpreted as a simple risk affecting the risk perception. Some opinions or voices may also be dismissed as irrelevant, segregating stakeholders and make reaching a clear decision difficult (IRGC, 2017).

## 2.2 Internal Crisis Communication literature framework

The fifth step of the IRGC Risk Governance Framework dives deeper into the communication aspect of risk management. This refers mostly to communication with external stakeholders and the public but also to the communication within an organization better known as internal communication. Daily internal communication is what shapes the work environment and trust between and among employees, enabling the operation of an organization. In times of crisis, employees will try to make sense of situation and rely on fellow colleagues and managers to do so (Adamu & Mohamad, 2019). In crisis, an organization can use Internal Crisis Communication to maintain relations between company managers and employees and to distribute information to perform on the job (Adamu & Mohamad, 2019; Mazzei & Ravazzani, 2015). This section combines various Internal Crisis communication literature in order to display a holistic framework.

Internal crisis communication (ICC) contains wide range of aspects and principles (Appendix Figure 1). A literature review shows different reoccurring categories of importance addressing these principles: sense-making/giving, employee communication and organizational dynamics. Every category distinguishes ICC in its own way but is simultaneously interconnected with the other categories, creating an interlinking network of variables constructing ICC. The process of sense-making/giving represents a critical aspect within ICC. Sense-making/giving focusses mainly on individual understanding the crisis situation by means of collective employee communication. However, sense-making/giving happens within individually but is connected to employee communication as it influences the individual risk perception and situational understanding which eventually could lead to collective sense-making (Adamu & Mohamad, 2019; Kim, 2018; Maitlis & Christianson, 2014; Strandberg & Vigsø, 2016; Weick, 1988). The concept of employee communication represents the horizontal communication between and among colleagues (Strandberg & Vigsø, 2016). Employee communication usually happens with colleagues that employees frequently work with or form close relationships with (Adamu & Mohamad, 2019; Strandberg & Vigsø, 2016). In comparison, organizational dynamics relates to the vertical communication between senior managers and employees. It represents the extent to which employees can communicate bottom-up or top-down with other employees that are not in direct, every-day contact with each other (Adamu & Mohamad, 2019). Each category therefore has their own dimension that they display but interrelates with one another to represent ICC which is defined as *“the communicative interaction among managers and employees, in a private or public organization, before, during and after an organizational or societal crisis”* (Adamu & Mohamad, 2019, pg. 5). Each category and their most important concepts will be addressed and underlined in the following paragraphs.

### 2.2.1 Sense-making

Sense-making is a process of trying to understand the situation that has presented itself due to an unexpected, new or confusing event that contradicts previous expectations (Maitlis & Christianson, 2014). Sense-making is mainly co-determined by the factor's commitment, capacity, and expectations. Simultaneously, the severity of a crisis is determined by these same aspects, complicating sense-making (Frandsen & Johansen, 2011; Weick, 1988). Accordingly, Weick, 1988, pg. 305, states that the *“action that is instrumental to understanding the crisis often intensifies the crisis”*. So, people make more sense of the crisis situation due by engaging with their environment, meaning that while people act to understand, they bring the object of enactment into existence, making the crisis more real and present. For example, to understand ‘the Covid-19 pandemic’, an individual captures the field of experience regarding ‘the Covid-19 Pandemic’ and isolates it, putting a fence around it. This individual will now

move and act in that context and field of experience, forming their assumptions regarding the subject. This is important as individuals do not make the same field of experience, creating different levels of understanding. Individuals have different levels of commitment, capacity and expectations that determine their enactment and sense-making (Weick, 1988). On top of that, considering the example of the Covid-19 pandemic, much was still unknown at the start of the pandemic, limiting the potential field of expertise to act in (Moriss, 2020; Weick, 1988). Within the field, *commitment* helps people to make justifications regarding an action. *Justifications* create meaning surrounding the uncertainty of a crisis situation. A justification can provide sufficient structure for a person to support their view on what is going on in the situation. On the other hand, it can also blindside a person. When a person commits to an action, the person creates an explanation to justify the action which will persist into an assumption. An action is not limited to a physical form of movement but can already be, for example, deeming something not operational (Adamu & Mohamad, 2019; Frandsen & Johansen, 2011; Weick, 1988). For example, if a person makes a commitment to the assumption that the fire extinguisher is inoperable, than the last thing they would consider is to use the fire extinguisher in a time of fire, creating their own blind spot.

Secondly, one's *capacity* affect the perception on crisis. People feel a level of *capability* regarding the situation at hand. As an individual's capacity changes, so does the perception and actions regarding the risk situation. If someone feels very capable than that person can consider multiple inputs as he/she will be able to cope with it due to his/her relatively high capacity and see a change that needs to be made (Weick, 1988). The risk perception is likely to be more accurate as the person's response capacity is higher and sees the situation in context of society. The believe in one's capacity allows people to see more aspects and in turn intervene in more situations where it may be necessary (Weick, 1988). However, in a crisis, such actions may be prevented due to a shift in authority. When action-taking moves higher up the organizational hierarchy, fewer people take action or more action is taken but the same people remain to be the action takers. Consequently, this could reduce the totality of the organization competency to address the crisis and as action-taking is limited to a few, many have difficulty constructing what the crisis situation means (Weick, 1988). Capacity is further built on institutional memory and experience. Experience from the past regarding crisis can be varied and build *institutional memory*, enabling the organization to build some resilience. However, if this institutional memory is built on blindsided justifications influencing the perception on crisis, it could be inaccurate, hindering institutional memory to be an asset in future crisis management. It would be most favorable if employees possess different skillsets helping them to perceive the situation, various past experiences, and diverse justifications. A divers group of employees would be able to spot inaccuracies and hold an engaging discussion in how to go about the situation (Weick, 1988).

Lastly, *expectations and assumptions* made about the aspects of an organization often serve as an agent creating the effect of a self-fulfilling prophecy. Therefore, assumptions and expectations can increase or decrease the probability of error development within the components of an organization and help crisis prevention (Weick, 1988). For example, the expectation that fire will break out in a particular dry part of the forest during summer will put into action measures to potentially minimize the danger of such an outbreak. Similarly, if it is expected that masks will minimize the spread of the coronavirus, people may decrease their distance from each other due to newly gained increase in safety. In short, certain perceptions will put actions in motion to support and confirm the perception. Such assumption made in the higher hierarchy of an organization can lead to action without consideration and the control of other views that could filter minor errors, leading to a bigger crisis (Weick, 1988).

These three aspects co-determine sense-making. However, multiple other factors such as the quantity and quality of the information received, interpretation of the information, understanding of the situation by discussing it with others and the channel used to communicate all further influence these three aspects and therefore sense-making (Adamu & Mohamad, 2019; Frandsen & Johansen, 2011; B. F. Liu et al., 2020; Pinol et al., 1998; Schmidt, 2010; Strandberg & Vigsø, 2016; Westmyer et al., 1998). For example, it has been proven that receiving information regarding the situation does not automatically mean that the situation makes sense. In order to make sense of it, it needs to be interpreted and this is partly achieved by discussing the received information with others (Adamu & Mohamad, 2019; Strandberg & Vigsø, 2016).

ICC can be indicated with general aspects that influence the overall internal communication within an organization or institution. An aspect influencing overall ICC is the channel of communication used to communicate. The channel of communication can determine partly the effectivity of the communication between organization employees. Exemplary is the use of face-to-face meetings that have been proven to be a decisive effective way to communicate in a crisis situations (Frandsen & Johansen, 2011; Westmyer et al., 1998). Both the giving and receiving side of information prefer the use of oral communication, which make the telephone or video calling a replacement for face-to-face interaction. However, physical presence seems to also serve a purpose in meeting the communicative needs of both the giving and the receiving end. The 'personalness' or closeness provided is something people feel is needed in order to receive the communicated message properly (Westmyer et al., 1998). Other modes of communication such as the use of personalized intranet, online meetings and social media outlets can contribute to communicate to a large body of employees and follow close behind the use of oral communication but are always less preferred (Frandsen & Johansen, 2011; Strandberg & Vigsø, 2016). Therefore, the channel of communication used is one of the important factors of conveying the message properly. Next to the means of communication is the actual quality of the content conveyed. If information sharing regarding the content of the message is clear, open, and coherent than employees can feel satisfied with the information shared, enabling them to make sense of the situation. Other than their sense-making, employees develop a bond of mutual trust as they are made aware of what is happening in their organization. A way to achieve consistent and coherent information is the use of a one-voice-policy allowing only a few chosen spokespeople to communicate information throughout the organization (Schmidt, 2010). In previous research, fire management managers mainly provide messages regarding information updates. Further messages involved instruction information, how the organization is managing the crisis and how organizations are collaborating to manage the crisis. It was found that higher ups could improve and add messages with coping advice, especially in long-term crises. It was also desired to receive more messages with explanations and how the uncertainty is managed (B. F. Liu et al., 2020). Additionally, crisis situations develop fast with new information clarifying the uncertainty of the risk in short periods of time. The frequency of communicative contact surrounding an internal crisis is required to be higher for employees to be well-informed and up to date. The relationship between sender and receiver further has the influence to determine the channels used to communicate. The intensity of the relationship and the content of the message may cause the frequency of communication to go up and to use certain channels to communicate. For example, closer colleagues make more use of face-to face interaction than any other communicative medium (Frandsen & Johansen, 2011; Pinol et al., 1998; Schmidt, 2010).

## 2.2.2 Employee communication

Employee communication plays a role within internal (crisis) communication on the horizontal level. Employee communication refers to the transition and sharing of information between individuals or groups of various expertise and hierarchical order aiming to adapt the organization, implement certain actions or to coordinate daily activities (Adamu & Mohamad, 2019). Employee cooperation is needed on an everyday bases to achieve organizational goals.

Favorable employee communication is mainly constructed based on two components: the content of the information and the communication climate (Smidts et al., 2016). Regarding the content of the information, the level of information clarity communicated among employees, just as on the individual level of sense-making, determines how effective sense is made of the situation as it creates understanding on what is expected of them regarding their job but also their relationships with the management and the organization (Maitlis & Christianson, 2014). As information is received, colleagues can influence each other's sense-making and their own by the means of sense-exchanging and sense-giving. Sense-exchanging regards to the collective discussion of concepts of the organization too socially construct its identity. In turn, sense-giving does not include the discussion of concepts but solely tries to influence the sense-making and construction of meaning of others to match their own sense-making of the situation (Maitlis & Christianson, 2014). As such, it would be beneficial for an organization to meet employee needs in terms of the content of information to prevent confusion on a larger scale (Kim, 2018). In absence of the required information needed to make sense, employees rather rely on their colleagues for information than the formal sources of communication in crisis situations as, people tend to believe the information received from people in their close network. This could eventually lead to the creation and spreading of rumors in order to ease the uncertainty of the crisis situation (Kim, 2018; Reilly, 2008; Smidts et al., 2016; Strandberg & Vigsø, 2016; Waring et al., 2018). Providing effective ICC has been proven to improve employee communication in crisis situations, enabling communication between hierarchies in a way that employees are correctly and sufficiently informed of the situation and the actions the organizations will take in response to that situation. Employees also need to be sufficiently informed on their own personal role and their duties in the organization in the context of the crisis (Smidts et al., 2016).

In terms of the communication climate, there are a few dimensions that are of importance: involvement and participation, openness, and supportiveness. Employee involvement can influence the actions taken in response to the situation due this communication while simultaneously improving employee behavior (Adamu & Mohamad, 2019; Smidts et al., 2016). This can further be found in the concept of two-way communication: it focuses on a dialogue between employees to adjust their view or behavior. It distinguishes itself from one-way communication with its ability to build open and credible relationships, working towards mutual understanding and a respectful, encouraging communication strategy, involvement, and openness (Kim, 2018). Important in the construction of two-way communication is the need to listen to employee concerns, interests, and ideas. In a crisis, an organization must listen to the concerns, suggestions, and ideas of the employees otherwise they will not be able to construct the meaning of the situation due to the lack of needed information to sooth their concerns. They will also further feel not involved or enabled to have a say in the manner while the crisis definitely affects them. Therefore, using two-way communication to inform employees and involve them into decision-making would stimulate the mitigation of the crisis and results in effective internal crisis communication (Kim, 2018; Reilly, 2008; Smidts et al., 2016; Strandberg & Vigsø, 2016; Waring et al., 2018). Providing a supportive communicative environment where one is taken seriously could even have

positive outcomes for the mental health of the employees, lowering anxiety, depression, and burnouts. Especially the reliance on co-workers seems to help expressing *mental health* issues (Bronkhorst et al., 2015; ICplan, 2020). Also, it enables them to talk about their *physical well-being* (ICplan, 2020). Furthermore, leadership and supervisors can especially have influence on someone's mental health making it important to consider providing mental health support to stimulate a supportive environment for communication (Bronkhorst et al., 2015).

### 2.2.3 Organizational dynamics

ICC can also be related to the concept of organizational change. Changes within an organization cause a temporary change in stability. Such changes permit stress to influence employees as their daily job experiences change. It is recognized that strategic communication is used on the daily to continually deal with such changes. Just as with organizational changes, crisis is coped with effective internal communication. Change and crisis situations both induce effects such fear, confusion, and stress. In the case of change, individuals do not adjust on their own but are influenced by internal communication under psychological conditions. As such, organizational change and crisis are both mediate by internal communication. Therefore, the relationship between the organization and its internal stakeholders is of the utmost importance (Adamu & Mohamad, 2019). However, if a company (in)voluntarily applies ICC poorly, *the relationship with and trust of employees* will be neglected (Mazzei & Ravazzani, 2015). A lack of company and problem awareness may lead to evasive or defensive strategies facilitating difficult and inconsistent communication throughout the organization. There is a need to balance realistic and similar objectives but also listen to the concerns and expectations of employees. Creating mutual trust and commitment between the organization and its employees is considered key to effective internal crisis communication and the functioning of the company. Efforts to accomplish a healthy organization-employee relationship can be found in listening to employees, learning from their experiences and overall networking throughout the organization (Mazzei & Ravazzani, 2015). Organizations, as well as employees, would further benefit from involving employees in decision making, not only to allow them to make sense of the situation but also to improve strategy development (Splitter et al., 2019). If *employees can connect their own narrative to that of their manager/CEO*, it will allow them to discuss the topic and to raise new ideas. As employee involvement and influence grows, the more they refer to information given by managers and superiors resulting in the correct spread of information (Splitter et al., 2019).

