

LINKS

Strengthening links between technologies and society
for European disaster resilience

D4.2 FIRST DCT-METHODOLOGY FOR THE LINKS FRAMEWORK AND THE CASE ASSESSMENTS

Research Report

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EXECUTIVE SUMMARY

About the project

LINKS “Strengthening links between technologies and society for European disaster resilience” is a comprehensive study on disaster governance in Europe. In recent years, social media and crowdsourcing (SMCS) have been integrated into crisis management for improved information gathering and collaboration across European communities. The effectiveness of SMCS on European disaster resilience, however, remains unclear, the use of SMCS in disasters in different ways and under diverse conditions. In this context, the overall objective of LINKS is to strengthen links between technologies and society for improved European disaster resilience, by producing sustainable advanced learning on the use of SMCS in disasters. This is done across three complementary knowledge domains:

- Disaster Risk Perception and Vulnerability (DRPV)
- Disaster Management Processes (DMP)
- Disaster Community Technologies (DCT)

Bringing together 15 partners and 2 associated partners across Europe (Belgium, Denmark, Germany, Italy, Luxembourg, the Netherlands) and beyond (Bosnia & Herzegovina, Japan), the project will develop a framework to understand, measure and govern SMCS for disasters. The LINKS Framework consists of learning materials such as scientific methods, practical tools, and guidelines addressing researchers, practitioners, and policy makers. It will be developed and evaluated through five practitioner-driven European cases, representing different disaster scenarios (earthquake, flooding, industrial disaster, terrorism, drought), cutting across disaster management phases and diverse socioeconomic and cultural settings in four countries (Denmark, Germany, Italy, the Netherlands). Furthermore, LINKS sets out to create the LINKS Community, which brings together a wide variety of stakeholders, including first-responders, public authorities, civil society organisations, business communities, citizens, and researchers across Europe, dedicated to improving European disaster resilience through the use of SMCS.

About this deliverable

The aim of this deliverable is to provide the first DCT-methodology that guides and supports the development of the LINKS Framework and the case-based assessments across five cases. The DCT-methodology aims primarily to address the knowledge gaps identified in the DCT knowledge base (KB) and to further the structuring of DCT and elements relevant to DCT started in D4.1. In this respect, the DCT-schema is introduced and described in D4.1. It enables the classification and comparison of DCT based on a set of categories. It allows stakeholders to get a comprehensive overview of DCT and aims to support the selection of DCT. The DCT-schema is a key step in achieving the primary objective in LINKS: 'strengthening the links between technologies and society for improved European disaster resilience'. This approach is extended in this methodology by

introducing the DCT-landscape. The concept behind the DCT-landscape is to organise elements relevant to DCT such as good practices, related projects and guidelines for the technical implementation and usage of DCT and interlink them to DCT and themselves.

The identification of capabilities offered by DCT, the analysis and interlinking of elements relevant to DCT can help DMOs and other stakeholders to identify their own needs and to improve internal processes accordingly. The self-identification and comparison with other stakeholders could create mutual learning effects and thus ultimately unlock potentials. But this process is not only about mapping elements on the DCT-landscape but also about the analysis and understanding of the application of DCT in disasters.

This research is guided by three research questions (RQ):

RQ1: How do DMO apply DCT?

RQ2: What are the limits and potentials of the application of DCT?

RQ3: How can the implementation and application of DCT be further facilitated?

These research questions will be addressed by a comprehensive research design as well as a list of research instruments for the collection of empirical data process. The research design is based on two main pillars: The cross-case assessment, which follows a comparative multi-sited design, and the deep dive assessment, which allows the knowledge domain to research more deeply in their respective domain through the local LINKS cases.

The cross-case assessment is developed in close collaboration with Disaster Risk Perception and Vulnerability (DRPV) KB and the Disaster Management Processes (DMP) KB. They each are responsible for the two other LINKS methodologies: The DRPV-methodology (D2.3) and the DMP-methodology (D3.2). It is also developed in close collaboration with the case-assessment teams (CATs) for each local case under WP6.

