RiskPACC

INTEGRATING RISK PERCEPTION AND ACTION TO ENHANCE CIVIL PROTECTION-CITIZEN INTERACTION

GAP ANALYSIS AND ROADMAP OF KEY ACTIONS TO ADVANCE SOTA (CPAs)

Deliverable 1.3

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ABOUT RISKPACC

Increasingly complex and interconnected risks globally highlight the need to enhance individual and collective disaster resilience. While there are initiatives to encourage citizen participation in creating a resilient society, these are typically fragmented, do not reach the most vulnerable members of the communities, and can result in unclear responsibilities for building disaster resilience.

New technologies can also support preparedness and response to disasters, however, there is limited understanding on how to implement them effectively. Awareness of risks and levels of preparedness across Europe remain low, with gaps between the risk perceptions and actions of citizens and between the risk perceptions of citizens and Civil Protection Authorities (CPAs).
The RiskPACC project seeks to further understand and close this Risk Perception Action Gap (RPAG). Through its dedicated co-creation approach, RiskPACC will facilitate interaction between citizens and CPAs to jointly identify their needs and develop potential procedural and technical solutions to build enhanced disaster resilience. RiskPACC will provide an understanding of disaster resilience from the perspective of citizens and CPAs, identifying resilience building initiatives and good practices led by both citizens (bottom-up) and CPAs (top-down). Based on this understanding, RiskPACC will facilitate collaboration between citizens, CPAs, Civil Society Organisations, researchers and developers through its seven (7) case studies, to jointly design and prototype novel solutions.

The "RiskPack" toolbox/package of solutions will include a framework and methodology to understand and close the RPAG; a repository of international best practice; and tooled solutions based on new forms of digital and community-centred data and associated training guidance. RiskPACC consortium comprised of CPAs, NGOs, associated organisations, researchers and technical experts will facilitate knowledge sharing and peer-learning to close the RPAG and build disaster resilience.

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Executive Summary

This deliverable brings together research from the two previous Work Package (WP) 1 deliverables, that are outlined below, to discuss the gaps between the state of the art research (SOTA) and what occurs in practice in six the case study areas. The report defines concepts and processes of disaster management, discusses current operations, and suggests solutions to the gaps discovered. First, background information on the work already done in WP1 is discussed. Then, the gaps are examined in more detail, including information on how they were identified. While discussing the gaps definitions of DRM terms, current practices in case study areas, and suggestions of ways to address these gaps are also highlighted. Finally, the report provides a roadmap for future activities in RiskPACC, and how they can be used to close some of the gaps highlighted in the report. Additionally, the risk perception action gap (RPAG) is discussed in relation to the gaps and activities are suggested to close the RPAG going forward.

Chapter 2 of this report provides an overview of the previous work done in WP1. This includes a summary of the results of two deliverables, D1.1 and D1.2. D1.1 provides the theoretical background on disaster resilience, vulnerability and risk perception, leading to the creation of working definitions of these concepts for RiskPACC. There is then a dicussion of the current research on operationalising the concepts. The research on both disaster resilience and risk perception highlighted the need for more bottom-up activiites and an increase in two-way communication. This SOTA research was then contrasted with the work done in D1.2, where empirical evidence was gathered through interviews with CPAs in the case study areas. These interviews highlighted the current practices of different CPAs in the case study areas, which demonstrated the current use of top-down intiatives and communication strategies.

In Chapter 3, the gaps are discussed in depth. The gaps were discovered through a thorough analysis of the information provided in both D1.1 and D1.2, with the addition of data on the citizen perspective that is provided in D2.2. There are 15 gaps discussed in this report, which were categorized into the following major themes:

- Communication
- Theory vs practice
- Governance
- Operations and implementation
- Data and technology

Communication gaps address the current lack of communication between CPAs and citizens, and highlight the need for two-way communication, including creating better communication channels to facilitate this two-way communication. CPA and community experiences in communication are discussed, showing the current lack of engagement between the two groups.

Theory versus practice gaps discuss the theory surrounding disaster resilience and risk perception, and how these theories apply to current CPA practices. This includes the the need for a stronger focus on human and social factors in work surrounding risk perception and disaster resilience. Research in D1.1 showed the importance of acknowleding these factors in designing CPA activities, while D1.2 established that vulnerabilities were rarely incorporated during planning for activities in case study areas.The lack of consensus and use of the term resilience was also discussed, with solutions presented for addressing the lack of understanding of the term.

Governance gaps relate to norms, actors, and practices regarding CPA work. These gaps include better integration between CPAs, building trust in the community, more focus on bottom-up activities, and better understanding of the link between perception and behaviour. Bottom-up activities, which are important factors in building trust in the community, were not apparent in the current practices of many of the CPAs interviewed.

Operation and implementation gaps are related to ways that CPAs implement their activities. These gaps include a focus on prevention activities, more community engagement, and a lack of resources. More community engagement is required by CPAs, as it contributes to bottom-up activities and two-way communication.

Finally, data and technology gaps were considered. These gaps include the need for data on what is working, more standardized data, and the digital divide. More data is required for CPAs to understand what works and what doesn't, but in using new tools, CPAs need to be careful that people are not being left behind and excluded from practices.

Chapter 4 then discusses what these gaps mean for RiskPACC going forward, and how RiskPACC activities will address some of the gaps going forward. This includes highlighting the co-creation workshops planned for WP3, and how they will increase community engagement and two-way communication in the case study areas. This chapter also highlights how addressing some of the gaps presented has the potential to close the risk perception action gap (RPAG). Some further suggestions for closing the gaps are then discussed, to provide some additonal solutions that may close the RPAG. These suggestions include involving citizens in developing risk assessments for their area, to increase citizen engagement in two-way communication.

This report concludes with a discussion on how these findings will tie in with other deliverables and WPs within RiskPACC.

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Glossary and Acronyms

Acronyms	Description
CPA	Civil Protection Authority
D1.1	Deliverable 1.1
D1.2	Deliverable 1.2
D2.2	Deliverable 2.2
DFID	Department for International Development
DRM	Disaster Risk Management
EU	European Union
RPAG	Risk Perception Action Gap
SOTA	State of the Art
WP	Work Package

TABLE 1: GLOSSARY AND ACRONYMS

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1 INTRODUCTION

1.1 Deliverable overview

This deliverable (D1.3) "Gap analysis and roadmap of key actions to advance SOTA (CPAs)" is the output of Task 1.3, "Gap Analysis." This task seeks to identify the gaps in the current operationalization of disaster resilience and risk perception concepts, processes, and methods by CPAs by drawing together the desk research from D1.1 and the consultation with CPAs that occurred as a part of D1.2.

The main objective of this report is to discuss the gaps between state of the art research and practice, as well as discuss how these gaps can be addressed going forward and how they relate to the RPAG.

While examining gaps, the analysis will refine concepts and definitions relating to high level resiliency management processes, interoperability across different hazards and CPA structures, and different measures, approaches, and response options currently used for DRM in the case study areas. This report will also discuss organizational and resource management as well as different technical aspects that should be considered.

This report will also discuss ways that RiskPACC can address these gaps going forward. This includes suggested changes in CPA operations that highlight some of the management approaches and technical aspects discussed in the gap analysis. The report points out ways that addressing these gaps will impact the RPAG, with potential suggestions to close the RPAG.

This deliverable will focus heavily on the CPA aspects of disaster resilience and risk perception, and will be paired with D2.3, which focuses on gaps in community resilience. Together, these two deliverables will highlight the gaps in current operations for both CPAs and citizens, as well as presenting a roadmap for activities going forward. These gaps will also discuss how to best integrate the activities of CPAs and citizens to better address the RPAG. Both reports will provide suggestions for closing the RPAG going forward. Together with D2.3, this deliverable will feed into the baseline information required for WP3, "Co-creation lab and stakeholder integration," provide suggestions and recommendations that can be used in the second round of co-creation labs, and influence the development of the RiskPACC framework in WP4. They will also inform understandings of resilience, vulnerability, and risk perception that will be used throughout the project.

This report is developed with different intended readers in mind. As this information is necessary for RiskPACC going forward, the report is intended to be read by RiskPACC consortium members. Additionally, this report is developed for a wider audience, including anyone that is interested in DRM or RiskPACC.

1.2 Structure of the deliverable

This document includes the following sections:

- Section 2: This section provides an overview of D1.1 and D1.2 to re-introduce the concepts that have been discussed in previous deliverables. This includes the definitions of disaster resilience, risk perception, and vulnerability that were created in D1.1 and highlights of the interviews that were conducted in D1.2.

- Section 3: This section discusses the gaps that have been identified. It provides an overview of how the gaps were identified, and which deliverables can be looked at for further information. Following this overview, it will then provide an explanation of the identified gaps. These gaps fall into five categories:

    - communication,
    - theory vs practice,
    - governance,
    - operations and implementation,
    - and data and technology.

  Each of these categories are explained and then the gaps that fit into these categories are discussed in depth, including some recommendations on addressing these gaps.

- Section 4: This section discusses the gaps in terms of what they mean for RiskPACC going forward. It details how the activities currently planned for RiskPACC can address the identified gaps. It also highlights some recommendations for CPA activities that can be used to address the RPAG.

- Section 5: This section concludes and summarizes the report, presenting the next steps and relevant future work. This section addresses how the gaps identified and the work from WP1 will impact RiskPACC as a whole and how it will be used going forward.

2 OVERVIEW OF CPA PRACTICES AND OPERATIONALIZATION OF RISK PERCEPTION AND DISASTER RESILIENCE

Throughout WP1, the meaning of resilience, vulnerability, and risk perception for CPAs has been explored, through both desk based and empirical research. In D1.1, the evolution of terms was discussed, from their uses in other fields, such as engineering and psychology, to their uptake as important terms in the disaster risk management (DRM) domain. Following consultation of academic literature, as well as previous EU projects focused on resilience, the following definition of disaster resilience was developed for the RiskPACC project:

The ability of an individual, community, region, or country to resist, adapt to, and recover from the impact of a hazard, either natural or anthropogenic. Enhanced resilience can be embedded in activities in all stages of the disaster cycle, and includes positive transformation that strengthens the ability of current and future generations to adapt to future crises, and to survive and thrive as conditions change

This definition of disaster resilience was adopted based on several different definitions, namely the Sendai Framework definition, the Resilens (EU project) definition, and the DFID definition. It covers the breadth of CPA action in RiskPACC, as it applies to the community, region or country level. Additionally, it emphasizes that resilience should be incorporated in all stages of the disaster cycle.