Distributing information from top managers to their employees to gain control of the situation and to consistently communicate is better known as *top-down communication*. Next to the relationship between the organization and the employees, the *complexity, severity, magnitude, and the amount of information available* all influence the ability to spread information from the top managers to their subordinates. Due to the uncertainty of the risk, top managers may not be certain about the impact and influence of the risk on the organization, complicating top-down and bottom-up communication. Either way, top-down communication has often proven to be insufficient, leaving employees in the dark, leaving them to rely on gossip (Reilly, 2008). However, there can be different experiences regarding the sufficiency of information. Top managers usually believe that they receive a sufficient amount of information as they have occupations closer to the top. Employees agree that the top has the correct information to be distributed even though top-down information flow is often filtered through layers of bureaucracy, possibly making information distorted. The distribution of information may therefore be inconsistent because managers of different units choose what to share again and may even be lacking in

their communication skills (White et al., 2010). Administrators expressed that they often don't know what employees already know and what needs to be made clearer. Even though this is the case, both top and lower levels in the organization believed to have received *sufficient information*. Only the middle level expressed that they had too little information. However, this was not information that directly affected them: they wanted the information for the sake of having information. Employees like to be kept up-to-date even if the information doesn't affect them because it makes them feel important and needed. Being well informed is associated with feeling more connected to the organization especially if the information is coming directly from the top which builds trust (White et al., 2010). In the specific case of fire managers, top-down communication requires a certain level of leadership from higher ups. A study involving fire managers noted that to manage a crisis, managers should constantly be asking questions to not undermine the severity of the crisis. Furthermore, they should be constantly monitoring for warning signals using information gained from, amongst others, employees (B. F. Liu et al., 2020).

Not only top-down communication often needs work within organizations, but bottom-up communication seems to be generally lacking in times of crisis. *Bottom-up communication* revolves around the information that employees provide to top managers, may it be suggestions or concerns. If there is no bottom-up communication available, management may miss critical points of information clarifying the danger/risk. If there is a form of bottom-up communication present, then employees may be too preoccupied dealing with the crisis to make full reports to the managers. The contents of the report may also be adjusted to be more easily accepted by higher-ups. Furthermore, management may not be familiar with the information provided by employees if it is too technically advanced. In order for the content of the information to be reliable from employees to managers, a certain amount of trust has to be established between the managers and employees (Reilly, 2008).



## 3. Methodology

### 3.1 Research Design

This research aims to show how fire management strategies have developed over the course of the Covid-19 pandemic and if lessons could be learned from these developed strategies for future fire management. It further aims to see how fire managers internally communicated within the fire-pandemic context. These aims are mostly in service of the 'Management' and 'Cross-cutting aspects' steps of the IRGC Risk Governance Framework. Initially, (online) information regarding the 'Management' and the 'Cross-cutting aspects' was not clearly supported by fire management literature, because of limited information available of what to do in a fire-pandemic situation. As this research progressed, more information especially regarding the 'Management' step and what options could be taken to adjust existing strategies, became clear. However, how fire management professionals/organizations experienced the adjustment of strategies, if all of them applied the adjustments in strategies and whether they may be useful in the future is still underrepresented in reports and literature. Therefore, this descriptive research is designed to present 1) the direct, personal response of fire managers and their experiences regarding strategy development and ICC and 2) the secondary, online reported information on fire management strategy development to clarify and add to the experiences of fire managers. This combined effort aims to holistically represent how strategies have developed during the pandemic with its accompanying ICC.

To answer the research questions, both primary and secondary data has been collected. The primary data takes on the form of two surveys that were mostly expressed quantitatively due to the use of close-end questions. The purpose of the surveys was to display the actuality of what choices fire managers have taken regarding strategy adjustment over the course of the pandemic and to document their ICC at the time when they made such decisions. Both surveys were a case of purposive sampling were a diverse network of fire management professionals around the world and people part of Framework became the sample population. The first survey contains questions about the management strategies and was already send previous to this research and the second survey. The second survey further build on the questions of the first survey and included questions regarding fire management ICC to serve the aim of this research and was send to the same research population. The ICC data gathered from the survey was compared to the ICC literature framework to deduct the status of ICC within fire management during the pandemic

Secondary data was gathered from online reports, literature and news outlets and is qualitative in nature. The secondary data supports is meant to support the data gathered in the surveys regarding the adjustments made to existing strategies by applying the IRGC Risk Governance Framework.

As the events of Covid-19 in combination with fire management already required the full attention from fire management professionals, this research refrained from doing interviews to be mindful of their time and stress. Instead, surveys were conducted to still collect a large amount of data in a relatively short period of time from a diverse group of fire management professionals.

## 3.2 Survey

### 3.2.1 Procedure

Two surveys were conducted in the time span of one year. On the 17<sup>th</sup> of April 2020 the survey under the name 'Wildland Fire Management under Covid-19' was distributed among fire management professionals around the world through the network of the Wageningen University & Research (WUR) and the Food and Agriculture Organization (FAO). This first survey distinguishes several categories of questions, being: 'About your organization', 'General fire management', 'Fire suppression in Covid-19' and 'Fire training, risk reduction, readiness and recovery'. These questions included topics such as the concerns for Covid-19, the impact of Covid-19 on fire management practices and the capacity to deal with Covid-19 implications among others (Moore et al., 2020; Stoof, 2020; Stoof et al., 2020).

The second survey was a follow-up to check in with fire management professionals and how they have been doing in the Covid-19 circumstance since the first survey. Specific questions were added for this research. The survey was distributed on the 22<sup>nd</sup> of February 2021 under the title 'Wildland Fire Management under Covid-19 – Second Survey'. Similar to the first survey, the survey a year into the pandemic had the same categories; however, some questions were altered in phrasing, and new ones were added to get insight on what has been learned during the time fighting fire in the pandemic. Furthermore, two more categories of questions had been added: 'Mental health and work-life balance' and 'Organizational communication'. 'Mental health and work-life balance' further addressed the mental stress among fire management professionals and the support offered. The category 'Organizational communication' included questions representing the concepts of ICC to be measured among fire management professionals and their ability to make sense of the Covid-19 situation in fire management. These questions represented the concepts of ICC to be measured among fire management

### 3.2.2 Sample

A total of 492 fire management professionals from different agencies and jurisdictions (policy, incident command, support specialists, etc.) responded anonymously to the survey at the beginning of the pandemic. Approximately 40% of the respondents are located in the United States of America. Following the USA, the most respondents came from Spain, Italy, South Africa, Australia, Portugal, and Canada (between the 12 and 25 respondents per country). Around 20% of the respondents did not answer the question on which country they were stationed at. Fire management professionals from 38 countries responded to the survey from several levels of jurisdiction (province/state, national, local, international, tribal).

The second survey had 95 responses from fire management professionals. Most of the respondents were located in the United States of America (19% of the respondents) just as in the first survey. Following the USA, the most respondents came from the United Kingdom of Great Britain and Northern Ireland, Canada, Spain, and Mexico. 24% of respondents did not specify the country that they are based at. Fire management professionals from 21 countries answered the questions from the second survey. 24% of the respondents did not mention which country they were from.

### 3.2.3 Measurement instruments

The both surveys were mainly constructed out of close-ended questions on a 6-point Likert-scale with some additional open-ended questions to clarify the answer given in the close-ended question using the program Qualtrics. Most questions measured 'Not at all' at the point zero of the scale with 'Very much

so' at point five of the scale. Some questions used 'Strongly disagree' at the zero point and 'Strongly agree' point five. A few questions used 'Less than before the pandemic' at point zero and 'More than before the pandemic' at point five. Occasionally, questions were posed where they were given 4 options to choose from: 'Not at all', 'No more than usual', 'More than usual', and 'Much more than usual'.

### 3.2.4 Analysis

Both surveys had questions addressing which strategies and practices changed and what would be done with them in the future. Using SPSS, the distribution, mean and standard deviation regarding the answers was analyzed to show their development and potential as experienced by fire management professionals. If a question was included in both surveys, the answers would be converted to percentages to make up for the difference in response rate in order to be able to compare them. This enables a relative comparison. Furthermore, several close-ended questions can be complemented by the accompanying open-ended question to interpret the results. Answers without clarification could be, if possible, supported with the gathered qualitative data from the online sources.

Regarding the questions measuring ICC concepts, the mean, standard deviation and distribution were also measured. In addition, Spearman correlations were performed to seek relations of association between the concepts, providing insight in the connection between the concepts in fire management context. Eventually, these results will be compared to the ICC literature framework to determine the status of fire management Internal Crisis Communication.

The ICC literature framework displayed concepts that are measured in the survey one year into the pandemic. It should be noted that sense-making is made out of general aspects, commitment, capacity, and expectations of an individual. However, 'commitment' and 'expectations' are too complex to phantom in the scope of this research and the research method used, and therefore will be disregarded in this research.

### 3.3 Online sources

Online literature, fire management reports and newspapers are being used to gather information about adjustments made to management actions, the development of action taking, what concepts construct ICC and the context of fire management in the Covid-19 pandemic. This in turn is used to apply the IRGC Risk Governance Framework to show the deliberation behind the development and adjustments made to existing fire management strategies found in online sources next to the practical experience gathered from the surveys. Online sources could further support or add to survey outcomes. The main search engine used was Google Scholar together with Google for news reports and fire department websites. Search terms used vary from 'Health regulations for fire managers' and 'Affected wildfire management strategies under Covid-19' to 'Internal communication' and 'face-to-face sense making'.

In the following chapter the IRGC Risk Governance framework is (partly) applied. Chapter 5 will follow up with the analysis of both surveys resulting in three separate sections, first displaying the overall influence of Covid-19 on strategy taking with its possible limitations and benefits for the future. Secondly, three branches of fire management strategies and their development are analyzed: 'Shelter and evacuation', 'Fuel management' and 'Community engagement'. Lastly, the different aspects of ICC as have been measured among fire management professionals are showcased: 'Sense-making', 'Employee communication' and 'Organizational dynamics'.

## 4. Grey literature study: applying the IRGC Risk Governance Framework

In this chapter selected steps of the IRGC Risk Governance Framework have been applied to the fire-pandemic risk relevant to the eventual strategy development and communication efforts. This research is mostly in service of adding information to step 4 and step 5 of the framework. However, other steps have been, partly, applied to the fire-pandemic risk to 1) provide context of the fire-pandemic risk in combination with fire management and to 2) show the issues and deliberations that have eventually led towards the actual development of management strategies. The steps in the framework showcase issues that should be/will be taken into account while considering the adjustments that are going to be made. The focus especially lies on existing strategies such as fuel management, shelter and evacuation practices, and community engagement.

### 4.1 Pre-assessment

As fire management in the pandemic progressed, it became more evident how both the risks of the pandemic and fire intertwined and what for implications they would have on the performance of fire management. In the following sections, elements, and practical influences of the fire-pandemic risk in society and fire management are displayed to gain deeper understanding of the risk and to illustrate the deliberations that should be taken into account in developing and adjusting fire management strategies for in a pandemic (IRGC, 2017). Existing strategies and response suddenly faced problems that need to be taken into account when adjusting management strategies. Influences on shelters, team response and fuel management will be discussed in this section as social distancing mainly complicates strategy taking. Closing off, experiences that are somewhat similar to Covid-19 will be reflected on to see if problems regarding fire fighting and diseases have been encountered before and been learned from which could be beneficial for the adjustment of existing fire management strategies.

#### 4.1.1 Shelters

Sheltering and evacuating those affected by fire are partly the duty of fire managers. Now, concern lies with the relocation of residents affected by fires due to Covid-19. They are typically sheltered in large but crowded locations such as a church or gymnasium, risking exposure to the coronavirus. The circulation of infectious diseases in shelters is not something new. In the past, the norovirus compromised evacuation shelters and resulted in sometimes hundreds of cases of infections.

Furthermore, there is concern for the already vulnerable communities. Smoke has been known to cause a higher amount of hospitalized people due to respiratory illnesses. Extra exposure to the coronavirus could potentially worsen their symptoms putting additional pressure on health care facilities (Clark-Ginsberg et al., 2020; Karmarkar et al., 2020).

Moreover, community engagement programs are, among other things, used to educate civilians on what to do in case of fire (Department of Fire and Emergency Services, 2016). However, at the start of the pandemic the survey showed that education programs have been put on hold or have partly been continued online. Therefore, changes in shelter and evacuation protocols that need to be made may potentially not reach civilians that will be affected by fire, as shown in the next quote from a survey respondent: *“In my organization we have had to cancel and/or postpone such (community engagement) activities already. We are not sure if there will be adequate participation when we’ll try it in late May or June.”*

#### 4.1.2 Team response & social distancing

Fire management professionals often work closely together during duty, travelling and sometimes living together. Living/working so closely together is experienced to be necessary as it creates the team unity that enhances fire response. Moreover, just as in shelters, fire camps have had a history of circulating diseases, providing some experience and insights in how the coronavirus may circulate in camps. (Clark-Ginsberg et al., 2020). However, the introduction of social distancing in order to mitigate the spread of the virus seemingly has made it difficult for fire responders to operate closely and work together at fire sites or simply eat together at fire camps and is even perceived as impossible (Clark-Ginsberg et al., 2020).

Furthermore, social distancing may keep one's physical health stable, but this can instead deteriorate the mental health of fire management professionals. It has been reported that isolation as well as the inability to exercise and socialize results in a higher rate of depression and anxiety. Firefighters especially are more prone to PTSD and the pandemic is amplifying it in several ways (fear of getting infected and losing work, longer shifts due to sanitizing equipment, more calls with less staff available)(Fitch & Associates, n.d.; Lamplugh, 2020).

#### 4.1.3 Fuel management

The management of fuel laying on forest floors is an important measure to mitigate the intensity and reach of fires. An example of a complication with social distancing in fire management can be found within managing fire fuel: most fire management organizations stopped their prescribed burning to comply with the social distancing regulations as the effects of the virus were still unknown. (Government of Western Australia- Department of Biodiversity Conservation and Attractions, 2020; Jlevans3, 2020). However, the choice to continue or delay burning varied per country/state or organization. In the USA, federal agencies have halted their prescribed burning in response to the pandemic and some states maintained a burn ban (Fisher, 2021; Jlevans3, 2020; NCFs, 2021). On the other hand, in the south of the USA, many acres of land is private property and prescribed burning is continued by organizations, private owners and NGO's (Jlevans3, 2020). Some organizations, like Cal fire, never stopped their prescribed burning at all due to the high risk of fire (McCarthy, 2020). Nevertheless, if organizations are planning on burning, it is suggested by NC state university to comply with local jurisdiction's regulations and be able to ensure the safety and the health of the personnel and otherwise, not burn at all (Jlevans3, 2020).