To address the research gaps and research question the methodologies provides concrete research instruments which are applied to the cross-case assessment as well as in the deep dive assessment. These research instruments for the cross-case assessment are an online survey and qualitative interviews. Both are to be applied across the five LINKS cases. They aim to obtain comparable results.

This deliverable should be read in combination with D2.3 and D3.2. This deliverable is for both the LINKS partners and a broad audience. The described research design and instruments are useful for the scientific community.

TABLE OF CONTENTS

1. Introduction	1
1.1 Reading Guide	3
2. Towards a DCT-Methodology	5
2.1 Outputs of the Consultation Process.....	5
2.2 Ongoing Desk Research	7
2.3 The DCT-landscape	8
2.4 Stakeholder Analysis.....	10
3. Research Questions	12
4. Research Design for the DCT-Methodology.....	16
4.1 The Cross-Case Assessments	17
4.2 The Deep Dive Assessments	19
5. Research Instruments	21
5.1 Research Instruments for the Cross-Case Assessments.....	21
5.1.1 Online Survey	21
5.1.1.1 Process and Guidance.....	22
5.1.1.2 Selection of Participants	23
5.1.2 Qualitative Interviews.....	24
5.1.2.1 Process and Guidance.....	25
5.1.2.2 Selection of Participants	26
5.1.3 Complimentary Research Instrument: Focus Groups	26
5.1.4 Timeline for Cross-Case Assessments	26
5.2 Research Instruments for the Deep Dive Assessments.....	28
5.2.1 Qualitative Interviews.....	28
5.2.1.1 Process and Guidance.....	29
5.2.1.2 Selection of Participants	29
5.2.2 Workshops	29
5.2.2.1 Process and Guidance.....	31
5.2.2.2 Selection of Participants	31

5.2.3 Additional Research Instruments	31
6. Limitations and Ethical Considerations	33
7. Conclusion	35
7.1 Summary	35
7.2 Future Directions	35
7.3 Future Directions for the LINKS Framework	36
8. Bibliography	38
9. Annexes	41
9.1 Annex I: Overview of Stakeholders	41
9.2 Annex II: Consolidated Collection of Tasks performed by DCT	42
9.3 Annex III: Matrix for Assessing the Importance of Stakeholders.....	43

LIST OF TABLES

Table 1: Summary of Processes and Outputs from the Consultation Process	6
Table 2: Description of the Research Instrument Online Survey	21
Table 3: Description of the Research Instrument Qualitative Interviews	24
Table 4: Timeline for Cross-Case Assessments	27
Table 5: Description of the Research Instrument Workshops	29
Table 6: Overview of Stakeholders	41
Table 7: Consolidated Collection of Tasks performed by DCT	42

LIST OF FIGURES

Figure 1: Workflow of LINKS	2
Figure 2: Structure of the Document and Development of the DCT-Methodology	4
Figure 3: Developing D4.2	2
Figure 4: Draft of the DCT-landscape	4
Figure 5: Interconnected Research Questions	5
Figure 6: Overview of Research Questions for the First Case-Based Assessments	9
Figure 7: DCT Research Design	14
Figure 8: LINKS Cases	15
Figure 9: Future Directions for the DCT Knowledge Domain	16
Figure 10: Matrix for Assessing the Importance of Stakeholders	18