Furthermore, operationalization of resilience by CPAs was discussed in D1.1. This discussion found that CPAs tended to employ three different techniques when focusing on resilience (Rice & Jahn, 2020):

1. Top-down approach: In this, the influence is placed on practitioners and governments, with very limited input from communities. This approach includes developing risk assessments and developing physical infrastructure (Aldance et al., 2014).
2. Bottom-up approach: This approach emphasizes the role of the community in DRM activities and understands that resilience cannot be managed by CPAs alone.
3. Hybrid approach: In this approach, CPAs lead most resilience activities with consultation from communities.

These approaches are highlighted in Figure 1 and show that CPAs have started to embrace the understanding that communities have a role to play in resilience activities, albeit only in the past 20 years.

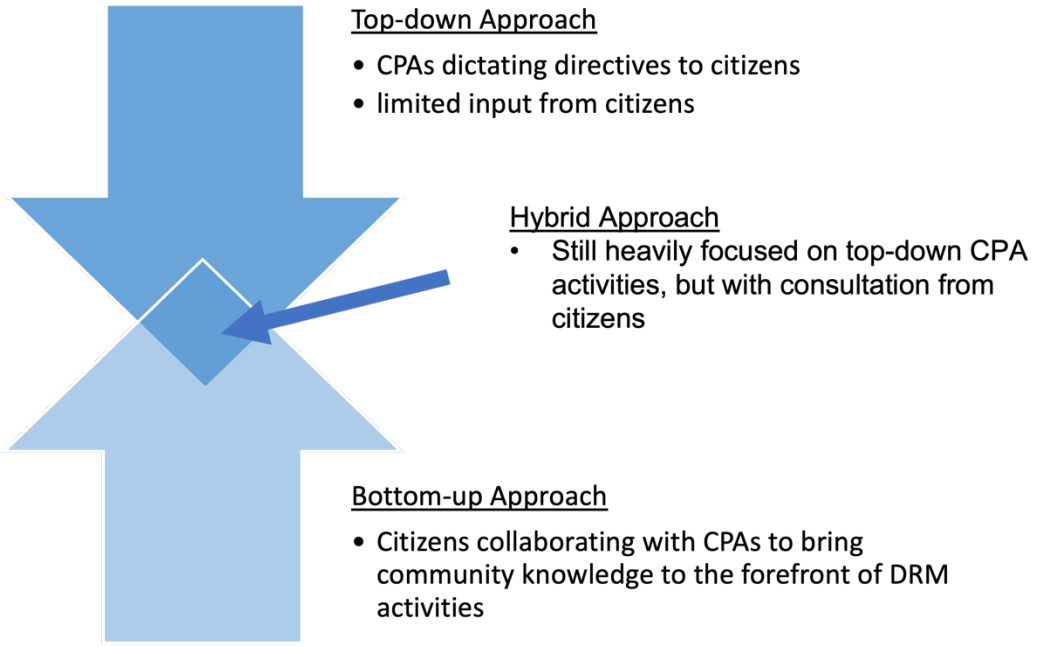

FIGURE 1: CPA APPROACHES TO DRM

While the literature highlighted a recognition of a need for more bottom-up approaches, empirical research from D1.2 did not identify many initiatives that involve community input. While some CPAs are working towards two-way communication, they were in the minority of respondents. This demonstrates that although research shows that bottom-up community engagement is beneficial in resilience work, it has yet to become a common practice among CPAs on the ground. Addressing this gap, and the gaps that result from this lack of bottom-up community influence, is the main goal of RiskPACC going forward. A further examination of the gaps in resilience practices will be discussed in depth in Section 3.

Additionally, the definitions and operationalization of risk perception among CPAs were discussed in D1.1. After consultation from literature in many different fields, the definition from the European Environment Agency was adapted for RiskPACC:

Risk perception involves people's beliefs, attitudes, judgements and feelings, as well as the wider social or cultural values that people adopt towards hazards and their benefits. The way in which people perceive risk is vital in the process of assessing and managing risk. Risk perception will be a major determinant in whether a risk is deemed to be "acceptable" and whether the risk management measures imposed are seen to resolve the problem (EEA, 2019).

This definition covers many of the factors involved in risk perception that are discussed in D1.1, as well as highlighting that people's perception of risk is vital to assessing and managing risk.

Research has shown that many of the traditional, top-down activities that are used by CPAs to increase risk perception are ineffective and that a more bottom-up, participatory approach is needed. This is highlighted when assessing CPA activities that were discussed in D1.2 as well, with several CPAs saying that there was a need for more two-way communication to increase risk perception and that the traditional approaches to increase perception are not always effective.

As described in D1.1, there are two primary ways that CPAs increase risk perception. The first are the traditional top-down techniques, where CPAs communicate risk to citizens in a one-way direction, with little input from citizens. These are the activities that are most commonly conducted among CPAs, although other solutions are beginning to be employed. These new techniques are more participatory in nature, with much greater citizen involvement. These bottom-up practices, that heavily involve citizens, are believed to allow for citizens to be able to better communicate with CPA, leading to better understandings between both groups.

In addition to disaster resilience and risk perception, the concept of vulnerability and how CPAs conceptualize the concept was presented in D1.1. In this review, the definition of vulnerability developed by UNDRR was adopted as the working definition for RiskPACC:

[t]he conditions determined by physical, social, economic and environmental factors or processes which increase the susceptibility of an individual, a community, assets or systems to the impacts of hazards.

Much research has been done on the relationship between vulnerability and resilience. These two concepts have previously been described as positive and negative polls of the same continuum, where being highly vulnerable means low levels of resilience, and being resilient means that vulnerability is very low. However, other authors see vulnerability and resilience as two completely different concepts, while they can partly overlap (Melkunaite, 2016; Rankin & Bång, 2016; Vollmer & Walther, 2018). RiskPACC has taken the view of the relationship in which resilience and vulnerability are influenced by each other. Factors relating to resilience such as capacity to adapt or capacity to recover can influence different vulnerabilities, such as social and economic, which in turn can also influence ones' capacity to adapt, cope, and respond (Birkmann et al., 2013).

Both vulnerability and resilience can be influenced by people's risk perception. Risk perception can be seen as a component of vulnerability, i.e. it can lead people to take preventive or preparatory actions, which decreases their vulnerability. In turn, if people experience a disaster, and are therefore vulnerable, this potentially changes their risk perception. An increased risk perception can also help – through an increased preparedness – to better cope, recover or adapt to stresses or disaster events. While vulnerability was not to focus of D1.2, D1.1 demonstrated that vulnerability is interrelated with the other key concepts of RiskPACC.

The review of the state of the art (SOTA) research illustrates that bottom-up activities are the most effective in increasing resilience and risk perception. While this is the case, current CPA activities remain mostly top-down, with little input from citizens.

While consulting with CPA, many gaps between the state of the art and common practices have been discovered. These gaps will be discussed in this deliverable.

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3 GAPS IN CPA ACTIVITIES

This section highlights the gaps in the SOTA for disaster resilience and risk perception and discusses what they mean in terms of the main objective of RiskPACC, closing the RPAG.

3.1 Gaps overview

The gaps in this deliverable are derived from both the desk-based research done in D1.1 as well as the interviews and consultations with various CPAs that were part of D1.2. To identify the gaps, both deliverables were reviewed in depth and discrepancies between research and practice were noted. Additionally, as these gaps are informed by interactions between CPAs and citizens, information from the WP2 deliverables has also been considered. Table 2 below shows the identified gaps and from which deliverable the gap was derived.

Gap	Main sources/deliverables used	Other sources/deliverables used
Communication Gaps		
Increased communication in general	D1.2 and D2.2	
Two-way risk communication	D1.2	D1.1 and D2.2
Lack if existing communication channels	D1.2 and D2.2	
Theory and Practice Gaps		
Better understanding of social and human factors	D1.1	D1.2
Contested terminology	D1.1	D1.2
Governance Gaps		
Better CPA integration	D1.1	D1.2
Better incorporation of bottom-up activities	D1.2	D2.2
Trust	D1.1	D1.2
Linking perception and behaviour	D1.1 and D1.2	
Operation and implementation gaps		
More prevention work	D1.1	D1.2
Lack of community engagement	D1.2	D2.2

Lack of understanding of community needs	D1.2	D2.2
Resources available	D1.2	
Data and technology gaps		
Lack of data on what is working	D1.2	
Standardized data	D1.2	
Digital divide	D1.2	

TABLE 2: DETAILS ON DELIVERABLES WHERE GAPS WERE DETERMINED

The gaps that have been identified fit into the following **five overarching themes**:

1. communication gaps,
2. gaps in theory vs practice,
3. governance gaps,
4. operational and implementation gaps,
5. and gaps in data and technology.

While these gaps have been gathered from both desk-based research and information that has been given by CPAs as part of the empirical research, not all gaps apply to all case study areas and CPA groups.

3.2 Communication gaps

As mentioned above, much of the communication done by CPAs occurs in a top-down way, where CPAs impart information to citizens through various channels without many opportunities for feedback. This communication style has been highlighted in both D1.2 and D2.2, with both CPAs and citizens saying that new ideas for communication are needed. Several gaps have been identified relating to communication, and they are summarized in Figure 2 below.

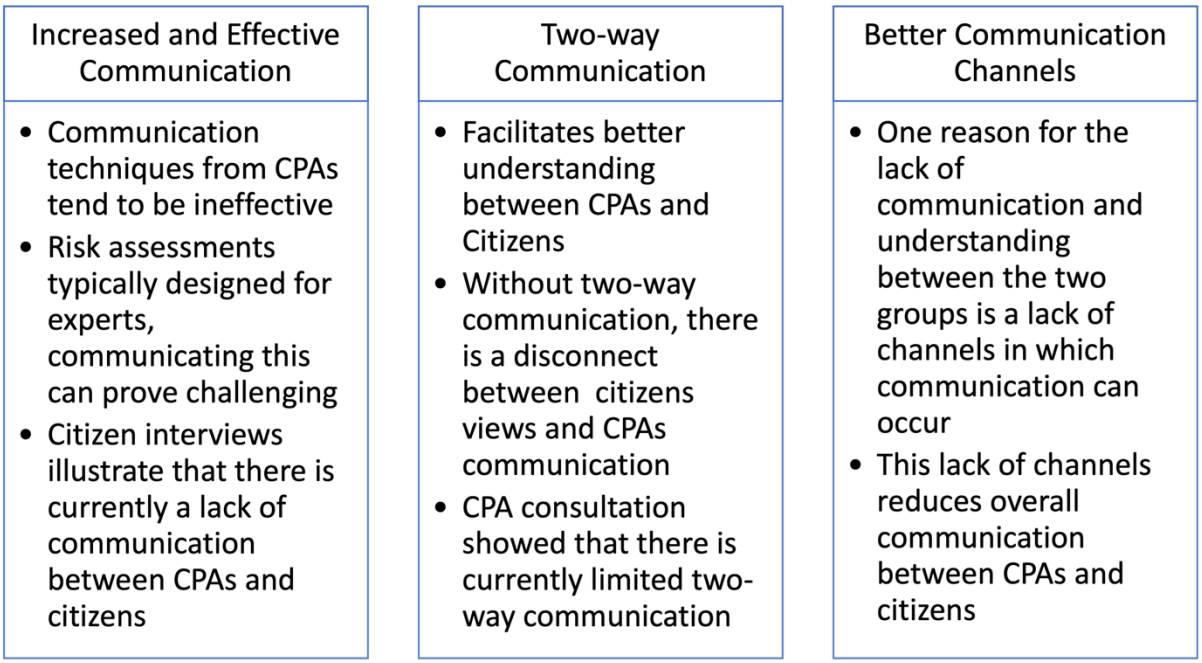

FIGURE 2: SUMMARY OF COMMUNICATION GAPS

This section addresses these gaps by examining the lack of communication in general, two-way risk communication, and lack of existing communication channels.