#### 4.1.4 Similar experiences to Covid-19

In fire management literature there are a few studies available regarding the disease among fire management personnel. However, this is mostly connected to illnesses caused by smoke or the change of core body temperature due to intensive firefighting (Bowman & Johnston, 2005; Regan et al., 2011; M. R. West et al., 2020). Nevertheless, there is little literature available to help prepare for diseases within fire management ranks on such a scale as a pandemic, as fire management strategies are not designed to handle such a disease occurrence. It is a constant learning process, where the current experiences gained teaches fire management professionals what the (wild)fire-pandemic risk actually is. As Cal Fire Battalion Chief Head expressed: *"None of us have had to do this before. None of us have had to deal with a major pandemic during wildfire season."*(Gibbens, 2020).

One of the few personal experiences fire managers can have that is in ways similar to the coronavirus can be found in fire camps (Clark-Ginsberg et al., 2020). Exemplary is the 'camp crud' which describes the annual transmitted combination of upper and lower respiratory illnesses within a fire camp

accompanied with coughing and fatigue (Pedersen, 2017; Sharkey, 2008). All kinds of illnesses are covered by the camp crud from a flu to athlete's foot and is it known to spread quickly and bench fire fighters from fighting fires (King, 2020). A lack of hygiene and poor physical conditions combined are facilitators for fire managers to get ill (Pedersen, 2017). Some say that Covid-19 is the new camp crud but it differs from the usual camp crud in intensity, scale and the counter measures available (King, 2020; Thompson et al., 2020). Challenges faced during the camp crud may therefore be recognized in the case of the coronavirus, giving (wild)fire managers initially some tools and regulations to respond to Covid-19 implications in fire camps. Examples of such tools are wash hands more frequently, increase personal hygiene efforts and managing the balance between work and rest. (Clark-Ginsberg et al., 2020; Pedersen, 2017).

## 4.2 Appraisal

Apart from the practical implications on fire management, those affected by the fire-pandemic risk and adjustments in strategies have their own personal perspectives, values and concerns: fire management professionals and residents in fire prone areas. Adjustments that need to be made to strategy taking can take into account these perspectives and concerns which in turn could optimize the strategy so it will be understood and accepted (IRGC, 2017).

### Concern assessment

Looking into the perspective on the fire-pandemic risk among fire management professionals, it seems that little has been reported. Struggles related to managing fire, the coronavirus and the services provided to counter the risk are relatively well disclosed in news articles but there is no specific information regarding individual fire management personnel stories and their perspective on the fire-pandemic risk. Only general concerns of fire management personnel became known. Especially in the starting phases of the pandemic, circumstances were uncertain as the effects of the coronavirus on fire management work ethics slowly became more clear whilst the procedures to counter the virus effects were still questioned and developed: the effectivity of social distancing, vaccines and other measures enforced by governments still needed to be determined (Clark-Ginsberg et al., 2020). As the pandemic continued on, a big concern of fire managers seemed to be the potential lose of work due to being sick because of the coronavirus (Lamplugh, 2020).

In contrast, residents of Wildland-Urban Interfaces (WUI) affected by fire did not think that they would respond differently to a fire outbreak due to the emergence of Covid-19 (the respondents of this research consisted out of more men than woman and were relatively older)(Edgeley & Burnett, 2020). Generally, residents expected that they could remain safe from the fire while keeping a safe distance to prevent transmitting the coronavirus. Residents were not as worried for their own preparation efforts, there was more uncertainty about the influence of Covid-19 on fire management practices and support. In cases of lower risk perceptions among residents, that is partly due the lack of education on what the fire-pandemic risk would be (Edgeley & Burnett, 2020).

## 4.3 Characterization and evaluation

In characterizing the fire-pandemic risk based on to be simple, more complex or ambiguous, fire management organizations can estimate what kind of strategies to take or adjust to (pre-caution based, routine-based, resilience based, etc.)(IRGC, 2017). The characterization discusses the issue of the fire-pandemic risk being a hybrid risk and how this may complicate strategy adjustment.

### 4.3.1 Characterization of the fire-pandemic risk

Even though the pandemic put several fire management practices on hold (e.g., fuel management), the general view on the necessity of fire management remained unquestioned. The emergence of especially damaging wildfires in 2019/2020 in Australia, the USA and the Amazon, among others, led fire management to prepare for the next fire season with more restrictions than ever (Field & Appel, 2020; Groom, 2020; Jlevans3, 2020). Some fire chiefs expressed that it is not just a season anymore but a whole year of fire (Westover, 2015). Politicians are also convinced that managing fire is essential due to the devastating damage fire can bring (The White House, 2021; U.S. Department of the Interior, n.d.). Nevertheless, the world is also convinced that the risk of Covid-19 needs to be acted on (Tal Axelrod, 2020). Managing the risk of fire while simultaneously reducing the risk of Covid-19 seem to hinder each other, not being able to do one with maximum effort at the expense of the other as could be seen in the pre-appraisal. And therefore, perspectives may clash. Actors might feel that that Covid-19 has overshadowed other disasters such as intense fires. However, others may feel that managing the pandemic is priority number one (Brimicombe et al., 2020; Energym, n.d.; Tal Axelrod, 2020). In reality, is one risk more important than the other? In the world multiple risks happen at the same time and people learn to prioritize the risks based on their experience, gender, age, trust in support agencies, etc. For example, women associated both the risk of Covid-19 and fire to be higher than men. There is also an optimist bias present were people don't think the negative effects of both risks will affect them (Edgeley & Burnett, 2020). This may bring ambiguity to the fire-pandemic risk: perspectives may vary on which risk to prioritize, influencing fire management strategy taking and adjusting. The occurrence of this hybrid risk could complicate decisions on how to adjust fire management strategies in order to both manage fire and Covid-19: one adjustment may be more in favor of countering Covid-19 than managing fire.

However, it may not be this black-and-white as now wildfire smoke seems to enhance the susceptibility to the coronavirus, intertwining both the coronavirus and wildfire as a danger that simultaneously does physical damage with fire and respiratory damage with smoke and corona (Edgeley & Burnett, 2020; Partlow, 2021). Researchers could explain 15% of mortality caused by the coronavirus globally as air pollution affects the susceptibility to Covid-19 (Leifer et al., 2021). The latest study even showed that some counties in California and Washington, who were heavily impacted by wildfires, displayed an average of 20% of the corona cases that were related to high levels of wildfire smoke in the air. One county could even link 41% of their corona cases back to wildfire smoke inhalation. In over 90 other counties, the high percentage in deaths could also be linked back to the level of wildfire smoke present (Partlow, 2021). Ideally, adjustments to strategies would benefit both fire management and countering the virus simultaneously.

Concluding, ambiguity regarding the risk may rise due to different experiences with both risks (e.g., fire managers may have a higher tolerance on what an acceptable risk is due to their frequent exposure) and may call for different views on how to handle the situation (West, 2021). However, both risks are not mutually exclusive needing them to be both handled. Furthermore, disputes within fire departments brought about by the vaccination debate on whether to get vaccinated and if that should be mandatory for fire managers can potentially affect the number of personnel available for managing fire and their performance (LA Times, 2021; West, 2021). In line with the above, the fire-pandemic risk can potentially be ambiguous but seems to be more of a complex risk in accordance with the IRGC Risk Governance framework. Nevertheless, the character of the risk seems to be rather more flexible than fixed as measures evolve and compromises are being explored (Partlow, 2021).

### 4.3.2 Risk Evaluation

The fire-pandemic risk can with proper mitigation measures be reduced to tolerable levels. From practice it has been noticed that the spread of the coronavirus can be somewhat managed with risk reduction measures making it not an intolerable risk. Vaccines, masks, and social distancing, improved hygiene among others in combination with sufficient fire management mitigation tools, such as enough personnel, vehicles, supplies, etc., can bring the risk to tolerable levels as it allows fires still to be handled with adjustments made to existing strategies (Sok, 2021; U.S. Department of the Interior, n.d.; WHO, 2020, 2021). However, as mentioned before, some of these practices may hinder each other to be less effective (e.g. social distancing makes it hard for fire management to perform large scale prescribed burnings)(Jlevans3, 2020). Views may clash on whether some of these measures trying to mitigate Covid-19 and fire at the same time need to be practiced at all. Therefore, clear plans and protocols are needed to manage the risk properly.

## 4.4 Management

In accordance with the risk characterization, this section showcases written measures and protocols that have been proposed for fire management (professionals) in order to manage fire under the circumstance of the pandemic with regard to shelter & evacuation measures, fuel management and community engagement. Next to strategy-specific suggested measures for fire management, governments have also made measures for the general population that further apply to fire management professionals that need to be incorporated in their practices.

### 4.4.1 Risk management

To mitigate the effects of the pandemic, general country wide management implications are determined by the governments informed by scientist. Pre-caution based strategies are currently most applied to mitigate the effects of the coronavirus as resilience-based strategies are scarcer. These individual pre-caution based measures taken are wearing masks, social distancing, hygiene protocols, limited amount of visiting people at home, national lockdown, self-quarantining, working from home and homeschooling, travel restriction, penalties when measures are ignored and more (BBC, 2020; Rijksoverheid, n.d.-b, n.d.-a, 2020). The vaccine is an example of a resilience-based strategy. As the pandemic progressed and more people increasingly got vaccinated, governments became more flexible in their regulations maintained and started carefully lifting measures as social distancing and wearing masks(Miller & Balsamo, 2021; Rijksoverheid, 2021; Shepardson, 2021). For fire management there were some additional measures already in place such as limiting the amount of firefighters per vehicles and in some cases living together isolated from other people (Stoof et al., 2020).

Next to the general strategies maintained by governments, specific for the fire-pandemic risk, fire management has managed to make protocols that offer options to adjust existing practices to cater to both managing fire and keeping safe from the pandemic. The adjustments suggested for fire management during the pandemic are briefly discussed below.



#### 4.4.1.1 Shelters

Social distancing complicates shelter procedures as less people can be sheltered in the same space. In response, four pre-caution-based suggestions were made to enhance shelter procedures for Covid-19:

**1. Elevate the capacity of shelters, especially in vulnerable communities**

Increased demand for shelters will mostly come from communities that are vulnerable as more people seek and need shelter. To comply with physical distancing the capacity of shelters needs to be conform to the amount of people estimated to need shelter (Campbell et al., 2021).

**2. Reduce the reliance on large mass shelters, adjust their design and collaborate with local partners**

Other options may take on the form of reducing the shelter population size by seeking and expending to generally unconventional shelter spaces. This divides the number of evacuees over more space, enabling them to socially distance. Collaborations can be made with hostels, hotels and B&B's, schools, churches, student dormitories and campgrounds in the area to shelter people from fire while still being able to socially distance. However, this could be logistically complicated if services such as food catering, hygiene procedures and basic supplies need to be provided when evacuees are scattered (Campbell et al., 2021). Another option may be that evacuees themselves secure a place to stay beforehand (Edgeley & Burnett, 2020).

**3. Incorporate additional safety measures in shelter design**

Health measure can be taken which may include wearing masks, testing, monitoring and isolating spaces in shelters for people who may have been in contact with the virus (Campbell et al., 2021).

**4. Seek more personnel and adjust training plans**

Increasing the number of shelters and their capacity will require more shelter staff. Additional shelter staff may be found with students looking to fill their clinical hours or internships, concert and event personnel, community emergency response teams or reserve medical corps. While training old and new staff it should be ensured that the practices are following public health regulations. The training should increase their ability to explain the procedures in an understandable manner to evacuees as well as explain why the procedures are important to increase their motivation to perform the job (Campbell et al., 2021).

#### 4.4.1.2 Evacuation

Regarding evacuation protocol, three options have been proposed:

**1. Addressing the support needs of the people affected**

An assessment of the population is needed to locate people who are vulnerable, most likely to experience disaster and are more likely to become ill with the coronavirus. Furthermore, if there are any boundaries to the evacuation process, support should be offered or be discussed with multiple agencies in order to coordinate the support (Campbell et al., 2021).

**2. Transportation planning**

Existing transportation providers may experience a shortage of personnel in times of fire, leading to an increased demand of transportation staff. Moreover, transportation services can be modified to comply with public health regulations by wearing masks, increased sanitation, social distancing and ensuring personal protection equipment for drivers and riders. Next to public

transportation is the use of personal vehicles. Evacuees often carpool and need to be informed on the possible difficulties they might face (closed facilities, maximum shelter capacity, shelter location changes) (Campbell et al., 2021; Kuligowski & Gwynne, 2020). Moreover, evacuees need to be aware of the precautions they can take to minimize exposing others and themselves to the virus at travel destinations and in cars. While traveling with multiple households it can be advised to wear masks and to roll down the windows to enable airflow even if no one is experiencing symptoms. Emergency kits can also be helpful and be put into the car beforehand with masks, sanitizer, and protective equipment for rapid sudden hazards. To guide evacuees, geographic specific messages can be spread with information regarding areas with the highest risk and where evacuees can seek shelter and be informed on the capacity of the shelter. This will prevent evacuation towards unsafe areas or full shelters (Campbell et al., 2021).

### **3. Adjust evacuation guidance**

Evacuees may have concerns regarding the evacuation process and whether it can be safely done with the coronavirus, especially under the more vulnerable population. Evacuees (un)consciously prioritize the risks they face at the moment of crisis. Therefore, their concerns need to be addressed and tools need to be provided to safely proceed. News outlets, weather forecasters and health officials need to coordinate on a clear message if the immediate threat of extreme weather is more dangerous than being exposed to the virus and provide clear instructions on how to still be safe while evacuating. Updated information on best practices to how to keep their distance, wear masks, and not sharing food and water, need to be provided (Campbell et al., 2021).

#### **4.4.1.3 Fuel management**

Early in the pandemic, if organizations choose to continue to burn fire fuel instead of cancelling/postponing, some practical options could be considered as burn units might have been limited or sick. Burning areas could be considered that are smaller or less technical to burn to only need the minimal amount of personnel. Organizations could also choose to use burn units that already had well-defined fire breaks (e.g. a strip of open space in a forest) so that on the-day-of, fire break preparations can be made with a minimal amount of personnel (Jlevans3, 2020; Merriam-Webster, n.d.). Lastly, instead of burning, mechanical treatment and chemicals could be used instead of prescribed burning when that is not possible (Jlevans3, 2020).