LIST OF ACRONYMS

Acronym / Abbreviation	Description
BMA	Business Market Analysis
BBK	Bundesamt für Bevölkerungsschutz und Katastrophenhilfe (translated: Federal Office for Civil Protection and Disaster Assistance Germany)
CATs	Case Assessment Teams
DCT	Disaster Community Technologies
DMC	Disaster Management Cycle
DMO	Disaster Management Organisations
DMP	Disaster Management Processes
DPPI SEE	Disaster Preparedness and Prevention Initiative of South Eastern Europe
DRM	Disaster Risk Management
DRPV	Disaster Risk Perception and Vulnerability
FEU	European Union Fire Officer Associations
GA	Grant Agreement
ISCRAM	Information Systems for Crisis Response and Management
KB	Knowledge Base
LCC	LINKS Community Center
LCW	LINKS Community Workshop
NGOs	Non-governmental organisations
PTF	Practitioners Task Force
RI	Research Instrument
RQ	Research Question
SIC	safety innovation center e.V.
SMCS	Social Media and Crowdsourcing
THW	Technisches Hilfswerk (translated: Federal Agency for Technical Relief)



vfdb	Vereinigung zur Förderung des Deutschen Brandschutzes e. V. (translated: Association for the Promotion of German Fire Protection)
WP	Work Package
WPL	Work Package Leader

DEFINITION OF KEY TERMS¹

Term	Definition
Case-based assessment	Five case studies are evaluated to assess the operationalisation of the key concepts retrieved from the DCT knowledge base
Crowdsourcing	Describes a distributed problem-solving model where the task of solving a challenge or developing an idea is 'outsourced' to a crowd. It implies tapping into 'the wisdom of the crowd' (definition builds on Howe, 2006; see also LINKS Glossary).
Disaster Community Technology (DCT)	A DCT is a software(-function) for interaction with, within or among groups of people who have similar interests or have common attributes (communities) in case of a disaster as well as performing analysis of these interactions (LINKS Glossary and D4.1).
Disaster Management Cycle	Set of phases related to disasters and their management (UNDRR, 2016).
Disaster Management Processes (DMP)	A collective term encompassing a systematic series of actions or steps taken to reduce and manage disaster risk. Disaster management processes are often associated directly with the phases of the DMC. In the context of LINKS, we specifically refer to DMP as the policy frameworks, tools and guidelines developed to govern disasters across all phases of the DMC (LINKS Glossary).
(Disaster) risk perception	Risk perception is the way individuals and groups appropriate, subjectivize and perceive risks that might or might not be calculated in an objective manner during risk assessments. The importance of studying risk perception more seriously is obvious: risk perception directly influences people's ability and level of preparedness. Risk perception covers what is also referred to as "risk awareness" (UNDRR, 2016).
LINKS Community Center (LCC)	A flexible and user-friendly web-based platform for online sharing and integrating lessons learned and ongoing experiences and knowledge within the LINKS Community, as well as with broader EU and international networks.

¹ Definitions are retrieved from the LINKS Glossary (forthcoming).

LINKS Framework	A set of learning materials, such as methods, tools and guidelines for enhancing the governance of diversity among the understanding of SMCS in disasters for relevant stakeholders. Methods in LINKS refer to approaches that will enable researchers and practitioners to assess the effects of SMCS for disaster resilience under diverse conditions. Tools are practical instruments supporting first-responders, public authorities and citizens with the implementation of SMCS in disaster and security contexts. Guidelines are recommendations for improving national and regional governance strategies on SMCS as well as introductions and explanations of how to apply the methods and tools under diverse conditions (LINKS Glossary).
LINKS Knowledge Bases	The outputs and knowledge obtained from the assessment of three knowledge domains. This knowledge is used to develop the LINKS Framework (LINKS Glossary).
LINKS Knowledge Domains	The three crucial domains of analysis for studying European disaster resilience and SMCS. These include: Disaster Risk Perception and Vulnerability (DRPV), for assessing changes in the citizens' perception of disaster risks induced by SMCS, as well as assessing the changes in the vulnerability of practitioners and citizens. Disaster Management Processes (DMP) for analysis of how SMCS changes the procedures and processes within the crisis and disaster management. Disaster Community Technologies (DCT), for assessing SMCS related technologies used by practitioners (and citizens) in disasters (LINKS Glossary).
Natural hazard	Natural hazards are naturally occurring physical phenomena caused either by rapid or slow onset events which can be geophysical (earthquakes, landslides, tsunamis and volcanic activity), hydrological (avalanches and floods), climatological (extreme temperatures, drought and wildfires), meteorological (cyclones and storms/wave surges) or biological (disease epidemics and insect/animal plagues) (IFRCC).
Resilience	The ability of individuals, institutions, and systems to recover from disturbance and to develop and adopt alternative strategies in response to changing conditions (definition builds on Tyler & Moench, 2012; see also LINKS Glossary).