3.2.1 INCREASED AND EFFECTIVE COMMUNICATION

Work done in WP1 thus far has shown the need to enhance communication practices between CPAs and citizens, due to the lack of engagement between the two groups in RiskPACC case study areas. Risk communication is considered the communication to the public about risks and hazards that can potentially impact populations (Glik, 2007). The purpose of risk communication is to provide information so that everyone at risk can make informed decisions to mitigate or address their risk (WHO, 2020). Historically, there have been difficulties with CPAs communicating risk, as many of the risk assessments are created by experts for other expertise, and the technicalities are difficult to translate to lay-people (Feteke, 2012). Terminology can be confusing, and many people do not understand the use of statistics and uncertainty. Therefore, communication between CPAs and citizens faces many challenges. Additionally, many of the techniques used, including brochures and websites, are deemed ineffective (Feteke, 2012; Xu et al., 2016).

In D1.1, communication surrounding risk perception was discussed, and the various degrees of success were mentioned. Some CPAs, particularly in Bangladesh, had some success in increasing risk perception through communication (Sattar & Cheung, 2019). This was mainly due to the heavy focus on risk communication at every CPA level (local, provincial, country-wide) in the country to try and reduce the impacts of cyclones. Other countries, such as Costa Rica, had not had as much success in risk communication, due to the information not reaching those that required it most. They provided the information mainly in an online format, while most people with the greatest risk did not have reliable access to the internet (Van Mamman, 2014).

Most CPAs interviewed for D1.2 discussed their current communication methods. Many used the more traditional methods, including brochures, town halls, and help lines. These are the typical top-down methods employed by most CPAs, and therefore they have various degrees of effectiveness in communities. While interviewing community groups for D2.2, many expressed frustration at the level of communication coming from CPAs. Many were not aware of the risks in their area and did not know what to do during a crisis due to this lack of communication. Additionally, several commented that during an emergency, there was a lack of communication from CPAs on what to do. The help lines were either overwhelmed or unhelpful, brochures had been lost, and the physical presence of CPAs spreading messaging via megaphones was not sufficient.

This exposes a large gap in CPA communication in the case study areas. The lack of communication frustrates citizens, and in their mind leaves them unprepared for crises. Many CPAs commented that communication needs to be improved, but some believe there is sufficient communication present due to the methods mentioned above. Increasing levels of communication may address some of these problems, as it will help citizens better understand CPA activities, and allow CPAs to better understand risk perception and needs in the areas that they work.

3.2.2 TWO-WAY RISK COMMUNICATION

In addition to general communication improvements, the specific need for two-way communication has been identified as an important gap in CPA activities in the RiskPACC case studies. Communicating risk has historically been seen as a mechanism to align the public view of hazards, including their acceptability, with those of CPAs. This has typically involved one-way communication and this model of risk communication assumes that the public lack an understanding of their risks (Frewer, 2004). While this view has been held by many CPAs, it has often not led to a meaningful change in knowledge or increased action on the part of citizens. While there are many reasons for this, one of the most important is that this approach to risk communication has reinforced the public's beliefs that societal values (their values) are not taken into account by risk managers when risk mitigation strategies are developed (Frewer, 2004; Kjellgren, 2013). While new approaches to communication are being developed, and CPAs have been working towards a more inclusive form of risk communication, the majority of CPA communication still occurs in a top-down manner (Frewer,2004). This leads to a gap in CPA practices, where the various ways that risk is communicated do not fit people's needs, and therefore are not as effective as they could be.

In addition, two-way communication is one way that CPAs and citizens can better understand each other's perspectives. For example, CPAs that were interviewed for D1.2 mentioned that they did not want to give citizens information that would cause them to "panic," while citizens interviewed wanted much more information on risk and the actions they can take than they have received. It has been shown that citizens are much less likely to panic than conventional CPA wisdom believes (Quarantelli, 2001), which CPAs could better understand through improved two-way communication.

Through this dialogue, CPAs would understand better what information citizens want and need, and can then pass on more relevant information.

As highlighted in D1.1, many of the traditional top-down communication methods were ineffective in increasing risk perception. One of the reasons for this lack of change in perception is that communication of risk is not presented in an understandable and helpful way to individuals and may not fit the needs of a given community (Kjellgren, 2013; Höppner et al., 2012; Ardaya et al., 2017). For example, many CPAs use hazard maps to convey an individual's risk, but research has found that these have been an ineffective communication tool (Kjellgren, 2013). New techniques that build more on individual and community knowledge and understanding are needed to increase the effectiveness of this work (Kjellgren, 2013; Höppner et al., 2012). This shows the need for two-way risk communication, which can bring community knowledge into the CPA understanding of risk.

In D1.2, which included consultation with CPAs, risk communication was an important topic discussed by all local CPAs. Most CPAs interviewed still employ more traditional methods of risk communication with communities. These include information campaigns such as giving out brochures in neighbourhoods that are high risk, developing websites, relaying information via loudspeakers during emergencies, and spreading information about the emergency plans in place. In some cases these activities have had an impact, such as enhancing understanding of earthquake safety among children in Israel, but according to CPAs interviewed in most case study areas, risk perception in their communities is low and new techniques for risk communication are necessary to increase this perception. One interviewee directly mentioned the need to increase two-way risk communication, as traditional methods were not effective in their area, while other interviewees mentioned the need for more community engagement in their activities.

Two-way communication may help increase risk perception in an area by finding better solutions to develop risk knowledge. Research has demonstrated that two-way communication can bring individuals' understanding of the community, as well as their beliefs and past experiences, into the understanding of risk (Höppner et al., 2012). By incorporating the community perspective, both CPAs and citizens will have a more holistic view of risk. Increasing risk perception is one aspect of addressing the RPAG, and, therefore, there is a strong need to increase the two-way risk communication practices in the case study areas.

3.2.3 LACK OF EXISITING COMMUNICATION CHANNELS

There is a lack of identified communication channels where CPAs and citizens can discuss different issues, contributing to the general lack of communication. There are communication channels for CPAs to disseminate information to citizens, such as loudspeakers, mass media, and patrol cars, but there are very few communication channels for citizens to discuss their needs and concerns with CPAs (Clerveaux et al., 2008). This can again lead to a lack of understanding in the differing responsibilities and needs of each group.

This lack of communication channels was commented on both by CPA interviewees from D1.2 and citizen group interviewees from D2.2. There were differing explanations as to why this lack of communication channels occurs depending on who is asked. Many citizens believed that CPAs were too busy to establish these channels and were less interested in active communication. CPAs commented that it was difficult to reach many citizens and that not all were interested in participating in their communication events. This inconsistency of views shows the need for better communication channels. The lack of channels causes misconceptions in the practices and attitudes of the different groups.

RiskPACC will attempt to address this gap with the technical solutions being developed. These include the STAM platform, which aims to enhance communication between CPAs and citizens. While several of the CPAs currently use apps or online platforms to communicate with citizens, the majority of those interviewed did not. The platforms being developed for RiskPACC may provide communication channels that have not existed prior to their development, with the potential to address this gap. Explanations of all of the platforms can be found below in Table 3. These tools can be used as different solutions to increase communication channels between CPAs and citizens.

RiskPACC Technical Solution	Solution Description
VGI Tool	• This tool will provide VGI strategies to include communities in gathering data for risk assessment and disaster response. • **Information generated from geodata by remote volunteers:** risk map updating by volunteers by identification of relevant changes • **Tasked local mapping by volunteers**: monitoring of vulnerability and exposure of elements at risk; facilitating improved people-centred, post disaster response • **Opportunistic local mapping by volunteers:** provision of incidental information by volunteers
AR Mobile App for Climatic and Natural Hazards Assessment	• User-friendly crowdsourcing mobile application that enables **timely information exchange** to enhance preparedness and response • **Increase bilateral communication between CPAs and citizens:** real-time interaction between experts and vulnerable communities • Effective communication of climate risk and warnings to citizens to increase preparedness • **Augmented reality and gamification** techniques to enhance training and education
***Crowdsourcing from Community* - Community Platform**	• **Facilitating communication between CPAs and citizens**, sharing information as quickly as possible; receive and send targeted notifications to users based on vulnerabilities;

	communicate with posts and chats about hazardous events from both CPAs and citizens • Inform citizens about actions to take given vulnerabilities and current situations
Monitoring of Open Data	• Crowdsourced data to help organizations obtain **real-time insights and situational awareness** • Messages, video feeds, and images through online application • **Ability to send personalized alerts** • Creation of real-time searches specific for the CPA user-case

TABLE 3: SUMMARY OF RISKPACC TECHNICAL TOOLS

3.3 Gaps in theory versus practice

This section discusses gaps in CPA theory versus practice. It highlights the theoretical research that has been conducted in the DRM field and contrasts that theory with what occurs in practice. The gaps between theory and practice include issues such as the definition of resilience and the incorporation of different factors into CPA methods.