Later on as the pandemic progressed, between January and June 2021, depending on the state, country and organization, organizations started their prescribed burning again as the burn ban lifted and the threat of catastrophic fires became more real the longer burning was postponed (Fisher, 2021; M. Liu, 2020; McCarthy, 2020).

#### **4.4.1.4 Community engagement**

Fire departments often have a plan to engage and involve communities in their area. Inclusion of communities and residents in issues that impact them, increase their capacity and ownership regarding the results of their actions. Collaborating with communities means strengthening the understanding of the risk of fire through education, creating trust, self-reliance, capacity and being able to adapt to the circumstances (Department of Fire and Emergency Services, 2016; Northamptonshire Fire and Rescue Service, n.d.). Online sources do not reflect how community engagement have changed during the pandemic. However, as educating and working with communities is not possible in person, some fire

department have made an effort and sought other options in the form of online engagement such as with videos, social media, games and blogs (National Fire Protection Association, n.d.).

#### 4.4.2 Implementation, monitoring and review

The review and monitoring of implemented strategies is what this research contributes to. More on this will be presented in chapter 5.1 and 5.2 and will be further discussed in chapter 6.

### 4.5 Cross-cutting aspects

#### Communication

The uncertainty due to the lack of information of what the pandemic would mean for fire management, means that fire management personnel are trying to move forward without the information needed to make sense of the situation (Kim, 2018). In times of uncertainty, it is especially important to communicate well with all involved stakeholders in order for them to make sense of the situation and be able to continue their work (Adamu & Mohamad, 2019). This is something ICC provides. However, inadequate communication may lead to more confusion amongst colleagues and may not satisfy their needs to move forward (Kim, 2018). More on the status of internal crisis communication among fire managers which will be presented in subchapter *5.3 Internal Crisis Communication status within fire management* and chapter 6.

## 5. Survey results

### 5.1 Development of strategy taking

In the survey a year into the pandemic, three orienting questions were posed to seek out the general influence of Covid-19 on fire management strategy presenting limitations, benefits, and future plans for strategies in correspondence with the second research question (Figure 2). Next, both surveys included overlapping questions targeting specific strategic actions to be taken to functionally operate fire management in times of Covid-19. These questions offer a more in-depth analysis of specific strategies based on the experience gained during the fire season, showcasing their development, and providing insights regarding the first research question. Strategic actions regarding shelters, evacuation, fuel management and community engagement have changed from the early stages of Covid-19 to the experience-rich fire management with Covid-19 that is experienced in 2021.

#### 5.1.1 Overall influence of Covid-19 on fire management strategy taking

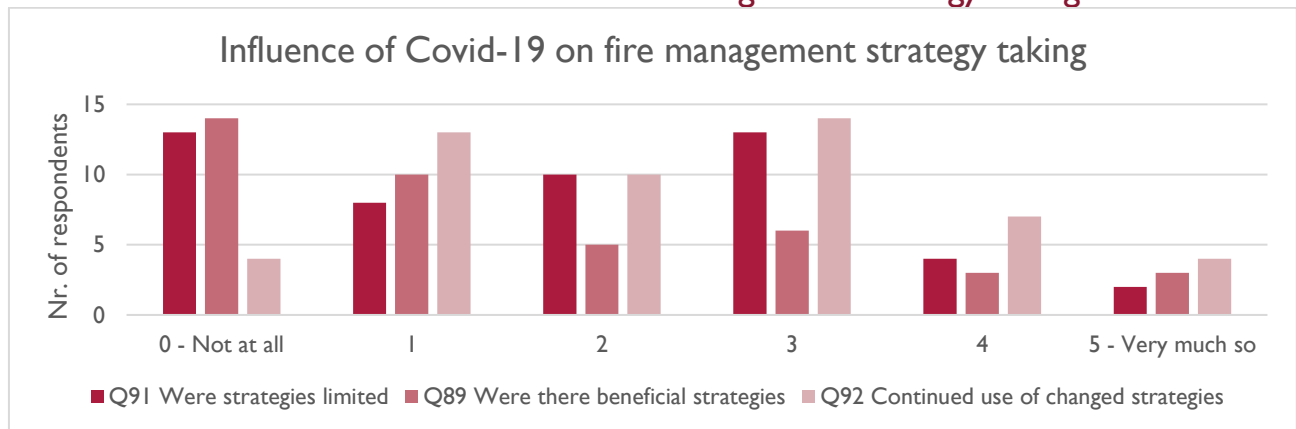


Figure 2. The influence of Covid-19 on general strategy taking. The graph displays if fire management professionals feel that existing strategies are limited, if they have experienced advantages due to a change in strategies caused by the pandemic and if they are going to continue using the changed strategies.

#### 5.1.2 Limitations in strategies due to Covid-19

Most respondents did not think that overarching fire suppression strategies were limited under Covid-19. However, it can be deduced that a group of participants of the same size have experienced somewhat limitations but not so bad that they could not operate fire suppression strategies anymore (Option 3 - 26% of respondents). There is only a small percentage that have experienced definite limiting effects under Covid-19 (Figure 2). The survey provided respondents with an open space to share their experience and the following limitations were found:

- Social distancing is expected to be complicated within fire management practices.
- Less wildland fire use options were available due to public health concerns about the combination of smoke and Covid-19.
- Less resources were available to respond to fire and a reduction of intermittent patrol with a general lower response to interagency wildfire. Furthermore, resources to collaborate with external contractors were reduced.
- Less crews are available and the ability to conduct groupwork has been affected.
- Multiple infections happen simultaneously (but strategically placing aircraft and support staff could reduce this).

### 5.1.3 Benefits from the changes made in strategies due to Covid-19

In comparison with the question discussing limited strategies, even though most respondents did not think that Covid-19 limited their practices, many did not find the effects of Covid-19 at all beneficial for fire suppression (Option 0 – 34,1%) (Option 1- 24,4%). Again, the survey provided open space to explain answers given were respondents shared their experience:

- Usually, fire camps made it effective to go to work but now crews arrive in fewer numbers and would have to work harder. On the other hand, someone argued that reducing the traditional use of fire camps to a support function and the need for multiple crews to mobilize and return could in turn reduce camp crud and encourages self-sufficiency within organizations and crews.
- The additional health precautions prevented the staff from having normal flus and colds.
- More attention is paid to health and safety which is beneficial for fire management.
- Limited resources are being used more wisely.
- Next to fighting wildfire, firefighters have other responsibilities but many of those responsibilities were reduced/stopped which made additional staff available to assist in fire response.
- There is more focus on indirect strategies and on the ‘why’ we suppress a fire and what accompanying benefits can be gained.

### 5.1.4 Future plans for changed fire management strategies

When asked which strategies changed and if they will continue to keep those changes, some are clearly to be continued and some are clearly to be stopped. Of the mentioned strategies almost all have experienced a wholehearted change since the start of the pandemic except for the number of vehicles and type of transport used. From those mentioned strategies, most respondents would stop current changes made concerning physical separation, controlling group sizes and number of (people in) vehicles. However, when answering the survey a year further into the pandemic, some fire management professionals were still uncertain about stopping those strategies. Changes in personal hygiene, cleaning of surfaces, communication through virtual technology and digital documentation are to be continued by most organizations. Lastly, the strategy met with the most uncertainty is how to set up fire camps after the pandemic (Figure 3 and 4).

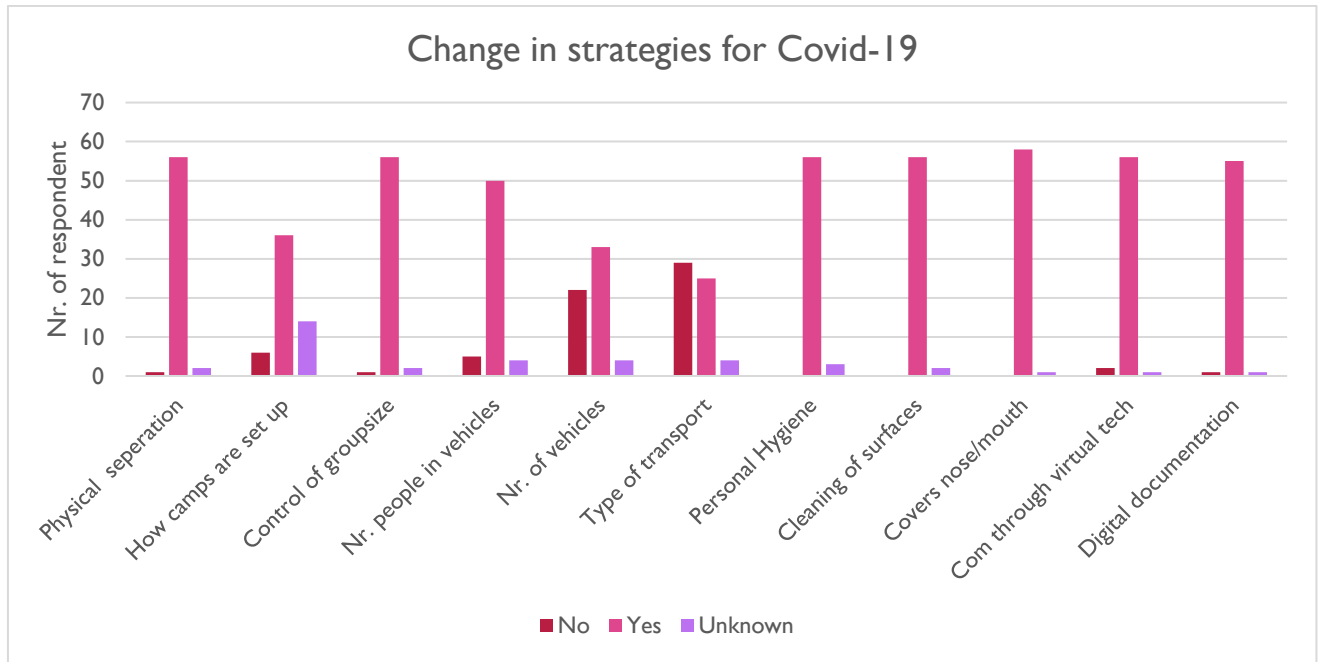


Figure 3. Strategies in fire management that have or haven't been changed during the occurrence of Covid-19.

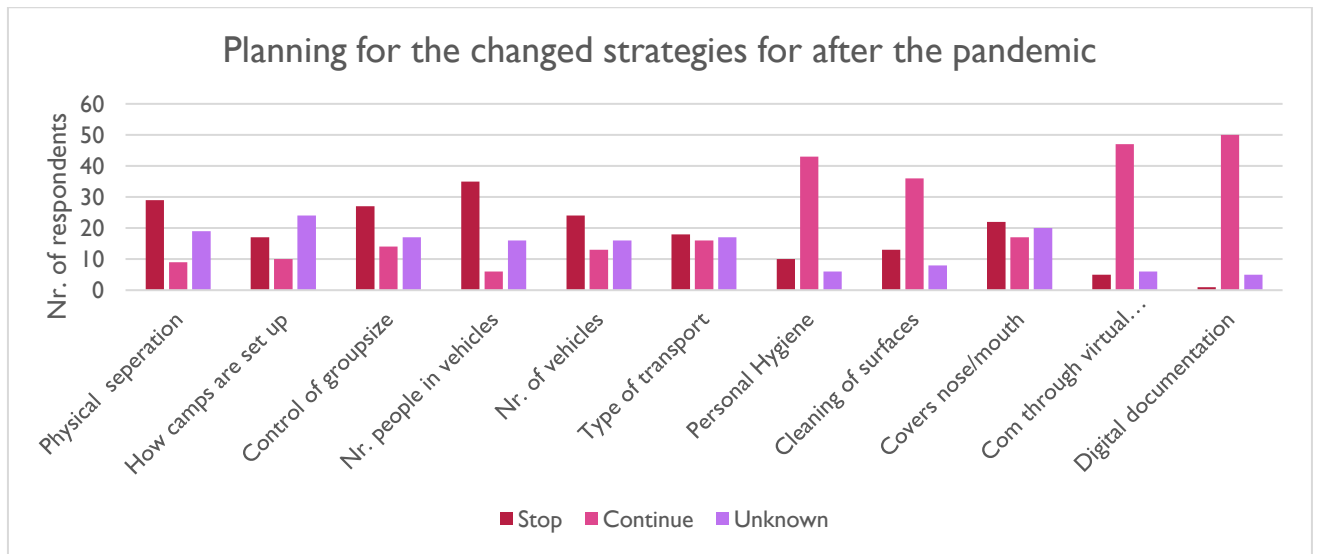


Figure 4. Planning for the strategies in fire management that have changed during the occurrence of Covid-19 and if they will be continued or stopped.

## 5.2 Experiences in strategy development

Specific strategies in accordance with the general practice of fire management have been included in the first and second survey. As can be seen in Appendix Table 1, most means lay between the three and the four on the scale. However, the distribution offers a more interesting insight. This section presents the distribution specific to the strategy and offers a comparison of the strategies one year apart. This comparison shows the expectations per strategy versus how fire management professionals have experienced it, with an occasional explanation why.

### 5.2.1 Shelters and evacuation

At the start of the pandemic most respondents very much so expected a change in community evacuation and community shelter procedures during Covid-19 (Option 4 – 29,7%) (Option 5 – 27,2%) as many proclaimed in the accompanying qualitative question that the usual use of community shelters wouldn't be possible in the same way as before Covid-19, but also not knowing how to approach the situation. Some respondents made it known in the accompanying qualitative survey question that evacuation is generally more important than getting infected by Covid-19. On the one hand, some believe that focus on hygiene and separation is possible, but it will be a concern when a large group needs to be evacuated, and some respondents doubt that the air in shelters will stay clean. However, it was expressed that all precautions most likely will go out the window when communities are burning. Some mentioned that evacuation is under the jurisdiction of the municipality or other local/regional authorities. There is also the issue that in rural tribe communities' evacuation orders are seldom enacted under normal circumstances, forget the Covid-19 circumstances.

One year further in the pandemic, two separate questions relating to the shelter and evacuation. Most expressed somewhat of a change in the number of shelters used (option 3 – 36,4%) with a normally distributed curve (Figure 5). The second question in Survey 2 targeted the experienced change in the total nr of people in a shelter. Most respondents definitely experienced somewhat of a change in the total amount of people in a shelter (option 3- 5 – 66,7%).