<p>Scenarios</p>	<p>The LINKS scenarios refer to the hazards in each case (case 1, earthquake, Italy; case 2, industrial, the Netherlands; case 3, drought, Germany; case 4, flooding, Denmark; case 5, terrorism, Germany). They are instrumental to case-based assessment of the Framework as they are the “storylines” through which both the gaps, needs and challenges emerge and the research design (first iteration of the cases), learning materials and other components (second iteration of the cases) are assessed. They are not used to assess the performance of the teams involved in the cases, as in crisis management exercises.</p>
<p>Social media</p>	<p>A group of Internet-based applications that build on the ideological and technological foundations of the Web 2.0 and that allow the creation and exchange of user-generated content. Forms of media that allow people to communicate and share information using the internet or mobile phones. Web 2.0 is the Internet we are familiar with today in which people are not just consumers of information but producers of knowledge through social networking sites and services like Facebook, Twitter and Instagram (definition builds on Kaplan & Haenlein, 2010).</p>
<p>Sustainable Advanced Learning</p>	<p>A maintainable and evolving collection of knowledge and best practices produced for and by relevant stakeholders. Sustainable Advanced Learning entails a cognitive dimension (the capability to gain in-depth knowledge of <i>e.g.</i> crises and crisis management), a social dimension (the collaborative efforts to implement that knowledge into new practices), and a transformative dimension whereby reflections are made on how knowledge was learned, what has changed in the process, and how and in what ways new knowledge might continue to evolve.</p>

1. INTRODUCTION

The increasing availability of the internet worldwide and the associated increase in the number of users has led to a growing availability of large amounts of data. A significant part of this is generated by user interactions on social networks. Social media and crowdsourcing (SMCS) have become an important part of people's daily lives, enabling them to communicate and collaborate in ways never before possible. The availability of information on and through social media platforms is becoming increasingly important for a wide range of applications - including disaster situations. This makes social media platforms relevant for Disaster Management Organisations (DMOs) (Mauroner & Heudorfer, 2016).

The main goal of the LINKS is to 'understand and assess the effects of SMCS on European disaster resilience' (Grant Agreement, 2019). This process was started with a study and consolidation of the knowledge across three knowledge domains:

- Disaster Risk Perception and Vulnerability (DRPV)
- Disaster Management Processes (DMP)
- Disaster Community Technologies (DCT)

In D2.1 (Bonati, 2020), D2.2 (Pazzi, Morelli, & Bonati, 2020), D3.1 (Bach Nielsen & Raju, 2020), and D4.1 (Habig, Lüke, Sauerland, & Tappe, 2020) several knowledge gaps, as well as challenges in using SMCS in disaster situations, are identified. Each linking people, institutions, and technologies, considering DRPV (D2.1 and 2.2), DMP (D3.1), and DCT (D4.1) which establish the three knowledge bases (KB) of the LINKS project.

The conducted research in D4.1 has shown that while the use of SMCS in disasters is generally considered useful there are barriers that can hinder its use. It was found that there is a lack of available information about the implementation and application of DCT. The information available is scattered in various sources on the internet and is time-intensive to obtain. Therefore, the systematic preparation and presentation of DCT were deemed to be useful to stakeholders in disasters. This realisation led to the development of the DCT-schema. The DCT-schema enables the classification and comparison of DCT based on a set of categories. A DCT focuses on the applications that are used for SMCS in disasters and is therefore interested in their technical characteristics. Based on the set of the categories, the DCT-schema allows stakeholders to get a comprehensive overview of DCT and aims to support the selection of DCT. In accordance with the GA, the DCT-schema is a key step in 'strengthening the links between technologies and society for improved European disaster resilience'.