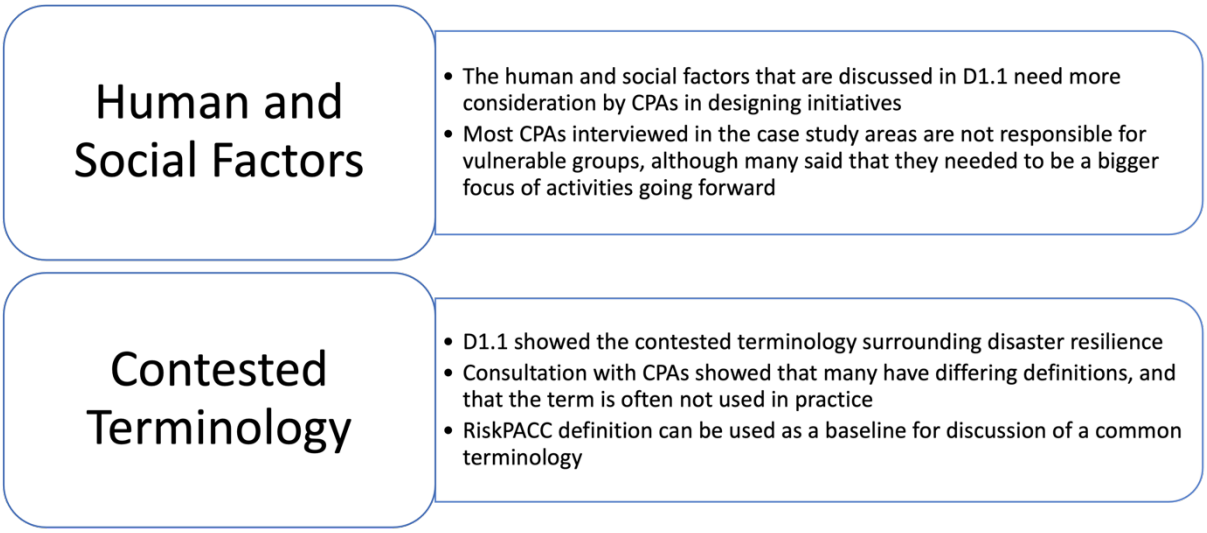

FIGURE 3: SUMMARY OF THEORY VS PRACTICE GAPS

3.3.1 BETTER UNDERSTANDING OF HUMAN AND SOCIAL FACTORS

As demonstrated in D1.1, social and human factors play an important role in both risk perception and disaster resilience (See D1.1, section 2.6 and 4.2). Human factors refer to previous experience with a hazard, education levels, trust in authority, as well as knowledge and skills. Factors such as previous experience with hazards and trust in authority play a large role in risk perception of citizens, and therefore needs to be considered by CPAs when planning different education and communication activities. As described in D1.1, previous experience with a hazard generally indicates that an individual will be more likely to be receptive to education and communication by CPAs, as they will have higher risk perception (Cui & Han, 2018). Similarly, trust in authorities will have an impact on risk perception and disaster resilience, as citizens are more

likely to listen to CPAs, follow advice given, and participate in activities if CPAs have established trust (Sullivan-Wiley & Gionnati, 2017).

Additionally, social factors are important in understanding risk perception and disaster resilience in citizens. These factors include aspects such as income level, education, gender, age and ethnicity. Understanding these factors can help CPAs better tailor their activities to increase risk perception and disaster resilience. For example, research has shown that women tend to have lower disaster resilience than men due to societal and structural conditions (Lightfoot et al., 2020). Similarly, older citizens tend to have lower disaster resilience, but higher risk perception than younger citizens (Lechowska, 2018). As social and cultural factors may impact a person's individual risk perception, identifying and tailoring activities to these factors may result in communities with overall improved perception (Yong & Lemyre, 2019).

In interviews for D1.2, a question was asked about tailoring activities to different vulnerable groups. Most of the CPAs interviewed had limited information on how to address these social factors in the DRM cycle. Many expressed the sentiment that assisting different vulnerable groups was not their responsibility, and that other authorities are supposed to address these issues. Of those that had a responsibility to address vulnerable groups, the majority focused mainly on the elderly and children during the disaster response phase. Additionally, CPAs identified the fact that there is a fragmented response amongst different CPAs in addressing these vulnerable groups.

There were several CPAs that discussed risk communication amongst vulnerable groups, saying that they focused on their activities on the elderly. Others mentioned that risk communication was not tailored to vulnerable groups, and that this was a major concern.

Research has shown that these factors need to be considered in CPA activities, and that they should be reflected in all facets of the DRM cycle. Unfortunately, interviews with CPAs show that often these factors are not included in much of the planning and activities, and if they are, they are focused only on the response phase. In the case study areas, risk communication and other activities are rarely considering vulnerabilities in the activity design. This leaves a large gap in CPA activities in the case study areas, where addressing these factors can change CPA activities for the better. One CPA group interviewed described increased outreach to vulnerable groups, and considering these factors in their activities, to be a top priority going forward. They have been involved in research on better inclusive communication, which involves considering social and human factors in their risk communication work going forward. Activities such as this should be considered by more CPA groups, as they can better tailor activities to increase risk perception and disaster response.

3.3.2 CONTESTED TERMINOLOGY

Research has shown that the definition of disaster resilience has been contested throughout much of its history (See D1.1 for a detailed explanation of this). This contested terminology has led to difficulties in both operationalizing disaster resilience among CPAs and measuring the resilience of an area. CPAs have different opinions

on whether resilience is more about recovery and reconstruction, or if the focus should be more on prevention and disaster preparedness (Manyena et al, 2019; Mayta & Pelling, 2014). Additionally, there has been disagreement over whether resilience means build back, or if the concept is more about building back better (Schelfaut et al., 2011; Sudmeier-Rieux, 2014). The contested terminology leads to confusion among different CPAs as to what is meant by resilience, and has the potential to make it a term that is not useful in the field. As a part of D1.1, a definition was presented for RiskPACC, but this has yet to be widely discussed or adopted by CPAs and citizens in the case study areas.

The challenges in terminology can be seen in the interviews conducted for D1.2. All CPAs interviewed were asked about the definition of resilience used, and all of them gave different answers. Most of them did not mention any sort of prevention or preparedness as part of their definition. Additionally, many interviewees stated that they did not use the term resilience in their work, even though they are working on disaster resilience activities. The majority mentioned that this is because citizens did not understand the term, or because other terms such as disaster management or emergency management seemed more applicable.

To reduce conflicting understandings and improve cohesion, it is important for the CPAs in the case study area to share the same definition of disaster resilience, as well as to ensure citizens have a similar understanding of the term. RiskPACC can address this issue by creating a dialogue with different CPAs and citizens that would lead to a commonly accepted definition. The definition developed within RiskPACC can serve as the basis for this dialogue, which can be adjusted based on the practical experiences from CPAs and citizens.

3.4 Governance gaps

This section discusses gaps that have been discovered in governance activities, especially in how different CPAs operate and their structures. Disaster governance is understood here as "the interrelated sets of norms, organizational and institutional actors, and practices that are designed to reduce impacts and losses" (Albris et al., 2020). Table 4 gives an overview of the gaps that will be presented in this section.

Governance Gaps	Gap Description
CPA Integration and Interoperability	• Currently different CPA communication and operations are fragmented, leading to a lack of cooperation between different CPAs • This was noted in interviews with CPAs, where communication in disaster response was fragmented • Integration needed to make sure CPAs are on the same page when communicating with citizens
Bottom-up CPA Activities	• Important to get citizens involved in all aspects of DRM, which means creating different bottom-up initiatives

	• This can bring the citizen perspective into DRM activities in the case study areas • There was a lack of interaction noted in both D1.2 and D2.2, meaning more effort needs to be put into creating these bottom-up activities
Trust	• As established in D1.1, trust is a very important aspect of risk perception in communities. If there is trust in CPAs, communities tend to be more receptive to information and advice from CPAs • D2.2 showed that many community groups do not have trust in their CPAs, as there has been very limited interaction between the two
Linking Perception and Behaviour	• While very difficult to do, understanding perceptions and linking that to behaviours among citizens is vitally important and is not currently being done by CPAs • The interviews showed that both CPAs and citizens believed that risk perception was drastically different between the two groups • More needs to be done to address why, and how to link perception and action

TABLE 4: SUMMARY OF GOVERNANCE GAPS

As seen in table 4, the gaps in governance for RiskPACC include better CPA integration, the need to include more bottom-up activities into CPA operations, the need for these CPAs to build better trust from a citizen perspective in their organisations, and better linking perception and action. The sections below will provide more information on the gaps outlined in the table.

3.4.1 BETTER INTEGRATION AMONG CPAS

Interoperability between different CPAs in an essential factor in operational resilience and has the capacity to increase disaster resilience in an area (Barasa et al, 2018). Interoperability is understood as the "ability of two or more systems or organizations to exchange data and to mutually understand the information which has been exchanged" (Gencturk et al., 2015). For CPAs, this means that different organizations should be able to communicate effectively and maintain systems that can share data and operations efficiently, so that all CPAs have a common understanding during a disaster response. This will enhance collaboration, as all systems that are commonly used should be able to work together. This is a challenge for many CPAs, as systems and activities are usually developed separately (Gencturk et al., 2015; Marsella & Marzoli, 2014). Typically, one of the few ways different organizations share information is via telephone calls, which can be a challenge in emergency situations. Issues surrounding integration and interoperability among CPAs can also stem from different organisations having different working cultures and procedures (Marsella & Marzoli, 2014). If CPAs can increase interoperability, they can better integrate their operations and provide a more holistic response that citizens can rely on.

There is currently a lack of integration and interoperability between different CPA organizations in the RiskPACC case study areas. Many of the interviewees for D1.2 expressed a desire for better integration of services. For example, in the UK, there was a desire from someone outside the police force to have better communication and integration with police activities. The police are normally the first to respond to various disasters, while other organizations are responsible for long term response and recovery. If these two services are not integrated, there can be fragmentation in the recovery effort, leading to a suboptimal response. Other CPAs interviewed have also commented on the need to better integrate the different CPAs that work in the area in question. Integration is also essential in communication with communities. If different CPAs have different styles of communication, and communicate different advice to citizens, confusion might be created and a lack of trust in information.

This gap in operations of CPAs in the case study areas is something that should be addressed going forward. Interoperability and integration should be priorities between different CPAs, as it can encourage a robust DRM scheme in a local area. Additionally, different CPAs did not believe it was in their purview to look after vulnerable groups. If these CPAs do not coordinate, those whose responsibility it is to look after these groups may not have good communication with others involved in the response, potentially allowing for the most vulnerable to be overlooked. While some case study areas have good integration between CPAs in their areas, those that lack this should consider ways that integration and interoperability can occur.

3.4.2 BETTER INCORPORATION OF BOTTOM-UP ACTIVITIES

As mentioned in Section 3.2, there is a need for CPAs to include more two-way communication into their risk communication activities. The need to better incorporate the community into CPA activities extends beyond risk communication to other activities in the DRM cycle. It has been noted in research that involving civil society and citizens into the entirety of the DRM structure is the gold standard of CPA activities, although many issues have been presented as to why these activities do not always take place. The conditions that lead to a lack of incorporation of bottom-up activities include (1) the lack of follow-up among CPAs and (2) lack of continuity in activities (Albris et al., 2020).

This incorporation of bottom-up activities is important, as local knowledge is very specific to the culture and context of a community and is hard for CPAs to ascertain without this community involvement. Adding local context to all levels of DRM will lead to more comprehensive CPA activities (Kruse et al., 2019). The need to incorporate bottom-up activities and knowledge arises because many of the top-down CPA activities lack openness and are not adaptable to local situations. Additionally, most activities and plans are developed without input from the local community (Kruse et al., 2019). The neglect of local community knowledge can lead to the perception that the activities planned are not appropriate or useful to citizens (Solerino et al., 2021).