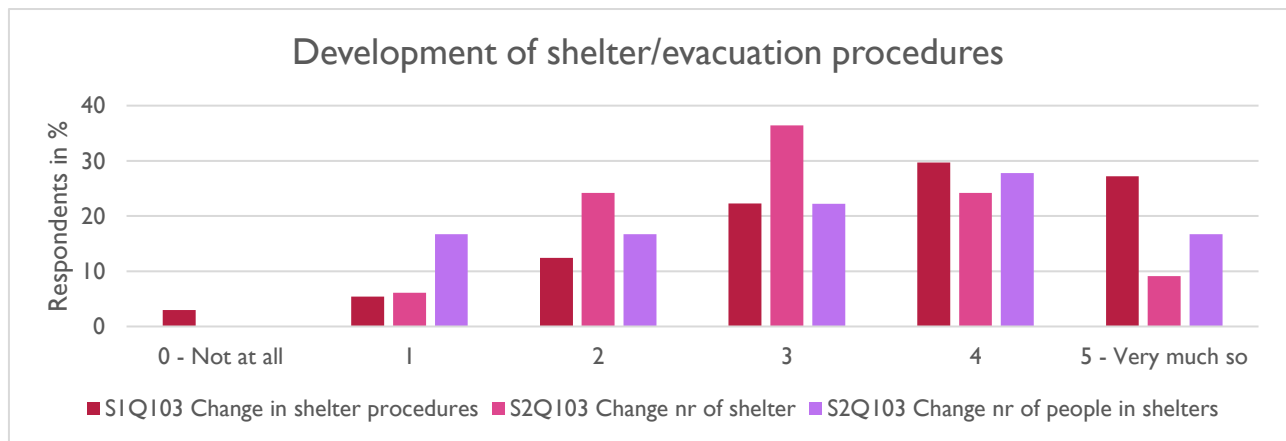


Figure 5. The development of shelter/evacuation procedures during Covid-19.

### 5.2.2 Fuel management

Respondents at the start of the pandemic very much so thought that fuel management would experience change (option 4 - 25%)(option 5 - 35,3%)(Figure 6). In the qualitative survey question that offered space for an explanation, respondents expressed that planned burning had been postponed/cancelled/banned

from autumn to spring in hope that the worst of the pandemic would be over. Some described the cancellation as “dumb”, as fuel would accumulate, and they would be met with a bad situation when the weather takes a turn for the worse. Other changes came about due to budget cuts and countries being on lockdown so work couldn’t be done. Fire management teams also switched to more mechanical treatment due to less prescribed fires. A general consensus among fire managers was that the time frame had changed due to teams staying at home and some departments took in account that prescribed burning could worsen the effect of Covid-19 on personnel. Only one participant commented that vegetation management continued to go on as normal. Some expressed to have no strategy at all.

A year further in the pandemic, responses with regard to whether fuel management had changed were distributed almost perfectly normal (Figure 6). Deducting from the data, the risk reducing activity of fuel management had had no change according to most respondents (option 3 - 38,6%). However, there are also quite some respondents who experienced fuel reduction to be a bit less affected than before the pandemic (option 2 – 19,3%) while some have experienced fuel reduction to be more affected (option 4 – 21,1%) (Figure 6).

In short, in the early stages of Covid-19, respondents experienced more or were planning to experience more of a change in fuel management while more recently most have not encountered any change.

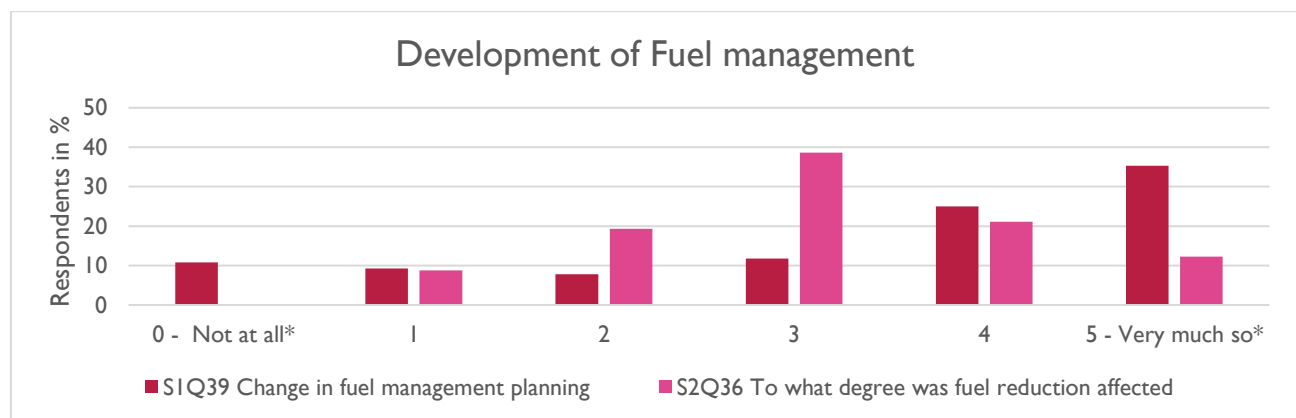


Figure 6. The development of fuel management during Covid-19. \*Note that the scale for S2Q36 has been adjusted to ‘1 – Less than before the pandemic’, ‘3 – No change’ and ‘5 – More than before the pandemic’.

### 5.2.3 Community engagement

At the start of the pandemic, most respondents had experienced a definite change in pre-season community engagement influenced by Covid-19 (option 4 - 27,9%)(option 5 - 38,5%) (Figure 7). The accompanying qualitative question showed that community awareness couldn’t be done like normal and was often cancelled: *“During peak burning season in East Tennessee, ALL activity and interaction stopped. Lots of programs were dropped and will be picked back up at a later time.”*

However, some fire departments have been carrying out educational activities through other media: social media, online tools, press, written communication. This is in accordance with restricting ICS personnel from the public. In the beginning of the pandemic, most respondents expected ICS and specialized staff to be at least somewhat restricted from the public (option 3-5 – 70,2%). Further into the pandemic, it became evident that these expectations were matched in reality: fire suppression staff was



in varying degrees restricted from the public (option 3-5 – 69,1%).

Nevertheless, it became clear in the optional qualitative space in the survey that online options through IT technology were not always available to rural communities. Furthermore, communities are distracted by other issues such as how to deal with Covid-19 and have the fear of ‘strangers’ coming to teach them while risking infection.

Further into the pandemic, the answers of fire management professionals were more divide whether if community engagement had changed more or less than before the pandemic in comparison to the beginning of the pandemic (Figure 7). On the one hand, the largest group expressed that community engagement was affected more than before the pandemic (option 5 - 29,8%) but on the other end of the spectrum respondents also experienced that community engagement was less affected than before the pandemic (option 1 - 17,5%) and (option 2 - 22,8%) (Figure 7).

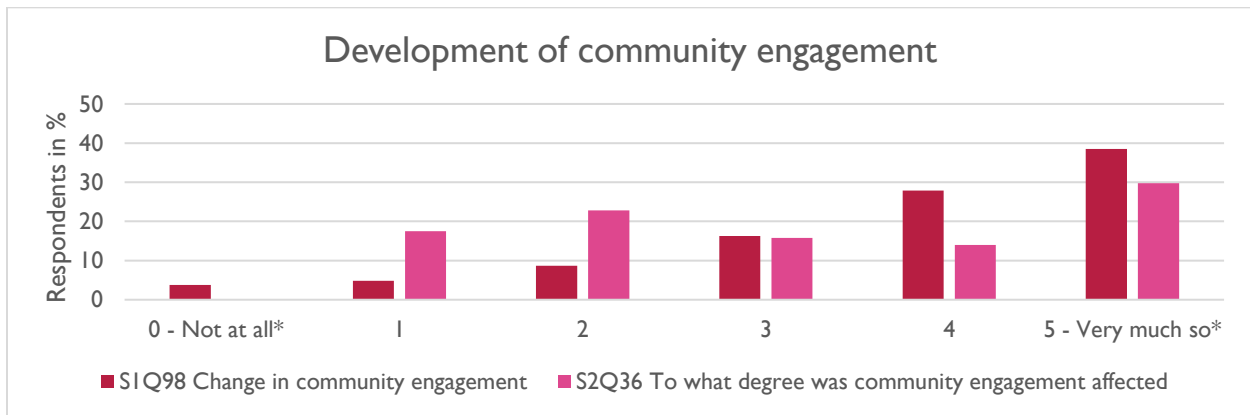


Figure 7. Development of community engagement during Covid-19. \*Note that the scale for S2Q36 has been adjusted to ‘1 – Less than before the pandemic’, ‘3 – No change’ and ‘5 – More than before the pandemic’.

### 5.3 Internal Crisis Communication status within fire management

In accordance with the third research questions, ‘What did Internal Crisis Communication (ICC) look like within fire management organizations during the Covid-19 pandemic?’, the concepts involved in ICC will be separately analyzed, trying to isolate where specifically ICC is struggling and where it is thriving by studying the distribution of answers. The aspects of ICC, as they have been presented in the Internal Crisis Communication Framework, will be underlined in the upcoming sections. Prior to that, the general question was posed if respondents initially experienced change in their way of communication (Figure 8). The means and standard deviation will be disclosed in Appendix Table 2,3 and 4 as the distribution offers a more interesting perspective on how different fire managers experienced ICC..

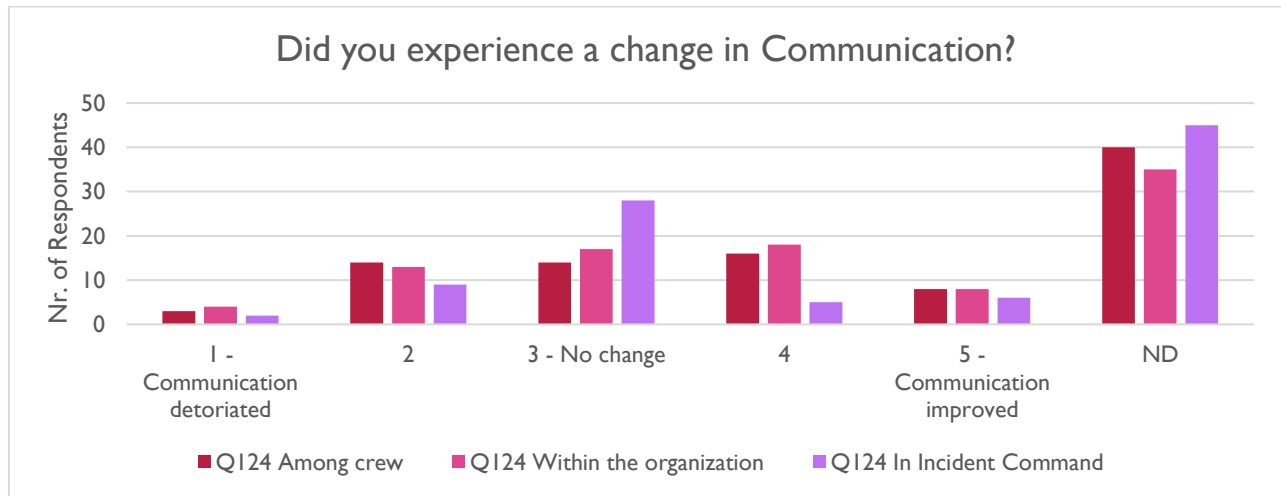


Figure 8. The initial general experienced change in communication within crew, the fire organization, or Incident Command. ND represents the non-data, the number of respondents that skipped the question.

For all three aspects of fire management (crew, organization and incident command), the majority of respondents experienced no change. Incident Command has the strongest association with there being no change. There is a clear link between Incident Command and the absence of change in communication. Among crew and within the organization, there appears to be more of a divide with some respondents reporting somewhat deteriorated and somewhat improved communication (options 2 and 4). However, overall, the majority of survey responders did not answer the question (ND) (Figure 8).

#### 5.3.1 Sense-making

##### 5.3.1.1 General

In general, the deductions made regarding each aspect of general sense-making factors were all positive for sense-making. Most respondents had experienced moderate to no **challenges in their use of communication channel**. Face-to-face contact has been minimized and instead respondents opted for other modes of communication. Online meeting, the use of intranet, e-mailing, text messages and WhatsApp/Signal/Telegram were all generally used more further into the pandemic than before the pandemic to keep in contact. The use of Internal blogs, bulletin boards, internal social media, newsletters, and the organizational magazine were all similar to before the pandemic. In terms of communication **frequency**, the majority of the respondents had been experiencing the same amount of communication or a little more than usual.

Representing the consistency of the information shared, it stood out that there were varying experiences regarding a **contradiction within received information**. Most respondents leaned slightly more towards the fact that the received information didn't contradict each other (option 2 - 23,5%) followed up by the second largest group expressing that they had somewhat experienced information contradiction (option 3 - 21,6%). Furthermore, there was somewhat of a challenge regarding the **clarity of the information** that respondents received (26,3% - option 3). However, most respondents did express in varying degrees that they did not find communicating challenging regarding the clarity of the message (54,4% - option 0, 1 and 2) (Figure 9). Connecting the two aspects in a spearman correlation revealed that when information was unclear, it was strongly positively associated with a higher contradiction of information (0.597 correlation coefficient).

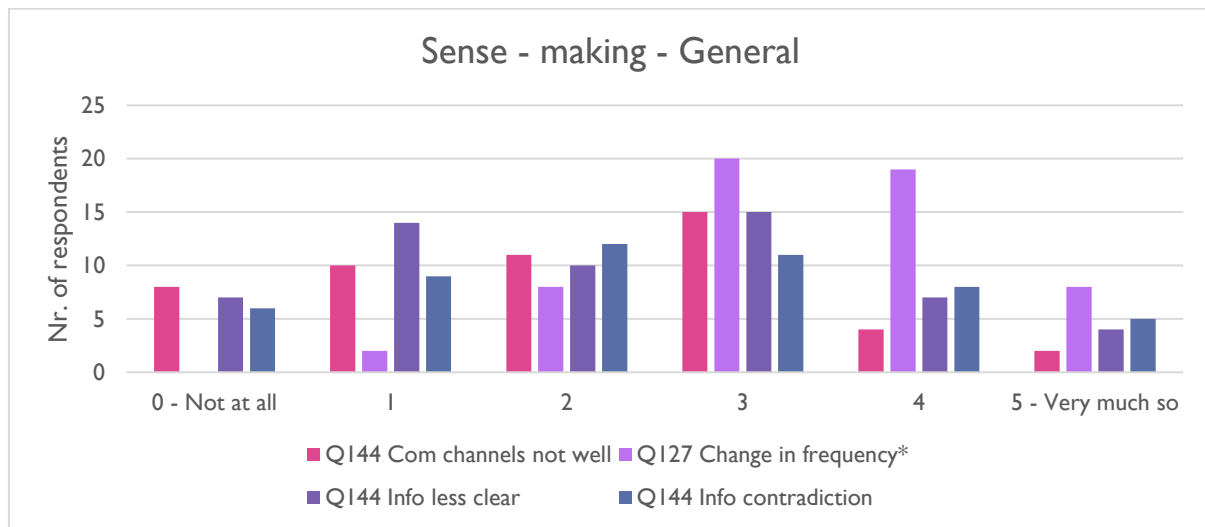


Figure 9. The general aspects determining sense-making within ICC. \*Note that the scale for Q127 has been adjusted to '1 – Lesser than before the pandemic', '3 – No change' and '5 – More than before the pandemic'.