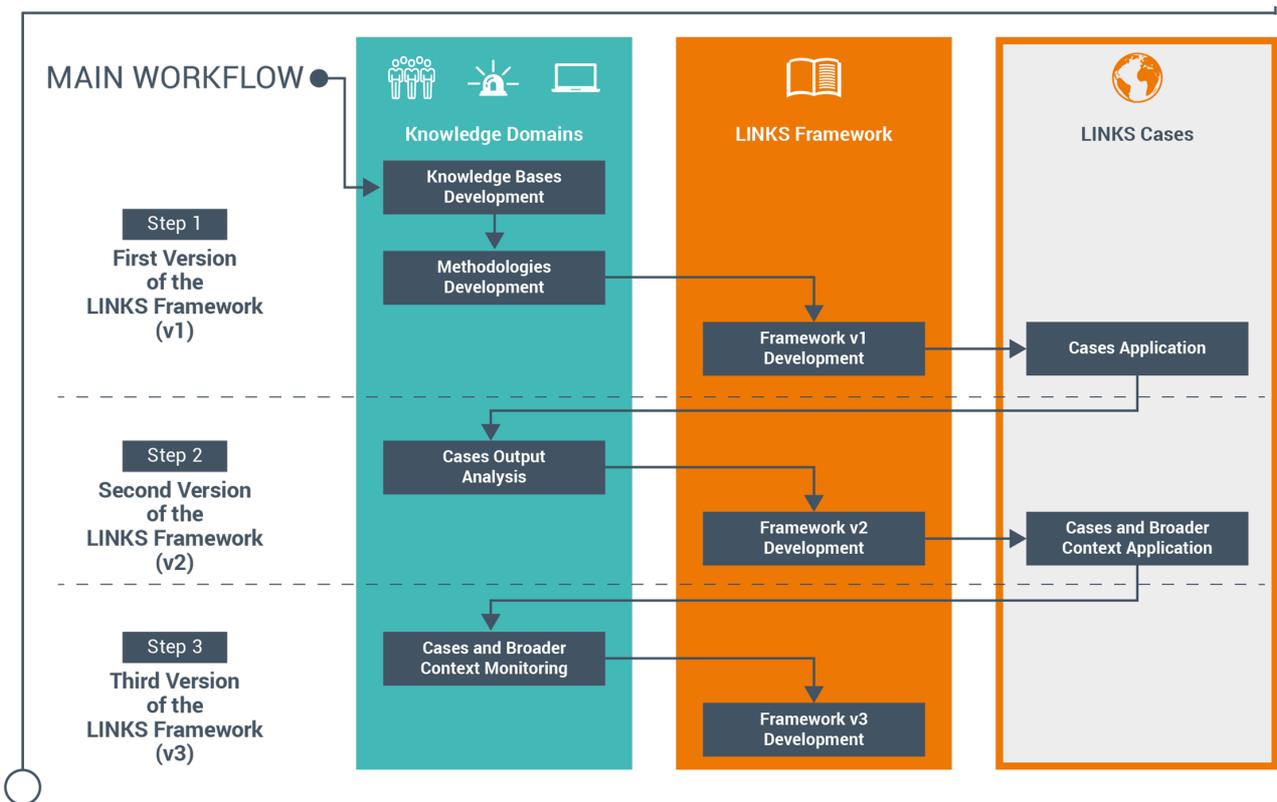
The main objectives of the DCT-methodology are to deepen the understanding of the application of DCT in disasters and to better understand its limitations and potentials. This is crucial for assessing how to support and facilitate the use of DCT.