In the consultation with CPAs for D1.2, many mentioned that they did not have much interaction with citizen groups. This lack of interaction indicates that many CPAs have not yet adopted policies that will lead to integration of bottom-up activities. This was echoed in D2.2, where most citizen groups discussed the lack of interaction with

CPAs. Some CPAs interviewed acknowledged the need to increase local participation, and some even mentioned the need for more bottom-up activities. While these activities have yet to take place in many of the case study areas, there is the acknowledgement that these activities need to be adopted. This is one of the most important gaps to address going forward in RiskPACC, as better integrating community knowledge is a central idea in addressing the RPAG.

One suggestion for improving the incorporation of bottom-up activities is the creation of web-based platforms to facilitate stakeholder engagement (Albris et al., 2020). This falls under the activities of RiskPACC, where there is an attempt to create online platforms that will increase disaster resilience. Different platforms that have been developed for RiskPACC will accomplish some of these objectives. Additionally, other research has suggested that games that integrate bottom-up knowledge into risk prevention activities can increase co-learning among citizens and CPAs, therefore integrating bottom-up knowledge into future CPA activities (Solerino et al., 2021; Backlund & Hendrix, 2013). This is an opportunity for RiskPACC to lead the way in increasing bottom-up activities. While these tech-based platforms will increase engagement, a wide range of solutions needs to be provided, as solely focusing on these web-based solutions may exclude particular groups (see section 3.6.3).

3.4.3 BUILDING TRUST

Trust in CPAs is a complicated process that is comprised of many different facets, including perceptions of competence, integrity, and honesty, as well as whether the risk managers are perceived to have the communities' interest at heart (Eiser et al., 2015). It is essential for CPAs to develop trust among community members, because without trust, most individuals are unlikely to participate in CPA initiatives (Peng et al., 2020). This trust comes from creating a relationship between CPAs and citizens, typically through the two-way communication that was discussed in Section 3.2 (Busa et al., 2015). A lack of trust in authorities can be dangerous in emergencies, as it can lead to citizens not listening and responding to CPA warnings. This was the case for many during Hurricane Katrina, where individuals did not evacuate when instructed to because they did not trust the authorities issuing the orders (Busa et al., 2015).

Research has also indicated that increased trust can also increase the participation of individuals in disaster management and preventive actions. It has been demonstrated that willingness to invest personal finances in DRM activities at the community level is significantly influenced by the level of trust in authorities (Kim et al., 2020). As mentioned in D1.1, and discussed here, trust is a major factor in risk perception and action in citizens.

Based on interviews with citizen groups included in D2.2, there were varying levels of trust that had been established by CPAs in the RiskPACC case study areas. For example, the interviewees from Israel, Greece, and the UK did not have favourable views of many of the CPAs they had encountered, and therefore lacked trust in their actions. In Israel, the interviewee had not had contact with their local CPAs, and therefore did not know what they would do in a crisis situation. In Greece, previous experiences of calling the emergency line during a fire had been disappointing, and there were aspects of politics in the disaster response that have led to a lack of trust.

In the UK, the interviewee had struggled to get help in a disaster response, leading to a deep lack of trust in many of the CPAs in the area. This lack of trust was not found in all interviewees, as the interviewee from Italy and others from Greece had very good relationships with their local CPAs. They worked closely together, and had established good lines of communication, which had built trust over the years.

This gap, while an important one to consider in the context of what RiskPACC is aiming to achieve, may be difficult to address in the context of the study. The co-creation workshops can be a step in the right direction, and the increased communication will help in building trust, but achieving this is a gradual process and takes sustained work. While RiskPACC activities may lead to an increase in trust, it may be difficult to measure beyond the course of the project and will take longer to establish than the duration of the study. Although it is a long process to establish trust, it should be incorporated in the design of study activities, as it should be considered one of the main aims going forward and having long term impact.

3.4.4 LINKING PERCEPTION AND BEHAVIOUR

Throughout the research previously completed for RiskPACC, a key risk governance gap has emerged. It has been described in both D1.2 and D2.2 that citizens and CPAs have different understanding and perception of risk. This can lead to different degrees of risk acceptance, and ultimately a divergence in the perceived appropriateness of different risk reduction actions. The challenge of CPAs is to understand how risk perceptions are linked to the perceived appropriateness of different risk reduction actions and what leads to taking these actions (Wachinger et al., 2013). Additionally, while some studies have shown that increased risk perception leads to an acceptance of different actions, as well as behaviour changes, other studies have not been able to create this link (Wachinger et al., 2013; Eiser et al., 2015). Since RiskPACC is aiming to close the gap between perception and behaviour, this gap in linking perception and behaviour will be essential in closing the RPAG.

While it has been acknowledged by both CPAs and citizen groups interviewed that there are vastly different understanding and perceptions of risk between the two groups, little has been discussed in the interviews for ways to address these differences. In order to link perception and behaviour, CPAs need to understand the different reasons why perceptions may not lead to action. Research is still lacking in this area, but there are some suggestions for why perceptions and behaviours do not match. It has been suggested that simply informing people of their risk is not enough to influence behaviour change. This is due to several factors, including individuals receiving contradictory messages of risk and a lack of resources to undertake adaptive actions (Rufat et al., 2020; Wachinger et al., 2013). Additionally, CPAs may lack the means to determine how to target their risk messages to the most vulnerable in order to persuade them to act. Some of the most vulnerable are considered “hard to reach” and CPAs may not have the resources available to tailor their messaging to these groups (Rufat et al., 2020). This can lead to different groups having different perceptions of the actions suggested by CPAs and may impact the acceptance of these actions.

Linking perception and behaviour also needs to acknowledge the historical precedent that CPAs were traditionally responsible for prevention activities such as flood protection, and citizens believe that the state would provide these protections. This is at odds with present circumstances where CPAs and governments are transitioning these activities to an individual level (Rufat et al., 2020; Rice & Jahn, 2020). This sentiment was echoed in interviews for D1.2 and D2.2, where CPAs believed that disaster prevention and some disaster response is an individual's responsibility, and citizens groups believe that CPAs need to do more in terms of DRM activities. This is a gap in perception that needs to be addressed, as linking behaviours may not occur until these divergent views are considered.

3.5 Operational and implementation gaps

CPA operations were discussed in depth in D1.2, as well as being touched upon in D1.1. In addition, much research has been done on the ideal operations of CPAs and how they implement their work. The gaps discussed in this section will cover areas in which operations and implementation of activities do not live up to the state of the art for CPA work. Figure 4 presents an overview of the gaps presented.

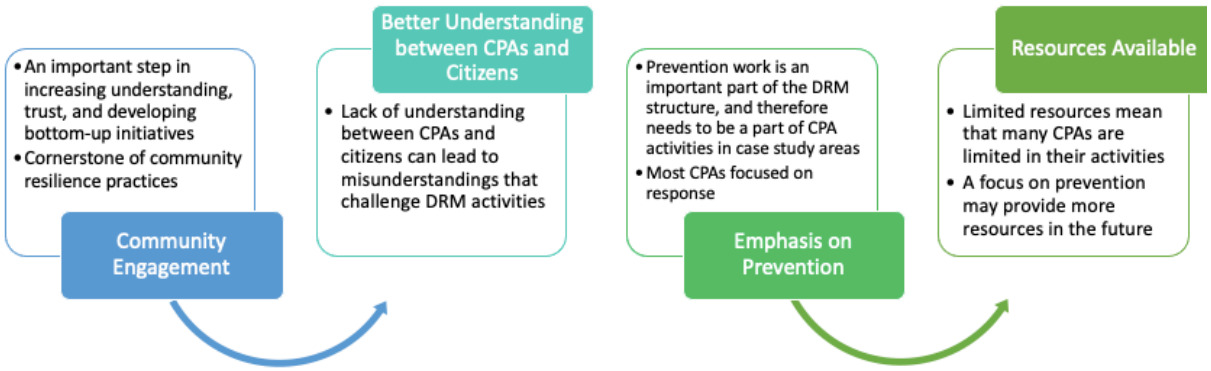

FIGURE 4: SUMMARY OF IMPLEMENTATION AND OPERATIONS GAPS

As seen in the figure, these gaps include aspects such as the lack of prevention activities among the CPAs in the case study areas, the lack of community engagement noted by both CPAs and citizens, a lack of understanding on the part of CPAs as to the citizens perspectives and activities, and issues caused by a lack of resources. The following sections will present a more in-depth analysis of these gaps.

3.5.1 MORE PREVENTION ACTIVITIES

As shown in D1.1, disaster resilience has shifted over the years to have a stronger focus on prevention activities (Feteke et al., 2014). This has followed the recognition that just "building back" may not be sufficient to completely address resilience. Resilience activities have to cover all aspects of the DRM, not just response and recovery (Matya & Pelling, 2014). While this change from bounce back to a stronger focus on prevention has occurred in the past 20 years in the DRM field, most of the CPAs interviewed for D1.2 focused much more on response and risk communication than they did on prevention activities. The limited concentration on prevention has also been shown in research, where one study found that the disaster preparedness levels in EU countries is barely considered as acceptable (Djalali et al., 2014).

Many of the CPAs have prepared emergency plans, but that is the extent of their preparation work and there was little else mentioned in terms of prevention activities. While emergency plans and risk assessments are an important part of CPA activities and form the basis and background of most DRM activities, they should be paired with more concrete prevention work. Disaster prevention can be more cost effective, and should therefore be a stronger focus of CPAs, as it has the potential to save funds in the long run (Amaratunga et al., 2015).

Some prevention activities include local risk assessments, which most CPAs do not complete. Most of the risk assessments are focused on regional or state levels, and therefore are not focused on local risks (Papatheodorou et al., 2014). Early warning systems are also prevention methods that should be considered, especially ones that involve community input. There are also legislative measures that can be taken for prevention, which include seismic building standards and land usage laws. While CPAs may not have much power over legislation, they can lobby for it, especially at the local level. Prevention also involves the coordination of different actors in the DRM sphere. Coordination occurs commonly in the response phase but is currently less common in most prevention work (Albris et al., 2020). Trainings and education is also considered a part of prevention activities (Djalali et al., 2014). While some of the CPAs in the case study areas mentioned they conducted educational campaigns, most were done infrequently and in a way that was not necessarily effective.

The goal of RiskPACC is to close the RPAG, and one of the main aspects of the RPAG is to increase the amount of preventive action that is undertaken in communities. If prevention is not a major focus of CPAs, then many citizens may not know what prevention activities they should participate in, or they may not know that a focus on prevention is important. Increasing the focus on prevention for CPAs may have an impact on the RPAG.