### 5.3.1.2 Capacity

In terms of capacity, the majority of respondents seemed to have felt capable in handling the crisis and making decisions during the pandemic on all fronts of their current capacity; capability, institutional memory and involved decision making. Almost all respondents had confidence that their **organization was capable** to perform fire management tasks with a small number of respondents that were only somewhat confident, indicating somewhat of an insecurity on if they could (Figure 10). Meanwhile, 66.1% of respondents felt that they were **personally capable** of making decisions the same way as that they would usually do without Covid-19. 16,1% felt more capable than usual in making decisions while 17.7% felt less capable.

Furthermore, most respondents had the feeling that their **recommendations were somewhat heard**. 73.3% (option 3-5) of respondent felt in various degrees that they were heard (Figure 10).

Lastly, the majority of respondents believed that **prior crisis experiences** had aided them in dealing with the pandemic (option 3 & 4 – each cover 27.1%). The same number of respondents said that previous crisis experience had helped them a little bit or a lot (option 2 and 5 – each cover 16.7%) (Figure 10).

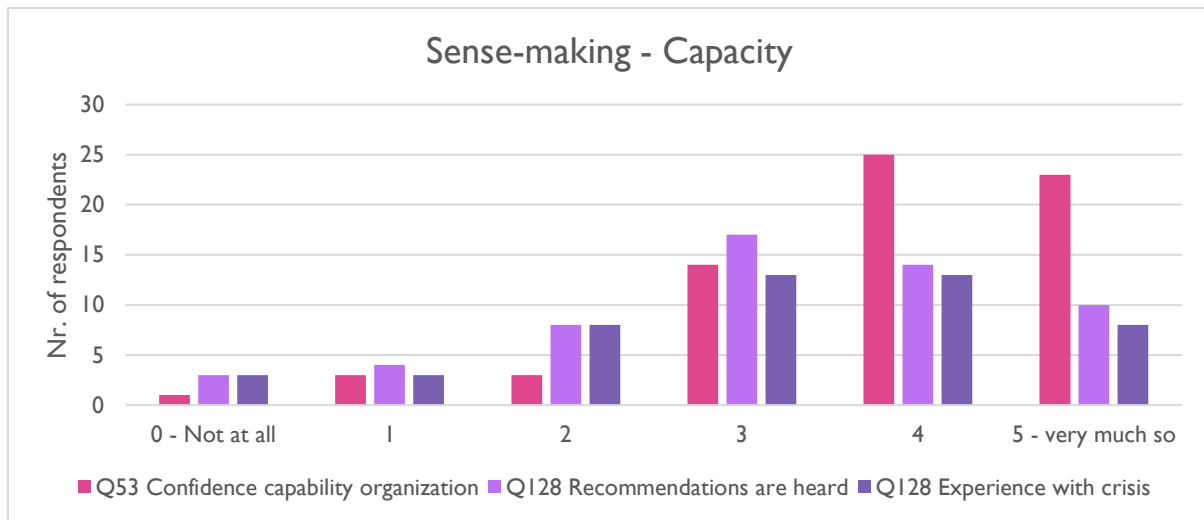


Figure 10. Capacity of fire management professionals within their sense-making.

## 5.3.2 Employee communication

### 5.3.2.1 Environment

Regarding the communication environment within the fire management organizations, the following deductions could be made. A variety of answers were given whether open top-down information flow was more challenging in fire management. **Top-down information flow** has been somewhat more challenging (option 3 - 27.3%). However, some respondents had experienced that it has not been challenging at all (option 1 - 21.8%) or it has been very challenging (option 4 and 5 – 30.9%).

In terms of supportiveness, most respondents had somewhat experienced **mental health support** from their organization (option 3 - 35.3%). All the other options have approximately the same number of responses, meaning that in most cases there has been help available (Figure 11). In a multiple-choice question regarding the mental health resources available, the highest frequency of response could be found in **talking with co-workers, supervisors**, friends, and family, and doing activities with friends and family. Experienced contact with colleagues and superiors has been mostly helpful in coping with the impact of the pandemic (option 3-5 – 78.9%) (Figure 11). It seemed that talking with people in the direct environment was among the favored ways of relieving mental stress.

A little more than half of the respondents had experienced somewhat helpful **physical health support** in varying degrees (option 3-5 – 56.6%). But responses remained varied as it meant that almost half had not experienced intensive support physically with 20.8% not experiencing it at all (option 1).

In terms of two-way communication, most respondents felt that somewhat or mostly their **concerns were being heard** (Option 3-5 – 66.6%) (Figure 11). A spearman correlation further showed a significant positive association between concerns being heard and the relation with the colleagues and management (0.691 correlation coefficient). Between recommendations being heard and the relationship with the colleagues and management, the correlation coefficient was significantly 0.628, also displaying a strong positive relationship. Read '**Recommendations heard**' at the subchapter 5.3.1.2 *Capacity*.

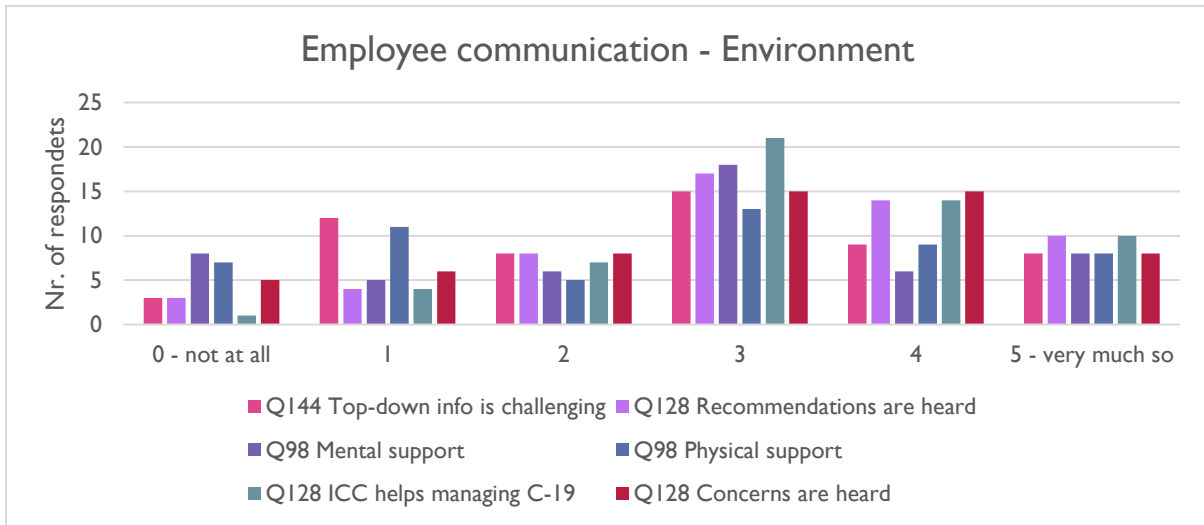


Figure 11. Experience of fire management professionals with their work environment influencing their communication among colleagues.

### 5.3.2.2 Content of the information

The following conclusions could be made about the content of the information shared within management organizations, exhibiting organizational and personal sufficiency of information and the actual usefulness of the information shared.

Some respondents experienced sufficient information, something in between, but also less sufficient information. Somewhat organizational information sufficiency was experienced the most by respondents (option 3 - 24.0%) but other options (option 2, 4 and 5) all emerged with a similar frequency to option 3 with values varying between 20 and 22%. All in all, the overall tendency of the graph leaned toward a **sufficient amount of information on general fire management**. Most respondents have experienced **sufficient information for their own work activities** (option 3-5 – 77.7%). Furthermore, a spearman correlation showed that the relationship between colleagues and management is strongly positively associated with personal information sufficiency (0.711) and organizational information sufficiency (0.788) implying that sufficient information to achieve fire management goals was not lacking. However, top-down information flow challenges and the organizational sufficiency are negatively associated (- 0.379 correlation coefficient) indicating that if there were more top-down information flow challenges, there is less sufficiency information addressing impacts of Covid-19 on the fire management organization.

Regarding the usefulness of the information shared, it stood out that most respondents had experienced somewhat **less information available** (option 3 – 39.6%). Nevertheless, there was variation in experiences between fire management professionals (Figure 12). Read about the **‘Clarity and contradiction of information’** in subchapter 5.3.1.1 *General*.

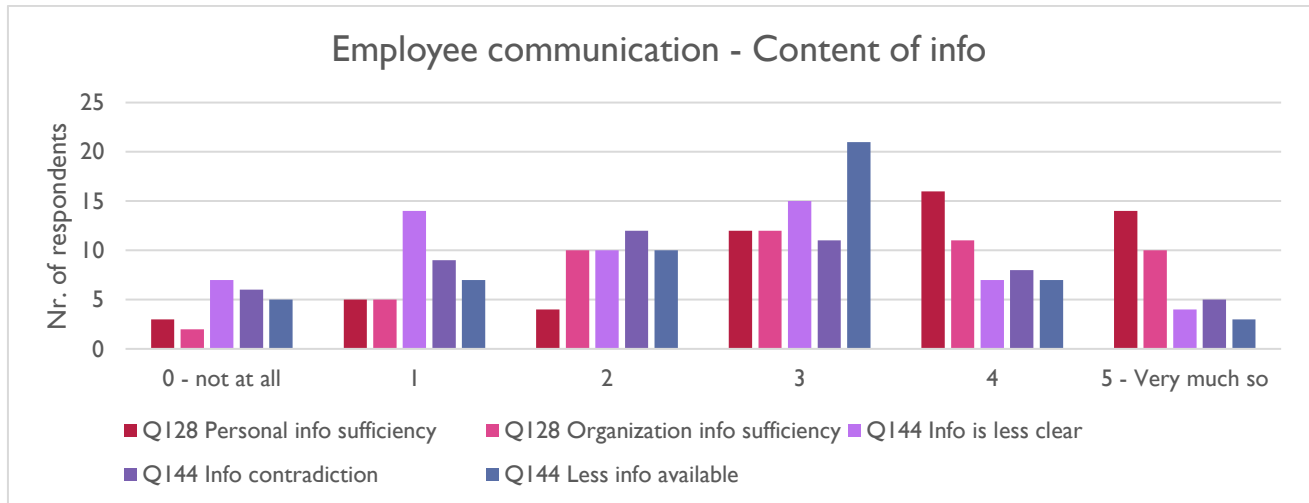


Figure 12. Experience of fire management professionals with the content of information received influencing their communication among colleagues

### 5.3.3 Organizational dynamics

#### 5.3.3.1 Information sharing

Information sharing is here defined by **Organizational** and **Personal information sufficiency** together with the amount of **Information available** (found in subchapter 5.3.2.2 *Content of information*). Information sharing regarding specific personal work activities seemed to be available. But information regarding fire management in general has varying responses. It could be that the information that is less available is the information about general fire management under Covid-19, however these variables were not significantly associated with each other.

#### 5.3.3.2 Upward-downward communication

Most respondents thought that at least **bottom-up information flow was somewhat challenging** (option 3-4 – 50.9%). In lesser degrees, some didn't experience as much of a challenge in the bottom-up flow of information. **Whether top-down information flow was challenging** can be found in the subchapter 5.3.2.1 *Environment*. In doing the spearman correlation, top-down flow challenges were found to be positively associated with challenges such as information contradiction (0.431) and less clarity regarding the message (0.341). The factor of information availability was not found to be significant with top-down information flow challenges. Bottom-up information flow challenges were not significant with any of the variables regarding the usefulness of the message.

#### 5.3.3.3 Relationship employee-organization

Employee-Organization relationship is here defined by the level of **mental** and **physical health support** together with the **helpful contact with colleagues and management** which can be found in subchapter 5.3.2.1 *Environment*. The relationship seemed to be stable on a communicative level between colleagues, management, and superiors. The support facilities from the organization seemed to vary per respondent.

## 6. Synthesis and discussion of the results

This research sought to give insight into how existing fire management strategies were to be continued during the Covid-19 pandemic and if there would be any lessons learned from this event for future fire management in accordance with step 4 of the IRGC Risk Governance Framework: *risk management* and implementation, *monitoring and review*. It further aimed to gain insight in the ICC among fire management professionals and whether the communication was lacking or thriving during the fire-pandemic risk, adding to step 5 of the framework: *Cross-cutting aspects – communication* (IRGC, 2017). Although this research was only descriptive in nature, the outcomes proved to provide such insights which will be discussed below where the grey literature study and the survey results will compliment each other.

This chapter starts with discussing the development of fire management strategies over the course of the pandemic providing insights in limitations, benefits and opportunities followed up by the development in strategies of three different main branches of fire management: fuel management, shelter & evacuation protocols and community engagement. Secondly, ICC within fire management is discussed followed by recommended practical implications for fire management. Next, a reflection on the used theoretical frameworks is given. The chapter concludes with this research's limitations and future recommendations.

### 6.1 Fire management strategy development

#### 6.1.1 Adjustments in strategies: limitations, benefits, and possible opportunities

Multiple new protocols and strategies adjustment were introduced in fire management over the course of the pandemic. The results showed that, according to most fire management professionals, fire management did not experience overarching limitations and/or benefits regarding their adjusted strategies to fight fire induced by Covid-19 (Figure 2). On average, the adjustment to strategies just seemed to be necessary to enable the continuation of fire management. Nevertheless, there were some changes made to existing fire management practices to enable fire management which simultaneously hindered it in other, non-critical, ways. Still, certain adjustment made to strategies may be continued in the future of fire management as they could benefit to addressing already existing problems in fire management before Covid-19.