The DCT-methodology is guided by three research questions (see Section 3). It outlines the research design for the identification, structuring, mapping, and analysis of DCT and elements relevant for a better understanding of DCT (e.g. good practices, practical examples and guidelines). To this purpose the DCT-landscape is introduced (Section 2.3). The findings will lead to the update of the DCT KB as well as the further development of the DCT-schema and the DCT-landscape.

Furthermore, the methodology presents a set of research instruments to address the identified gaps and answer the research questions. The research instruments are designed to yield results across four European countries and will produce comparable and context specific results across different, hazard scenarios, stakeholders as well as different socio-cultural contexts.

The DCT-methodology guides and supports along with the methodologies from WP2 (D2.3) and WP3 (D3.2) the development of the LINKS Framework (WP5) that will be applied in the case-based assessments (WP6). Collectively, an extended and enhanced version of the KBs is developed. This will result in initial recommendations for the type and scope of learning processes and materials that will be incorporated into the LINKS Framework as illustrated in Figure 1.

Figure 1: Workflow of LINKS



Source: LINKS

1.1 Reading Guide

The foundation of this methodology presented in this deliverable was laid in D4.1. The research gaps and corresponding research questions presented are based on the key findings described in D4.1. The research gaps and questions are addressed in this methodology with a research design and corresponding research tools.

Section 2 describes the process from D4.1 to the emergence of this methodology. The development of the methodology is based on a multi-layered approach in which different type of actions and inputs were considered. A consultation and discussion process with other work packages, the case assessment teams (CATs²), local practitioners, and the scientific community in the domain of public security and safety was initiated and will be continued. The outputs achieved in the consultation process are discussed in Section 2.1. Parallel to this the literature review and business market analysis, both components of the desk research started in the context of D4.1, were updated. The results are presented in Section 2.2. Following this, the DCT-landscape is presented in Section 2.3. To support the identification of research participants, Section 2.4 is dedicated to the stakeholder analysis. This section provides a comprehensive guide that structures the classification of stakeholders and will be the basis for the selection of participants.

Section 3 builds directly on the consultation process and the results of the ongoing desk research and presents the three research questions that guide the first round of the case-based assessment both at the cross-case and the deep dive level.

Section 4 is dedicated to the description of the research design. The section discussed the two main approaches: the cross-case assessment as well as the deep dive assessment. While the cross-case assessment offers a broad comparative perspective encompassing all knowledge domains and the five LINKS cases, the deep dive assessment provides the possibility for a KBs to research more deeply in their domain.