3.5.2 LACK OF COMMUNITY ENGAGEMENT

CPA engagement in the community is an important aspect in producing the bottom-up initiatives that aim to increase risk perception and produce more community and citizen centric DRM activities. It is the first step in developing these programs, as it entails gaining an understanding of and building a working relationship with the community. Community engagement is a cornerstone of community resilience practices, as it can lead to communities that understand and are prepared for hazards and risks (Lal Pandey, 2018). If communities are not engaged, they will not participate in any of the activities planned by CPAs, therefore making it harder to engage with CPAs and design their bottom-up initiatives and take part in two-way communication. Additionally, research has indicated that community engagement will heighten social connections and networks, an important social factor discussed in D1.1 that has the potential to increase overall disaster resilience (Cutter et al., 2016; Aldunce et al., 2016).

In interviews done for D1.2, many of the CPAs described attempts at community engagement. Some worked with students to train them on disaster response, some trained community volunteers, and some sent brochures on risk to households. While these activities point to some level of engagement, many of the CPAs interviewed

pointed to better community engagement as one of their main priorities going forward. Many felt that they were not doing enough to engage with the communities where they work, and some were actively doing things to address this. One of the interviewees in Belgium included a community meeting room when they renovated their headquarters. This was deliberately done so that CPAs could meet and engage with members of the community. This need for community engagement was echoed by citizens in D2.2, where many mentioned a lack of CPA presence in their communities.

To address this gap, more actions need to be taken similar to those in discussed by the Belgian case study. Having connection with members of the community will increase community engagement and therefore create more space and desire for bottom-up activities on both the part of CPAs and citizens. Increasing community engagement should also help address some of the other gaps that have been presented previously, including communication, perception to behaviour, and increasing trust in CPAs.

3.5.3 LACK OF UNDERSTANDING BETWEEN COMMUNITIES AND CPAS

Due in part to the lack of communication channels discussed in Section 3.2 and the different understanding of risk discussed in Section 3.4, there is a general lack of understanding between CPAs and citizens, where each have expectations of the other that are unrealistic. On the CPAs part, they believe that citizens need to take a more active role in their own protection. This is shown in both the literature (National Research Council, 2012) as well as in the interviews with CPAs.

As the literature suggests, CPAs want citizens to take a more active role in their own civil protection. CPAs around the globe have worked to get citizens to become more involved in ongoing disaster resilience activities (Rice & Jahn, 2020). This has included the USA, where resilience has been defined as the responsibility of everyone, including individual citizens (National Research Council, 2012).

This has been discussed by interviewees in D1.2 as well. Several interviewees discussed their desire for citizens to become more independent, hoping that they will take measure to address resilience in their communities. Additionally, CPAs have suggested that individuals need to engage more in their own safety. Several interviewees believed that citizens rely too much on CPAs being available whenever a disaster occurs and want more engagement from individuals. The desire for communities to put more effort in their own resilience come from the fact that CPAs cannot be everywhere during a disaster and therefore getting communities more involved will help CPAs handle disasters more efficiently.

Alternatively, communities believe that they need much more interaction with CPAs as well as help from CPAs to be able to properly respond to disasters. In D2.2, most citizens interviewed did not believe that they had sufficient resources and information on hazards and risks to properly respond to disasters when they occur. For example, in Greece during the fires season, citizens mentioned that they did not know what to do during the event and were not given adequate information when they reached out to CPAs. This sentiment was echoed across many of the citizen interviews, where interviewees needed much more information to be able to act productively and take

part in resilience activities. This presents a gap in implementation, where CPAs and citizens lack understanding of each other's role.

While the push for more community and individual responsibility will in the long run result in a more bottom-up approach to resilience, this gap also occurs when making such a push too early. Many communities have not had enough exposure to DRM activities, and in many cases communication with CPAs has not been robust enough. More community engagement, better risk communication, and preparation and response planning are needed from CPAs before many communities can take on the roles that are wanted by CPAs. Furthermore, more communication needs to take place between the groups on what the expectations are for one another. With such divergent expectations at the moment, a dialogue needs to take place. RiskPACC has begun the process in their case study areas, where co-creation workshops will facilitate dialogue between the two groups, leading to better understanding. While we understand that more work needs to be done to address this gap, these workshops should increase understanding of each other's beliefs and expectations.

3.5.4 RESOURCES AVAILABLE

The availability of resources is an issue within the DRM field, leading to CPAs having to conduct resilience activities with limited funds. This was found to be a problem in some of the case study areas, where interviewees mentioned limited funding available. For example, in Greece, the years of austerity have led to a limited budget for the past five years, resulting in cuts and the inability to take on certain initiatives. They also lack the funds to properly train all the volunteers that come in for the fire season and provide everyone with protective equipment.

Physical resources have also been an issue in many of the case study areas. One interviewee mentioned that all cars that their group was using were old and needed to be replaced. While the old cars still functioned, they were becoming too old to do the job properly and repair costs are getting expensive. Additionally, hiring additional staff can be difficult if there is a lack resources available to pay them. This was an issue with several of the CPAs interviewed. As mentioned above, CPAs are working to shift more of their DRM activities to the local level. This is another issue with available resources, as local authorities rarely have the resources necessary to cover their new responsibilities (Rufat et al., 2020).

While there is not much that can be done to address this gap at a project level, it is important to consider it when designing different activities for RiskPACC. Any new technology, for example, should be cost-effective and should not require any equipment that is not already available. Activities should not be too time intensive, as many CPA organizations are not fully staffed and therefore have time restraints.

A lack of resources can also mean that many of the activities mentioned in this report, such as establishing two-way communication, community engagement, and gathering evaluation data can be more difficult to achieve. Without proper staff, equipment, and time many of these activities will be seen as less important than the day to day functioning. While RiskPACC cannot do much to address the lack of resources in many of the case study areas, one area that has the potential to release extra funding

is a focus on prevention. There has been some research that points to a focus on prevention activities leading to a reduced need for financing response activities. One study showed that investing in prevention can reduce damage and loss by approximately 25% (Keating et al., 2014). Other research suggests that for €1 spent in prevention, €4-6 is saved in response (Amaratunga et al., 2015). With the limited resources that many CPAs have said are available, the gap of a lack of preventive works becomes more important. CPAs could save resources by focusing more on preventive actions.

3.6 Data and technology related gaps

As CPAs take advantage of advancements in technology, different communication tools and other apps have been created. While this has occurred in some places, there are many communities where CPAs still use more traditional methods for communication. While there is a variety of uses of applications and data, there are several gaps in current functions of CPAs in terms of data and technology used. Table 5 provides an overview of the data and technology gaps presented in this section.

Gap	Gap Summary
Lack of Data on What Works	• There is not enough data collected on what works in terms of resilience activities • Discussed during the D1.2 interviews, where interviewees had many initiatives, but no data on how well they were working • The Belgian case study will work to address this gap
Standardization of Data	• There is a lack of data sharing between CPAs for several reasons including interoperability issues between systems, confidentiality issues, and fragmentation of data • This can lead to CPAs not having a full organizational picture, which was mentioned by several CPAs during the interviews • Data sharing and standardization may be accomplished by some of the new technological tools being developed for RiskPACC
The Digital Divide	• With the growing emphasis on technology to communicate and engage with the community, those that are less likely to use these technologies (elderly, low income, non-native language speakers) will not have access to the same information. • Several CPAs interviewed were concerned about this divide, and therefore hesitant to rely on these tools • This divide should be considered when developing RiskPACC tools

TABLE 5: SUMMARY OF DATA AND TECHNICAL GAPS

As seen in table 5, the gaps include a lack of data on what CPA techniques are working, a lack of standardized data that can be shared across various CPAs, and the digital divide potentially increasing with the increased use of technology. The following sections will detail these gaps in-depth, including insights from D1.2 and potential solutions.

3.6.1 LACK OF DATA ON WHAT WORKS

Throughout disaster resilience scholarship, there is a lack of consensus on ways to measure resilience in a community (Ostadtaghizadeh et al., 2015). Additionally, it is a challenge to gather data on which initiative is effective in a community (Keating et al., 2014). Many try to measure resilience by collecting baseline data and then gathering data after an intervention. This is very labour intensive but can show whether initiatives are working. Other researchers have used big data, or social media data, to gather information on disaster response (Keating et al., 2014; Vicari et al., 2018). Regardless of the type of data used, there is consensus that there is not enough data collected on what initiatives are effective.

The sentiment found in research was echoed by several of the Belgian case study interviews for D1.2. These interviewees mentioned that they were attempting different risk communication techniques, and believed that they were effective, but they did not have any way to determine whether they were having an impact. They also did not have information on what worked best, what kind of knowledge was being retained, and if the knowledge was being acted upon. This is a major gap in CPA activities, as without information on what works best it is difficult to design effective programs.

This gap will be addressed within the Belgian case study, as they are attempting to determine whether their education programs are working. While this is the aim of the case study, other CPAs have encountered this problem as well. Greater concern should be taken to generate evidence on the effectiveness of different techniques, so that going forward evidence can be the basis of activities. While generating evidence is important going forward, there are typically a lot of resources required to establish this evidence (Vicari et al., 2018). Therefore, CPAs must balance between resources available and the need for evidence. While funding may pose a barrier to gathering this data, this gap still must be addressed, as CPAs should make communication decisions based on evidence to inform future approaches.

3.6.2 STANDARDIZED DATA

This gap is related to the gap in Section 3.3 on interoperability between different CPAs. While that section discussed mainly interoperability of communication systems, tools, and management of different CPAs, this gap is specific to data standardization. Different organizations collect different types of data, and in many instances, the data is not sharable between organizations (Keating et al., 2014). Typically, the data collected is either in a format that is not compatible with other organizations systems, it is fragmented, or it is considered confidential. This lack of standardization can undermine situational awareness during disaster response and can hamper interagency cooperation (Searle, 2018). This lack of standardization exists in both the collection of data and the storage and usage of data (Bemmelen & Fusco, 2002).

While not addressed in the D1.1 report, this gap has been found to exist among the CPAs that were interviewed for D1.2. For example, a CPA interviewee from Italy collaborates with multiple local and regional CPA organizations, including the fire department, volunteer organizations, and local governments. In their work, they share intervention data as well as weather and climate data with these different organizations. When asked what they would like to do better to coordinate with other CPAs, the interviewee expressed a need for common, standardized databases that can be used by all organizations working in the area. Similar sentiments were expressed by Greek CPAs that were interviewed, where they determined that what was needed for better cooperation was a centralized system for sharing data during emergencies.

This is a gap that the field of DRM as a whole is working on, which is why it has been mentioned by several of the case study partners in RiskPACC. If data can be shared across various CPAs, they will have better situational awareness of various hazards, and be able to better respond and prepare for disasters (Albris et al., 2020). This will improve overall operations and help CPAs maintain a better understanding of the areas they work in.