Even though most respondents did not experience overarching benefits for fire suppression under Covid-19, responses were mixed when asked if changes made to strategies were to be maintained. The most common answer among respondents was to somewhat keep the changes made (Figure 2; option 3 - 26,9%). However, even though some respondents want to keep a few changes, another big group answered that they would most likely not keep many changes that they have incorporated during Covid-19 (Figure 2; option 0-2 combined equals 51,9%). Regardless, it could also be interpreted as that some changes will be incorporated for future fire management, and some will not as it was clear which adjustments they would want to stop and to continue.

Respondents would stop current changes made in strategies concerning physical separation, controlling group sizes and number of (people in) vehicles. Such strategies are focused on avoiding physical contact. When keeping physical distance from each other is no longer necessary, almost all fire management professionals agree to stop such actions as they are limiting effective fire management (less crews are available, little collaboration with external contractors, less people per vehicle).

Changes in personal hygiene, cleaning of surfaces, communication through virtual technology and digital documentation are to be continued by most organizations. These adjustments are more focused on the individual's ability to perform their practical or communicational duties. Hygiene and cleaning adjustments are mainly to prevent the individual from being infected and to prevent other personnel from indirect infection. These practices are believed to help improve fire camps in the future. According to the data, there is uncertainty on how to set up fire camps in the future (Figure 3). Some see the benefits of traditional fire camps however it is known that camp crud has been a common event side-lining fire management personnel from firefighting. During the pandemic, there are less fire camps set up or fire camps have more restrictions. Where there were camps set, personnel noticed with the improved hygiene, camp crud had minimized.

The decrease in camp crud seems to be a positive by-product of changes induced by Covid-19 to fire camps. The pandemic also causes staff to be less available and teams to be smaller. However, in a post-pandemic situation, the combination of more staff able to be deployed and the increased measures in hygiene could prevent the spread of camp crud, just as the spread of the coronavirus (depending on the nature of the disease). As a result, less fire fighters might be side-lined because of camp crud in the future. However, in accordance with the research of Thompson et al., 2020, social distancing may enable camp crud to be minimized as infection rates remained low for Covid-19 while distancing and that is not an adjustment most fire management professionals are willing to make (Figure 4).

### 6.1.2 Development of existing fire management strategies during Covid-19

As we have learned from experience, existing practices have been, initially, altered to fit them in the fire-pandemic context. At first, respondents thought fuel management would change as prescribed burnings were cancelled/delayed or replaced by other fuel management practices aiming to continue in full when the Covid-19 situation would be better. Now it seems that most have experienced no change (Figure 6). Several private owners had soon after postponing their burning resumed their burnings in spring. Larger organizations continued to burn between January and June, depending on the organization and state/country restrictions, in fear of catastrophic fires and the necessity to burn more accumulated fuel in less time. (Fisher, 2021; M. Liu, 2020; McCarthy, 2020; NCFs, 2021; Tall Timbers, 2020). Some organizations never stopped prescribed burning at all. Now that most burning is continued, people are concerned with the effects of smoke on Covid-19 patients (McCarthy, 2020). Fire managers argued that they look at the wind conditions to not smoke people out but in terms of the virus a spokesperson expressed that truly at-risk patients are in the hospital away from the smoke (ENREC, 2020; McCarthy, 2020). However, people with respiratory problems remain worried (McCarthy, 2020). On the other hand fire management looks ahead were they see large fires approaching if controlled burning is not performed, leaving them to wonder how they would evacuate thousands while social distancing (McCarthy, 2020). Cancelling burning was precaution-based strategies, minimizing exposure to the coronavirus but increasing the risk of fire. Continuing burning is a resilience-based strategy, preparing and coping with fire but also with the virus. However, it is posed as trade: potentially endangering more people now with smoke but sparing people from fire and corona during the evacuation, considering the fire-pandemic risk (IRGC, 2017).

Regarding these shelter and evacuation procedures, respondents mainly saw the amount of people allowed in a shelter reduce due to Covid-19 while the number of shelters only somewhat changed (Figure 5). Research shows that with the fire-pandemic risk, half of threatened households have at least one evacuation route in mind, and more than two-third of the participants had arranged a place to stay where they though social distancing would be possible (Edgeley & Burnett, 2020). This



precaution-based strategy could make households less reliant on just regular shelters alone by enlarging the capacity to deal with the fire-pandemic risk, explaining why only somewhat the number of shelters increased (Campbell et al., 2021; Edgeley & Burnett, 2020; IRGC, 2017). This is in compliance with recommended emergency strategies regarding shelters: make people less reliant on common shelters (Campbell et al., 2021).

Further community engagement has been affected just as respondents had expected however some have experienced more and some less community engagement than before the pandemic (Figure 7). Research shows that community engagement has shifted more from in-person experiences to online engagement through social media and other channels due to social distancing (Miller-Rushing et al., 2021). However, not much information is available on the adjustment of community engagement other than that several organizations have opted for, already available but more elaborated, online education through blogs, safety videos, media campaigns, games and checklists (Londen Fire Brigade, n.d.; National Fire Protection Association, n.d.).

From monitoring the experiences of fire management professionals, it became evident that navigating the fire-pandemic risk is complex. It seems that sometimes compromises in strategies need to be made, potentially harming coping with one risk in the present to be able to cope with both in the future. However, it seems that working with the people affected could potentially lift the full weight of the fire-pandemic risk and be, to an extent, shared. They often possess necessary knowledge of the area and its history with fire what makes involving them valuable to fire management (Everett, 2002). Preparing to-be-affected households for evacuation in the context of both fire and Covid-19 provides fire management with the opportunity to improve on shelter and evacuation practices for the future. This can be enabled through education and collaboration programs (learning how to prepare your home and how to respond to fire), however some fire management organizations may have more opportunity to do so than others as community engagement varies (Figure 7)(Mascarenhas, 2011).

## 6.2 Status of the Internal Crisis Communication within fire management

As has been presented in the ICC theoretical framework, ICC consists out of the three main principals: sense-making, employee communication and organization dynamics. All three main principals will be discussed below in the context of fire management, comparing it with the ICC theoretical framework and eventually resulting in the status of fire management ICC.

### 6.2.1 Sense-making

On the individual level, fire management professionals were able to make sense of their situation. In line with ICC literature, the frequency of contact was the same or slightly higher than before the pandemic: for people to understand and operate in the crisis, individuals will reach out to gain more information and clear their uncertainty (Frandsen & Johansen, 2011; Schmidt, 2010). As expected, it further seemed that most people opted for online meetings followed up by emailing as their preferred communication medium replacing face-to face contact. Oral communication is the most preferred way of communicating a message due to its clarity and effectivity of conveying the message and online meeting are the closest to face-to-face interactions (Frandsen & Johansen, 2011; Westmyer et al., 1998).

Figure 3 further expresses the wish to continue virtual communication. Because although face-to-face is the most preferred way to communicate and prevent misunderstandings, it is ineffective in sharing a message with a large group or a whole organization (PowerDMS, 2020; Strandberg & Vigsø, 2016).

There seemed to be varying experiences regarding the clarity and contradiction in information. As could be seen in the results, when information was less clear, respondents associated this with a higher level of information contradiction. As the fire-pandemic risk is relatively new with many knowledge gaps, any contradiction of information could be explained due to the uncovering of new information that contradicts previous received information. This may affect the trust between the information provider and receiver (Carpenter et al., 2016). However, new, more scientifically accurate information could over time have been more beneficial for sense-making even though it is contradicting.

Finally, the overwhelming majority of respondents were positive about their capacity to handle the crisis, personally as well as on an organizational level (Figure 10).

Sense-making regarding the fire-pandemic risk seemed to function well although it should be noted that it might be due to the circumstances personnel are in at the moment. When the second survey was released, the fire-pandemic risk had been experienced by fire management personnel for almost a year, hardly being able to call it novel anymore. In fire management sense-making literature, when the risk was novel, professionals weren't able to make sense of the situation in that moment. Sense in fire management is often made in retrospect, learning from previous fires and monitoring of changes made by organizations (Dwyer & Hardy, 2016). Thus, the seemingly stable sense-making could possibly be related to the time able to learn more about the risk and the changes made by organizations that have seemed to handle the, at the time, novel risk.

## 6.2.2 Employee communication

On a more collective level, fire management employees seemed to be able to communicate well in the crisis with colleagues that they most commonly work with. Respondents were able to participate and seek support from their colleagues and superiors as it has been the most available way of gaining mental support (even though mental and physical health support were present in varying degrees). In addition to receiving support, most respondents were able to share their concerns and recommendations while being heard by management and colleagues which enabled them to deal with the impacts of Covid-19 on fire management (Figure 11). The results showed a significant positive association between concerns being heard and the relation with the colleagues and management. Furthermore, between recommendations being heard and the relationship with the colleagues and management, it also displaying a strong positive relationship.

In accordance with ICC literature, the ability to rely on one's colleagues allowed them in turn to make sense of the situation when there is a lack of information. Colleagues and management give meaning to the information received and discussed, confirming the uncertainty of the situation, or easing it. Either way it confirms the situations a person is in (Adamu & Mohamad, 2019). When further recommendations are considered, the person feels involved and has somewhat a grasp on the situation, again giving meaning to their situation and encouraging them to engage in two-way communication (Kim, 2018; Waring et al., 2018). As the work environment and relationship between the fire management professionals were favorable, it is probable that it has influenced individual sense-making regarding the situation, partly explaining the strength in individual capacity and general elements of sense-making shown (Adamu & Mohamad, 2019; Strandberg & Vigsø, 2016). It could even be suggested that a collective sense has been developed in order to make sense of the situation (Black et al., 2016).

Furthermore, the results showed that the relationship between colleagues and management was strongly positively associated with personal information sufficiency, and organizational information sufficiency implying that sufficient information to achieve fire management goals is not lacking.

However, sufficient organizational information was less prominently present but generally still available to the average respondent (Figure 12).

In terms of the nature and usefulness of the information, respondents seemed to have different experiences, where some respondents had experienced somewhat of a challenge where information was less clear, contradicting or less available. However, the correlations between these variables and organizational information sufficiency were not significantly associated with each other. Nevertheless, top-down information flow challenges and the organizational sufficiency were negatively indicating that if there are more top-down information flow challenges, there is less sufficiency regarding the information addressing impacts of Covid-19 on the fire management organization. And looking at the results, there were some challenges present regarding top-down information flow (Figure 11).

### 6.2.3 Organizational communication

Organizational communication is the least stable factor within fire management ICC. Both bottom-up and top-down information flow have had varying responses where some respondents were experiencing challenges, and some were not. The challenges may come from the level of usefulness of the message (the availability, contradiction, clarity) as contact with colleagues and the organization does seem to be stable. According to the results, top-down flow challenges were found to be positively associated with challenges such as information contradiction and less clarity regarding the message. The factor of information availability was not found to be significant with top-down information flow challenges. Also, bottom-up information flow challenges were not significant with any of the variables regarding the usefulness of the message.

From the literature we can see that companies lead successfully through effective top-down communication (White et al., 2010). However, top-down communication can be experienced differently. Literature shows that people closer to the top administrators in the organizational hierarchy, experienced higher information sufficiency as they were closer to the top. Further seems information to be filtered through layers of bureaucracy, making it less clear and more contradicting for personnel further from the top. Top managers admit that they sometimes don't know what happens to the information once it has been distributed to the level below. However, in general throughout the organization people believe to have a sufficient amount of organizational information sufficiency except from the middle level, regardless whether true or not (White et al., 2010). This could explain why organizational information may be somewhat less available to some but still is, on average, obtainable. In accordance with this possibility, an article confirmed that often times an organization-wide email is released or shift commanders are in charge of passing on the message without the guarantee of the information reaching everyone needed in fire management (PowerDMS, 2020).

### 6.2.4. Consensus on ICC within fire management organizations

In general, the ICC within fire management is functioning relatively well. Both individual sense-making and employee communication in fire management organizations are presented positively among respondents. Small challenges seem to sit with the sufficiency of information on general fire management and the flow of information top-down as well as bottom up. However, there are no overwhelming drastic responses were fire management professionals and organization are collectively responding negatively indicating a crisis within the organization on how to handle Covid-19 during the fire seasons communicatively. It could rather be said that ICC could be more effective within fire management by improving on the challenges. The overall functioning of ICC may even be linked back to the strategies presented to overcome the fire-pandemic risk and its difficulties. Strategies seem to

operate well without extreme limitations to the point fire can't be managed. However, ICC is only a cog in the machine that is effective fire management although it can be said that functioning internal communication is key to enable action externally, especially in times of crisis.

For individual fire management organizations, it can be recommended to look into their own ICC. Even though the general ICC in fire management is doing well, individual organizations may experience it differently from others. Often only one respondent gave their opinion on their organization's ICC, representing them fully while others may have had different experiences within the same organization. Further to tackle current top-down information flow challenges, some measures are available. Commanders can enable a system where personnel had to sign off on receiving the information needed, implement an open-door policy or personnel can perform a test providing feedback on how much they are up-to-date (PowerDMS, 2020).

### 6.3 Practical implications for fire management

Based on the insight gained during this research, some practical implications can be considered for fire management professionals:

- Keep hygiene implications used during the pandemic as they might help control camp crud in the future. Examples such as washing and sanitizing hands, using only your own utensils and drinking from your own cup, shower and do laundry often, cleaning surfaces after using them and other actions to improve personal and crew hygiene can all be continued in the future to minimize other diseases (Bureau of Land Management Fire & Aviation Directorate, 2020; Jlevans3, 2020).
- Prepare for possible hybrid risks by making fire management strategies more flexible. As experienced during the pandemic, the individual risk of fire can be possibly mixed with other risks. In order to prepare for additional risks in the future, strategies could be planned more flexible, so they are not so fixed to only work in one possible scenario. Creating strategies and plans may therefore consider various scenarios. Consider that this only can be done generally as the risk to be added to fire fighting is not known. However, by keeping this in mind, strategies may be able to be applied in various ways and more creative options may surface.
- Investigate ICC within individual organization with a focus on top-down and bottom-up communication as this relatively seems to be the biggest concern within. ICC per organization may vary significantly and some organization might experience poor ICC unknowingly while this is critical when enabling fire management.
- Communicate with the affected stakeholders. They may provide new ideas or may operationalize ideas and strategies to new problems fittingly in the context of the situation and can lift some of the uncertainty surrounding a new risk among fire managers. For example, they may find their own shelters. As the engagement with the community was relatively unknown (in reports and literature) during the pandemic, it will be beneficial to gain insight into this to better the relationship with affected residents and to come up with fitting solutions (Campbell et al., 2021; Edgeley & Burnett, 2020) .