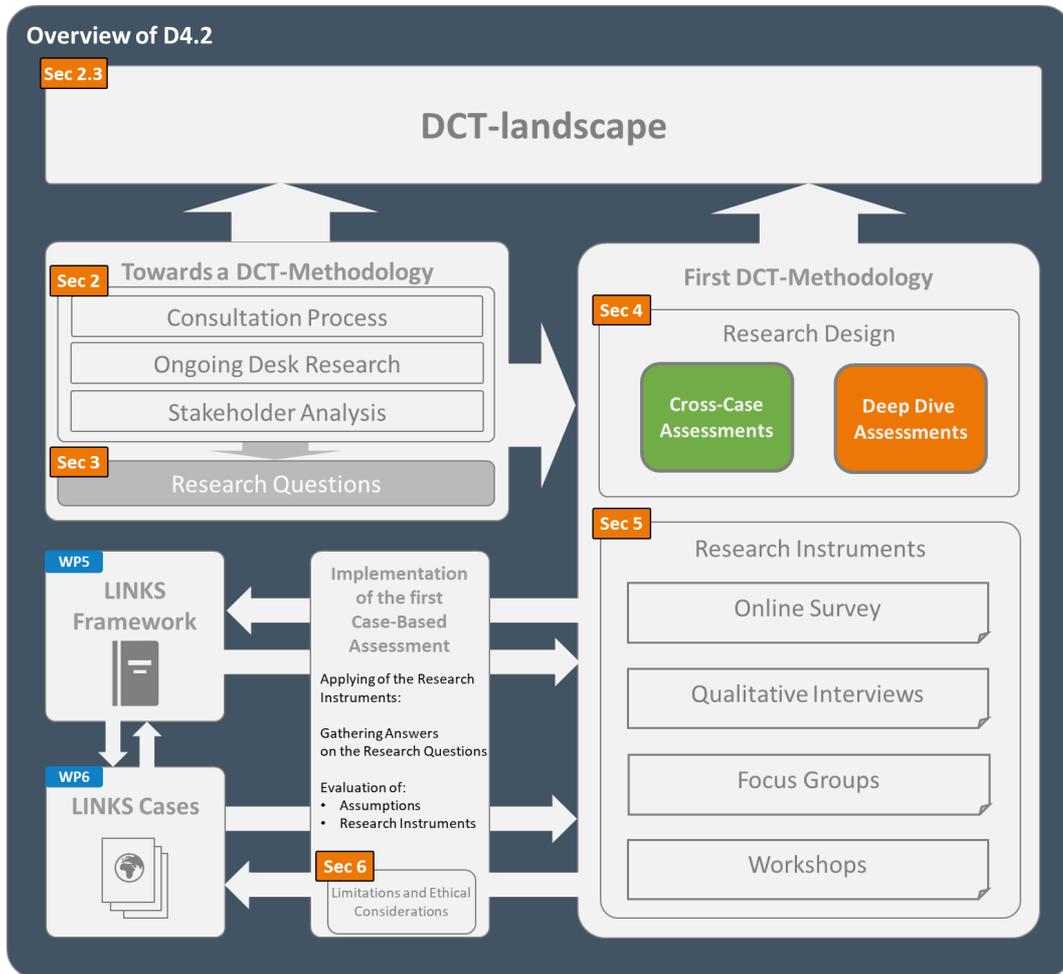
In order to do justice to both the complexity and the depth of the research project, a mixed-methods approach is necessary, which provides for the application of various research instruments. This is discussed in detail in Section 5. The research instruments are an integral part of the DCT-methodology are applied in the case-based assessment. On the one hand, the research instruments serve to address the research questions, on the other hand, the research instruments themselves are to be evaluated.

Section 6 is dedicated to possible challenges and their corresponding mitigation strategies. This section also includes the discussion of the ethical consideration.

The described structure of the document and its interrelationships are shown in Figure 2.

² The CATs are working teams organised in LINKS and carry out the case-based assessment in their respective case.