3.6.3 DIGITAL DIVIDE

As social media and technology becomes more ubiquitous in CPA actions on all parts of the DRM cycle, there is a concern that not all communities benefit equally from this increased use (Ramakrishnan et al., 2022; Dargin et al., 2021; Nagmassi et al., 2021). There are social factors that vary between communities that can result in social inequality in the access and use of social media data. This phenomenon is termed the digital divide, which refers to "the gap between groups who have access to information and communication technology and groups that do not have this access" (Ramakrishnan et al., 2022). Those that may not have access to this technology include the elderly, lower income individuals, people with disabilities, and isolated people (Dargin et al., 2021). These are some of the same social factors that are mentioned in Section 3.3 that CPAs need to take into account when designing resilience programs. These same factors apply in the digital divide, meaning that these factors are essential for CPAs to keep in mind in all aspects of DRM.

This digital divide may result in CPAs not having an accurate picture of the impact of disasters on communities and may limit the communication that CPAs have with underrepresented groups (Dargin et al., 2021). This was discussed in D1.1, where research indicated that elderly and low-income individuals may not be able to access the same information as others, and may have a harder time communicating using social media (Gibson et al., 2013). As technology plays a larger role in DRM activities, CPAs need to keep this in mind. RiskPACC is developing different platforms and applications in an attempt to close the RPAG among the case study areas, and therefore the digital divide in case study communities needs to be considered in their development.

During the interviews for D1.2, several interviewees also expressed a concern over the digital divide that an over-reliance on technology would involve. These interviewees expressed both their desire to use new technologies for communication

as well as their reluctance to abandon the traditional methods because groups such as the elderly may not receive messages if that was the case. A similar concern was expressed about the overuse of new tools, where several other interviewees did not mention the digital divide, but they did say they did not want to abandon all traditional methods of communication due the concern that some groups would not receive communications.

The need to consider the digital divide will be very important for RiskPACC going forward. Much of the work in the coming years will concern technological solutions to the RPAG, which could further the digital divide if it is not considered. Special consideration needs to be taken with all technical solutions to determine if they are easily accessible to all groups.

4 ROADMAP FOR RISKPACC AND RPAG GOING FORWARD

This section will bring together the gap analysis presented in Section 3, synthesizes the results and discusses how these gaps may be addressed by future RiskPACC activities, as well as how these gaps and solutions relate to the RPAG. The aim of RiskPACC, as seen in Figure 5, is to better integrate CPAs and citizen activities to enhance collaboration and communication.

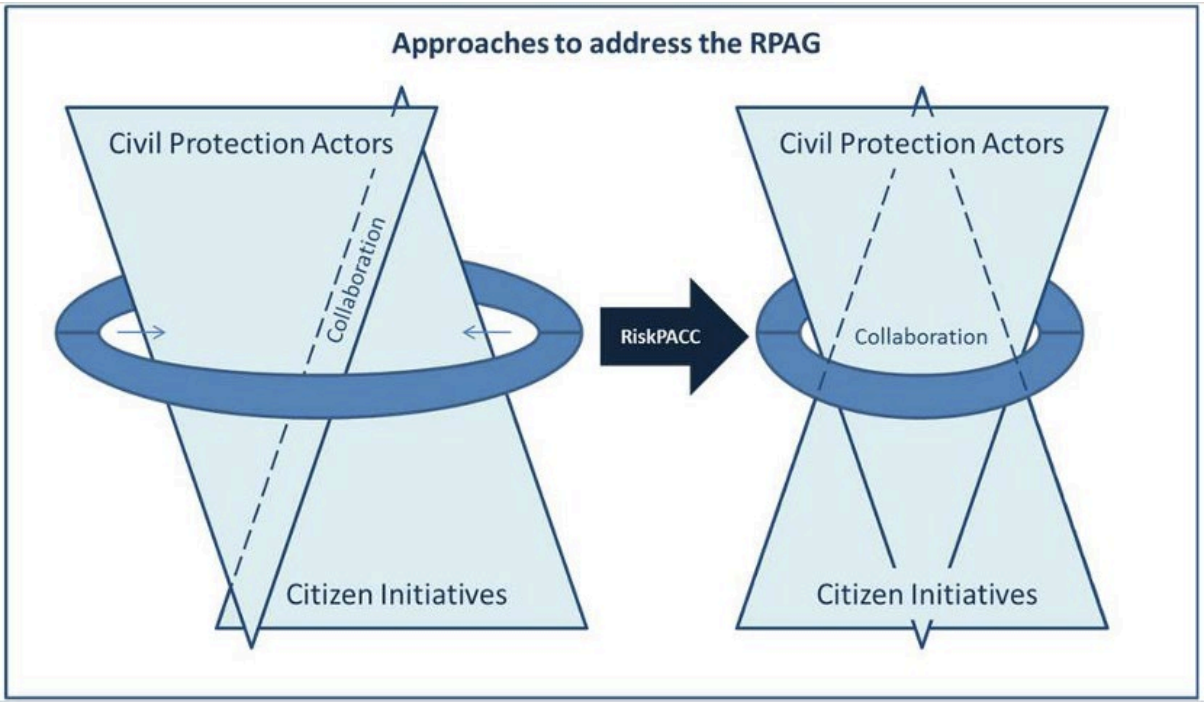

FIGURE 5: RISKPACC APPROACH TO ADDRESS THE RPAG

This section will address how future planned activities will accomplish these aims and potentially close the gaps that have been discussed.

4.1 Future RiskPACC activities and CPA gaps

The gaps discussed in Section 3 highlight some of the barriers to effective risk management in the case study areas, as well as ideas for addressing some of these gaps. While each gap has individual significance, many are interrelated and involve increasing and enhancing interactions between CPAs and citizens and incorporating more participatory methods in DRM activities.

Going forward, RiskPACC activities can address many of the gaps discussed. Table 6 presents a roadmap of the future RiskPACC activities, the gaps that can be addressed by each activity, how the tasks will address the gaps presented, and which deliverables will present the outcomes of these tasks.

Task Outline	Actions for Roadmap	Gaps Addressed	Expected Outcome	Relevant Deliverables
WP3				
Task 3.1	Baseline assessment of case study areas, in order to understand the RPAG and the needs to reduce gaps.	Two-way communication; Bottom-up collaboration; digital divide; standardization of data; human and social factors; better communication channels	This task will provide insights into the RPAG and develop indicators for what success may look like, providing an opportunity to discuss several of the gaps identified	D3.1; D3.2; D3.3
Task 3.3	Co-creation labs with CPAs, civil society, and citizens will provide space to develop creative approaches to addressing the RPAG. It will also prototype technical solutions.	Two-way communication; better communication channels; bottom-up collaboration; digital divide; social and human factors; Trust; Better CPA integration	This task will provide the first opportunity for two-way communication between CPAs and citizens in the case study areas as well as the ability to test the tech solutions	D3.5
Task 3.4	The second round of co-creation labs, where the set of solutions discussed in round one will be refined and tested	Two-way communication; better communication channels; bottom-up collaboration; digital divide; social and human factors; Trust; Better CPA integration	The technical tools will be further developed, providing additional opportunities for two-way communication, CPA integration, and bottom-up collaboration	D3.6
Task 3.5	The solutions are examined for their usefulness, where simple and practical privacy, social, and ethical impact assessments are conducted.	Human and social factors; digital divide; community engagement	This task will examine the human and social factors, most importantly gender, as well as the digital divide and enhancing community engagement	D3.7
Task 3.6	Case study areas will conduct knowledge exchanges and best practices, where community information will be gathered.	Community engagement; understanding community needs; bottom-up activities; better communication channels	This task focuses on the exchange of community data, therefore addressing gaps in communication and community interactions	D3.8
WP4				

Task 4.2	A repository of knowledge products and effective processes will be gathered to be used by CPAs and citizens to enhance collaboration and existing practices.	Better communication channels; two-way communication; Community engagement; understanding community needs; lack of data on what is working	This task will provide products and effective tools that CPAs/citizens use for enhancing collaboration, therefore addressing many of the communication and community understanding gaps	D4.2
Task 4.3	A collaborative framework will be developed to help CPAs and citizens work in collaborative and effective DRM partnerships.	Two-way communication; bottom-up activities; community engagement; understanding community needs; better CPA integrations	This task will focus on CPA and citizen collaboration, which will address many of the communication and collaboration gaps	D4.3; D4.4
Task 4.4	Training materials based on the needs identified will guide the users on the repository and the framework.	Two-way communication; bottom-up activities; CPA integration; standardization of data; digital divide; understanding community needs	This task will provide training materials to help CPAs and citizens address needs, which will provide training on many of the gaps identified. This includes communication, data, and operational gaps	D4.5; D4.6
WP5				
Task 5.1	The crowdsourcing solutions developed by CS and STAM will be updated based on the needs assessment and co-creation workshop outputs	Standardization of data; digital divide; CPA integration; better communication channels; understanding community needs	This task will enhance crowdsourcing tools, therefore addressing data and technology gaps as well as communication gaps and gaining a better understanding of community needs	D5.1
Task 5.2	CS will use the online sentiment analysis to establish correlation between citizen sentiment, citizen risk perception, and effectiveness of risk communication. This task will also enhance the VGI solution based on the outcome of co-creation lab activities.	Communication gaps; linking risk perception and behaviour; standardization of data; CPA integration	This task will help better understand risk perception and the link to behaviour, therefore addressing that gap as well as the communication and gaps regarding CPA integration	D5.2; D5.3
Task 5.3	Training material for the tools developed will be created, including fact sheets or videos, based on consultation with CPAs and citizens.	Digital divide; human and social factors; communication gaps	This task will provide training on the tools. This will address many of the communication	D5.4

			gaps, as well as provide a focus on the digital divide and human and social factors associated with these tools	
WP6				
Task 6.1	Peer learning will be organized between RiskPACC partners and non-RiskPACC end users to teach end users about the RiskPACC approach and solutions.	Communication gaps; technological gaps; governance gaps; operational and implementation gaps	The integration of RiskPACC tools into the wider community may have the potential to address most of the gaps identified	D6.1
Task 6.2	Cities will be chosen to test the RiskPACC solutions, including the methodology, platform, and tools.	Communication gaps; technological gaps; governance gaps; operational and implementation gaps	The integration of RiskPACC tools into the wider community may have the potential to address most of the gaps identified	D6.2
Task 6.3	Insights generated during the RiskPACC project will be processed into recommendations for different audiences, including citizens, volunteers, CPAs and policy makers.	Communication gaps; technological gaps; governance gaps; operational and implementation gaps; theory gaps	The integration of RiskPACC tools into the wider community may have the potential to address most of the gaps identified here	D6.3; D6.4
WP7				
Task 7.1	The architecture of the RiskPACC platform and the overall system design will be developed. This system architecture will pay special attention to interoperability.	CPA integration; technology gaps;	This task will develop the RiskPACC system, addressing many of the technology gaps. The focus on interoperability will address CPA integration	D7.1; D7.2
Task 7.2	This task will bring together the co-creation methodology, repository of good practices, frameworks, and technical tools to create the RiskPACC platform	Communication gaps; technological gaps; governance gaps; operational and implementation gaps; theory gaps	The creation of the RiskPACC platform may have the potential to address most of the gaps identified here	D7.3; D7.4