## 6.4 Thoughts about the theoretical framework

Zooming in on the theory used for this research, the IRGC Risk Governance framework displays a relatively general model of risk management which was considered to work well with research focused on an overarching group, encompassing fire management as a collective. In reality, this generality led to interpreting the model to however the researcher thought it would be intended which incorporated some level of bias. Exemplary, the management step in the framework, that this research mostly contributes to in terms of monitoring and reviewing management strategies, incorporated no information supporting how monitoring or the review of strategies should be done. The same goes for the cross-cutting aspects. It emphasized on the importance of communication and that it should look open, transparent and inclusive (IRGC, 2017). However, it was until a recent report was released that no options on how to achieve that were presented. The IRGC now advises to use science cafes, demonstrations, online information sharing, inquiry-based learning methods, dialogues, and discussion groups. Nevertheless, they don't mention any option to enable good communication methods among risk managers (IRGC, 2020). In my experience, and that of many others, the framework is more conceptual than operational with no instructions on how the risk presented should be assessed, characterized or managed, it only mentioned in what categories the risk could fall (Renn & Jäger, 2008; Rosa, 2008).

This leads me to the risk of this research, the fire-pandemic risk. The framework fails to see that multiple risks such as fire and a pandemic may happen simultaneously and doesn't offer any support on how to characterize it. Considering this, the main problem turned out to be that the fire-pandemic risk was very novel and constantly developing as this research progressed, leading me not to be able to put the risk in just one category as it develops with new threats, opportunities and strategies constantly being presented (IRGC, 2017; Renn & Jäger, 2008). Lastly, the model suggests incorporating all stakeholders involved so they are all equally voiced in considering the risk. Still, this research is meant for fire management professionals, prioritizing their view on the situation as views are always prioritized in accordance with the purpose or target audience that it is meaning to appeal to (IRGC, 2017; Renn & Jäger, 2008).

Regarding the future use of the IRGC Governance Framework, if the principles of the framework are further defined, it may be more suitable for a risk that is already specified and has all available knowledge. Therefore, in the future, this framework is more appropriate as a way to organize, summarize and present the data available for people who are not as knowledgeable about the management process of the risk and wish to be quickly updated on key points per step of the framework. If not for this purpose, it could be a good idea to improve on the framework's operability.

As previously mentioned, in terms of the step five of the IRGC Risk Governance Framework, the use of (risk) communication within the framework could be emphasized and operationalized more as this is to be of vital importance when managing a risk (Glik, 2007). In general, the model served the research well. The identified concepts could be spotted in the way fire management communicated internally in crisis allowing me to display the three main principles of ICC and relating it to the theoretical ICC frame build to make sense of fire management ICC. Nevertheless, the framework was not without flaws.

The eventual ICC model was operationalized, taking on the form of all quantitative Likert-scale questions, hereby it partly relied on a valid model available that measures ICC within an organization. However, the ICC model in this research used various other literary sources to reach saturation regarding ICC concepts. Therefore, the questions posed in the survey diverged from the valid model found in literature as well as using different terms in the questions to cater it to the audience's understanding.

Therefore, its validity has not been tested. In addition to that, it cannot be ruled out that some concepts of importance to ICC could be missing by overlooking some literature. For example, the literature on sense-making was relatively dated in comparison to that of employee communication and organizational dynamics, leading me to believe that there could be some new developments in sense-making attuned to our current era as it is connected to our environment as much as to individual's own thought-process.

The model could further be improved on its interconnectivity between the concepts independent from the three main principles. The model statically presents the three main principles and its concepts separately but many of the concepts across the three main principles interconnect and influence each other. Theoretically, it would have been more accurate to seek the interconnection between the concepts and display the model more as a whole than separately. Nonetheless, in practice, it would be 1) complex to measure not only the concepts individually but also their connection to each other outside of their main principle as ways to accurately measure ICC are lacking and 2) further only a limited amount of quantitative Likert-scale questions are to be spent on ICC in this collaborative research (Adamu & Mohamad, 2019).

For the ICC model presented in this research, it is recommended and encouraged to further research Internal Crisis Communication concepts and their interconnectivity to develop a more accurate operational model. If in the future the theoretical ICC frame will be used to create their own quantitative questions to measure ICC, it is further recommended to test the validity first and take care to pose the questions in a way that the interconnectivity between the ICC concepts can also be measured and researched (Adamu & Mohamad, 2019).

## 6.5 Limitations and recommendations for future research

Coming back to the context of this research, despite the results, this research is limited in a few ways. First, the results regarding ICC are measured at one moment in time and are therefore only a recording of fire management ICC in April. It would have been interesting to have more data points over time to see the development of fire management ICC over the course of the pandemic, but this can be considered for future ICC-risk management research. Second, fire management professionals around the world with varying functions and resources have different views and perspectives on what Covid-19 means for fire management in the context of their organization. This research provides a very general view on fire management as a combined force, leading the results to sketch a general picture which cannot be generalized to specific fire management organizations. Lastly, most questions were answered on a Likert-point scale which induces the extremist bias and answering the questions relatively to the questions answered before.

A recommendation for future or further research in specific to this topic is to include qualitative interviews with fire management professionals as it would be beneficial to support the current data. Within the scope of this research, it was not possible nor ethical to interview fire management professionals in the occurrence of the fire-pandemic risk. To accurately represent fire management professionals, in combination with the survey, interviews with fire management professionals can be arranged that have also responded to the survey as the survey mostly contains close-ended questions which leaves little space for situation descriptions, personal experience or other insights that could benefit the strategy-taking and communication efforts. Such insights will give deeper meaning and understanding to the results as they only touched on *how* the general fire manager perceived and felt towards the development in strategies and ICC but (barely) not on *why* they perceived and felt like that. Interviews can reveal 'the why' by documenting the context the respondent resides in and gain additional information interviews provide such as body-language and intonation use. Understanding 'the

why' could further support fire management organization in questioning and re-evaluating their practices, strategy-taking, and communication in the search for the most effective way to fight fire.

## 7. Conclusion

In conclusion to this research, the posed research questions will be briefly answered in this section. Fire management strategies developed in a way so that they could be performed in the context of the Covid-19 pandemic. Existing strategies were cancelled, postponed, or adjusted so they could serve against the risk of fire and the pandemic combined. Sometimes they were continued as usual as the risk of catastrophic fire could eventually also increase the effects of the coronavirus. Such developments and adjustments did not cause significant limitations for fire management and could even be useful to future fire management. Improved hygiene protocols could limit camp crud in future fire camps. However, physical adjustment to strategies such as social distancing are to be stopped as soon as possible. The increased use of digital documentation and communication is also to be continued after the pandemic. Furthermore, Internal Crisis Communication within general fire management during the Covid-19 pandemic seemed to be functioning relatively well especially on the individual and horizontal level with some small challenges in top-down and bottom-up information flow.

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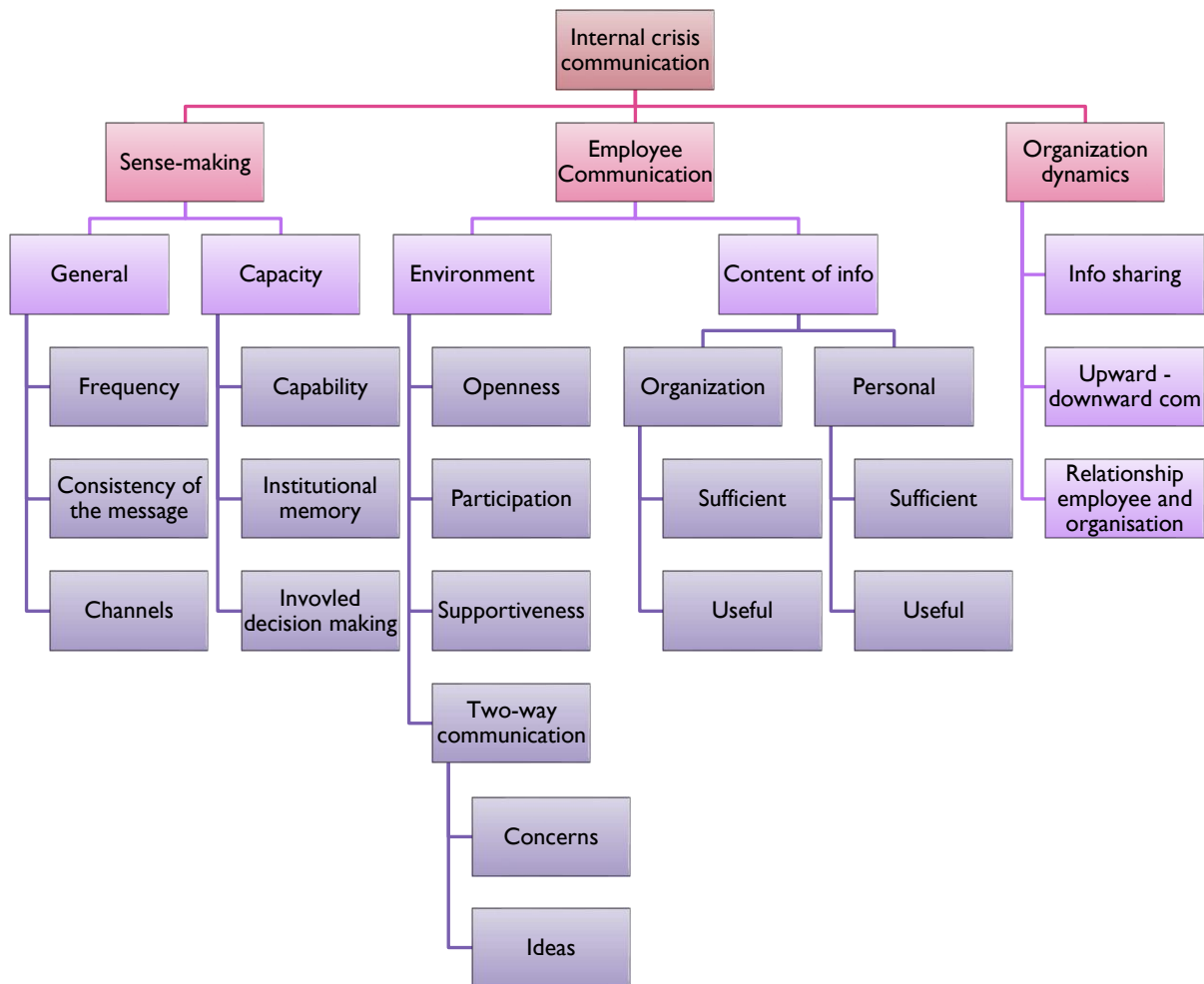
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## 9. Appendix



Appendix Figure 1. Internal Crisis Communication (ICC) aspects compiled out of literature. ICC is mainly determined by the general aspects Sense-making, Employee Communication and Organization Dynamics.

<b>Survey 1</b>	<b>Mean</b>	<b>Stnd dev.</b>	<b>Survey 2</b>	<b>Mean</b>	<b>Stnd dev.</b>
Q103 Change in procedures community evacuation and shelters	3.5	1.3	Q103 Change in shelter procedures	3.1	1.1
			- Number of shelters - Number of people at the shelters	2.9	1.7
Q29 Number of staff reduced in vehicles	3.3	1.7	Q29 Number of staff per vehicle reduced	3.0	1.6
Q74 Restrict fire suppression staff from the public	3.1	1.6	Q74 Restrict fire suppression staff from the public	3.1	1.7
Q39 Change in fuel management planning	3.4	1.7	Q36 Affected fuel management	3.0	1.1
Q98 Change of community engagement	3.75	1.4	Q36 Affected community engagement	3.2	1.5

Appendix Table 1. Strategies taken to enable fire management during the pandemic. These strategies have been included in both surveys. The table shows the means and standard deviations per question per survey.

<b>General</b>	<b>Mean</b>	<b>Stnd dev.</b>	<b>Capacity</b>	<b>Mean</b>	<b>Stnd dev.</b>
Q128 Channels of communication	2.1	1.4	Q53 Confidence in organization to perform	3.9	1.2
Q127 Frequency of communication	3.4	1.0	Q128 Recommendations are heard	3.2	1.4
Q144 Information is less clear	2.2	1.5	Q128 Previous crisis experience	3.1	1.4
Q144 Information contradicts each other	2.4	1.5			

Appendix Table 2. The mean and standard deviations of the survey questions representing Sense-Making aspects



<b>Environment</b>			<b>Two-way communication</b>			<b>Content of information</b>		
	<u>Mean</u>	<u>Stnd dev.</u>		<u>Mean</u>	<u>Stnd dev.</u>		<u>Mean</u>	<u>Stnd dev.</u>
Q144 Top-down information flow is more challenging	2.7	1.5	Q128 Concerns are heard	2.9	1.5	Q128 Organization info sufficiency	3.1	1.4
Q128 Recommendations are heard	3.2	1.4	Q128 Recommendations are heard	3.2	1.4	Q128 Personal info sufficiency	3.4	1.5
Q98 Mental support	2.6	1.6				Q144 Information is less clear	2.2	1.5
Q98 Physical support	2.6	1.7				Q144 Info contradiction	2.4	1.5
Q128 ICC helps managing C-19	3.3	1.2				Q144 Less info available	2.5	1.3

Appendix Table 3. The mean and standard deviations of the survey questions representing employee communication aspects.

<b>Information sharing</b>			<b>Upward-downward communication</b>			<b>Employee-organization relationship</b>		
	<u>Mean</u>	<u>Stnd dev</u>		<u>Mean</u>	<u>Stnd dev</u>		<u>Mean</u>	<u>Stnd dev</u>
Q144 Less info available	2.5	1.3	Q144 Top-down information flow is more challenging	2.7	1.5	Q98 Mental support	2.6	1.6
Q128 Personal info sufficiency	3.4	1.5	Q128 Bottom-up information flow	2.7	1.5	Q98 Physical support	2.6	1.7
Q128 Organization info sufficiency	3.1	1.4				Q128 ICC helps managing C-19	3.3	1.2

Appendix Table 4. The mean and standard deviation of the survey questions representing the aspects of the organization aspects.