WP8				
Task 8.3	This task will design and create of the main outputs of the Project the 'Risk Pack', in both physical and virtual form. The virtual 'Risk Pack' will equal the generated platform, while the 'Physical Box' will include paper documents and lab modules from WP3 as well as training material produced within WP3 and WP5.	Communication gaps; technological gaps; governance gaps; operational and implementation gaps; theory gaps	The creation of the RiskPACC platform may have the potential to address most of the gaps identified here	D7.3; D8.3.1
Task 8.4	This task will coordinate the Awareness workshops, where the overall project findings will be shared and disseminated to a wide array of external relevant stakeholders to ensure strong interaction with industry, end-users, citizens, solution providers and academic partners outside the consortium.	Two-way communication; CPA integration; better communication channels; understanding of community needs	The Awareness Workshops will be an excellent opportunity for project partners to share their experiences in co-production of tools with external relevant partners.	D8.4.1; D8.4.2; D8.4.3; D8.4.4; D8.4.5

TABLE 6: RISKPACC ROADMAP

While all RiskPACC activities will address gaps (see Table 6), the co-creation workshops are the first tasks that will involve the interaction between citizens and CPAs, and they are currently being designed, so they will therefore be discussed here more in-depth. The co-creation activities planned for WP3 will focus on increasing two-way communication. Co-creation consists of a collaborative approach that works with multiple stakeholders to collect a diverse set of views and opinions on new techniques and technologies. It is a way for all stakeholders, from citizens to CPAs, to become involved in the creation of new services (JISC, 2017). The workshops planned through WP3 will engage all partners in discussion on activities going forward. This will allow for better two-way communication, as it gives an opportunity for citizens and CPAs to talk to each other about issues in DRM in the case study areas. This increase in two-way communication will help address the following gaps:

- Communication improvement
- Lack of existing communication channels
- Better understanding of social and human factors
- Better incorporation of bottom-up activities
- Trust
- Linking perception and behaviour
- Community engagement and understanding community needs

While these gaps will not be addressed immediately, these co-creation activities will provide a place for two-way communication to occur, hopefully normalizing these activities. This can provide a baseline for future activities and continued CPA-citizen communication to address these gaps.

As a part of these workshops, the technological solutions will be introduced to the case study areas. Many of the technological solutions developed in the project will attempt to address the gaps around interoperability and integration among CPAs, as well as contributing to increased communication with citizens. The technological solutions will be different for all case studies, but they will involve online or mobile platforms that CPAs can use to communicate with each other, therefore providing a platform to better integrate their activities. Additionally, as multiple CPAs may be on the same platform, and all will be communicating with communities, there will be less miscommunication. As suggested above, one issue with the lack of integration of CPAs is that different CPAs will have a different level of communication with citizens, leading to CPAs having different perceptions of what citizens understand and believe. Having information accessible on mobile or web-based applications may also help address both the lack of data on what works, as well as the standardization of data that are both data related gaps that have appeared from the RiskPACC activities. If CPAs are getting data from these applications, then all CPAs will have access to the same data. These applications will also give citizens an opportunity to communicate directly with CPAs, therefore hopefully increasing two-way communication.

There are several gaps that may not be addressed in the planned RiskPACC activities. The lack of resources faced by some CPAs in the case study areas is not something that can be addressed by the co-creation workshops or the technical solutions. Neither

can the lack of prevention work. Prevention work needs to be given more priority in CPAs strategic planning, and although it may come up as a priority of citizens, nothing currently suggested as activities will promote prevention activities. In planning out the later stages of the RiskPACC project, this lack of prevention focus should be noted and acted upon. Available resources are something that RiskPACC cannot change, but the fact that prevention activities may reduce the funds needed to address disasters may be one way to increase the resources available.

4.2 Gaps and the RPAG

The gaps discussed in Section 3 have highlighted some concrete activities that CPAs can take as a part of RiskPACC to address the RPAG. Addressing the RPAG involves increasing citizen risk perception, better aligning CPA and citizen perceptions, and working towards increasing preventive or adaptive actions (Le Roux & Van Neikerk, 2019). The gaps discussed below are directly related to the RPAG, and some examples of potential solutions are presented here.

Some of the gaps would increase risk perception among citizens and better align CPA and citizen perceptions if they are addressed. These include increasing two-way communication, increasing trust, and more community engagement. As mentioned above, the co-creation workshops should increase the two-way dialogue between CPAs and citizens, but there are other options that should be considered. Community meetings have shown to be effective ways of increasing two-way communication, as they give an opportunity for citizens to give their opinions and views, therefore increasing CPA understanding of the local context (GFDRR, n.d.). Gaining this understanding can help CPAs better tailor risk communication to citizens, therefore increasing risk perception. Using social media platforms such as Twitter and Facebook is another way to increase this two-way communication, as these platforms allow for a dialogue between CPAs and citizens (GFDRR, n.d.; Anson, Petersen & Watson, 2017).

Another suggestion in using two-way communication to increase risk perception is to involve citizens directly in risk assessment activities that CPAs are conducting (Höppner et al., 2012). This participatory process allows citizens an opportunity to express their opinions and share their knowledge and allowed CPAs to impart knowledge of risk directly to citizens by involving them in the process (Buckecker et al., 2013). Many of these techniques to increase two-way communication will address the gaps of a lack of community engagement, as they emphasize direct involvement with citizens. There are many other ways that two-way communication and community engagement can be used to increase risk perception, and these should be explored by CPAs in the case study areas.

Communication, as well as better understanding and engaging with communities, can also better align community and CPA risk perception, as interactions between the two groups will lead to a better understanding of each other's views and perceptions. Additionally, better incorporating bottom-up activities and initiatives can bring the perception of CPAs and communities closer together. Examples of bottom-up initiatives include developing community run emergency shelters, teaming up with established community groups to work on preparedness and response, and finding

and training community volunteers to assist in disaster response (Sattar & Cheong, 2019). These activities allow CPAs and citizens to work together, therefore better aligning their risk perceptions. While these may be difficult to implement in the scope of RiskPACC, these examples can be used to start a dialogue between CPAs and citizens as to what bottom-up initiatives would be most appropriate. Data and technical tools can also be used in bottom-up initiatives to increase the data available to CPAs and citizens.

In terms of linking perception and response, the ideas presented in Section 3 for closing this gap, including more focus on prevention activities should be considered. Research has shown that focusing on participatory flood prevention measures was successful in increasing risk perception and the demand for prevention activities (Buckecker et al., 2013). These participatory methods included engaging in risk assessments and the design of early warning systems. Therefore, focusing on risk perception as well as the perception of prevention activities may increase citizen action. This should be considered by CPAs in the RiskPACC case study areas, as it may be one way to increase behaviour change and adaptive action in their communities. Technology, including the applications and platforms that are being created as a part of RiskPACC, may also be a solution to increase actions to align with risk perceptions. This should be monitored during the next phase of the RiskPACC project.

5 CONCLUSION

The gaps presented in this report show that, in some regards, current CPA actions in the case study areas are misaligned with the research SOTA. Information gathered from interviews within the project has shown that gaps exist in CPA practices regarding communication, risk governance, operation and implementation, theory vs. practice, and data and technology. These issues, and the gaps discussed within each category, have led to a general feeling among citizens interviewed for D2.2 that there is a lack of preparation for disasters in their community. This report has highlighted the desk research done in D1.1 as well as the empirical research completed in D1.2, comparing the information derived from both. It also highlighted some of the work that different CPAs are already undertaking to address some of the gaps presented.

In Section 3, the gaps are explained in detail. These gaps draw on new literature to further explain relevant concepts, while incorporating research that was done in 1.1. To explain the gaps and what they mean on a practical level, insights from the CPA interviews in D1.2 were explained. This section found that many of the gaps were related to better communication and collaboration between CPAs and citizens. CPAs gaining a better understanding of citizens, and vice versa, will be very important going forward to address the gaps that were found and close the RPAG. In addition to communication, gaps such as the need for better CPA integration and the need for data were also highlighted, showing the need for CPAs to work better together to make sure vulnerabilities are addressed and all CPAs are one the same page.

In Section 4, the future RiskPACC activities were highlighted as solutions for some of the gaps presented. Co-creation workshops and the technical solutions were discussed in terms of which gaps they may be able to address. Co-creation was considered one way to address two-way communication deficits in current CPA activities, as well as a way to better integrate bottom-up activities in CPA planning. The technical tools were discussed as techniques to increase CPA interoperability and data sharing, as well as to increase two-way communications. Finally, other solutions outside the current plan of RiskPACC were examined. These other solutions presented may be able to close some of the gaps discussed as well as address the RPAG.

Finally, while this report has focused on the gaps between the state of the art and current CPA operations, and therefore presents a critical view of some of the CPA actions in the case study area, it should be noted that the interviews with CPAs identified some positive actions that are currently being taken. First, there is a very high level of expertise among the CPAs in the case study areas. All are professionals in their field, and therefore have had years of experience working on some of the gaps that have been addressed. For example, one of the Belgian interviewees acknowledged many of the gaps that have been discussed in this report during the

interview, due to her years of experience working to address many of these issues. Second, many of the CPAs that were interviewed showed a willingness and in some cases eagerness to collaborate with local communities and citizen groups. This willingness to work closely will be beneficial for RiskPACC going forward, as well as will open up opportunities to address some of the gaps discussed. Third, while this was not the case with many CPAs, some have opened communication channels with citizens. This shows that they are willing to work on two-way communication. Examples from these communication channels can be used to attempt to increase communication in other case study areas. These positive examples should be highlighted in RiskPACC going forward and could potentially be used as steppingstones for all CPAs.

5.1 Future work and next steps

This work, along with D2.3, examines the gaps between the SOTA and current practices that are ongoing by both citizen groups and CPAs in case study areas. These two reports provide information on gaps in practices as well as provide a roadmap for addressing these gaps in the next phase of RiskPACC.

In addition to the work undertaken for WP1, this report provides evidence for WP4 and will be used to develop the RiskPACC framework. This framework will assist in understanding risk perceptions, communications between CPAs and communities, and other factors that may be behind the RPAG in different settings. The framework will then lead into the work that is done with communities and CPAs in WP3, including the co-creation labs. Along with WP2, this work contributes to establishing the conceptual foundations of the RiskPACC project.

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The RiskPACC Consortium

FIGURE 6: THE RISKPACC CONSORTIUM