Figure 2: Structure of the Document and Development of the DCT-Methodology

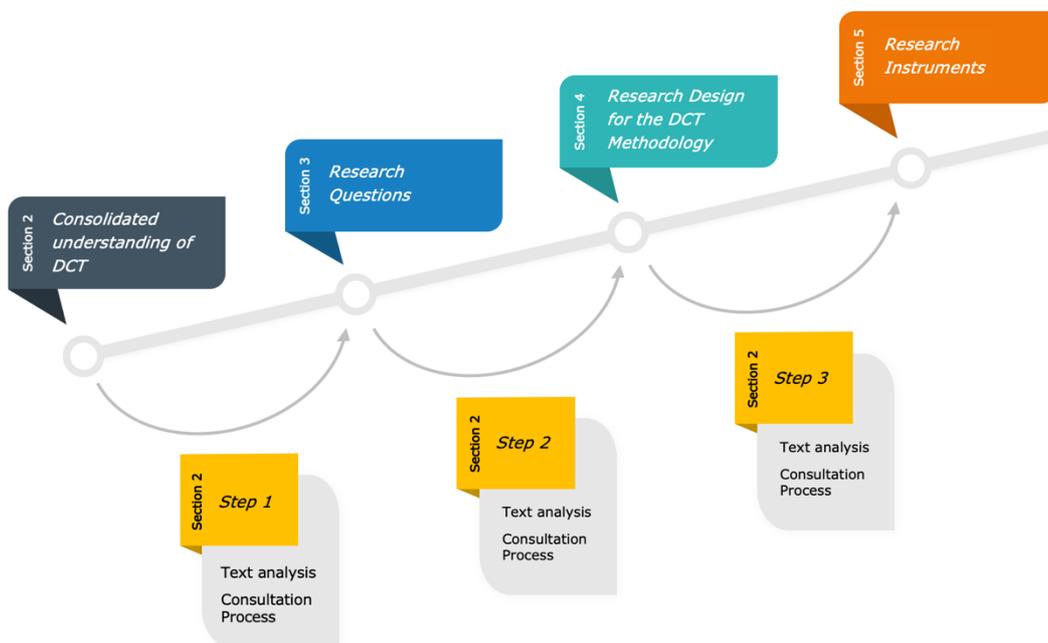


Source: Author's contribution

2. TOWARDS A DCT-METHODOLOGY

In this section, the process of creating the DCT-methodology is discussed and elaborated. The DCT-methodology is the foundation for the further development of the DCT-landscape. Section 2.1 describes the consultation which led to the refinement of the findings from D4.1 and highlights the process and the main outcomes. Section 2.2 presents the key result of the desk research and the business market analysis (BMA) that continued from D4.1. In Section 2.3 the DCT-landscape is described. This section concluded with the description of the stakeholder analysis in Section 2.4. The process for the development of the DCT-methodology is illustrated in Figure 3 below.

Figure 3: Developing D4.2



Source: WP3's contribution and adapted by WP4

2.1 Outputs of the Consultation Process

To ensure that the research is practice-oriented, the results must be coherent and applicable. To this end, a consultation process was initiated, involving the Work Packages (WPs) (namely WP2-7), Case Assessment Teams (CATs), local practitioners and the scientific community of the domain public safety and security. The consultation process, together with the ongoing desk research, forms the basis for the formulation of the research questions as well as aims and, building on this, for the DCT-methodology. A summary of the main processes and outputs is shown in Table 1.

Table 1: Summary of Processes and Outputs from the Consultation Process

With other WPs
<ul style="list-style-type: none"> • The research gaps from the respective KBs were compared and examined for commonalities and intersections. • Building on this, research interests (RIs) were agreed upon and overarching research questions defined. • A joint concept for the development of the respective methodologies and the associated cross-case based assessment was elaborated. • Different RIs were compared and evaluated for the intended research process. Thus, a selection of RIs could be made. • Due to the high degree of overlap, an agreement was reached with WP3 on a cooperation to be sought later in the project on a collaborative design of the DCT-and DMP-landscapes.
With the CATs
<ul style="list-style-type: none"> • In order to successfully collaborate with the CATs in the upcoming research process, a DCT-methodology task force was established. The DCT-methodology task force is intended to fulfil two main tasks: • to coordinate and promote the exchange between the DCT KB and the research to be carried out by the CATs in their respective cases • to carry out the cross-case assessment and give guidance on the application of the associated RI • Furthermore, it is worth mentioning that the cooperation with the CATs offers the chance to gain interesting stakeholders through their networks and contacts for the planned research work (especially for interviews). • The consultation process also benefited from the outcomes of the Practitioner Task Force (PTF) meetings and workshops (Cross WP5-6) attended by the WPLs.
With local practitioners
<ul style="list-style-type: none"> • The research gaps were discussed with local practitioners (<i>e.g.</i> member of the local fire brigade in Paderborn) and compared with their current needs. As a result, the research gaps were adjusted. • Analogous to the research gaps, the research questions were discussed and adapted as needed. • The DCT-schema was presented with the aim of reviewing the comprehensibility and completeness of the current categories. As a result, the categories were adapted as part of a continuous process. • With regard to the responsibility of the safety innovation center e.V. (SIC) over the drought case in WP6, initial discussions have already been held on the application of the DCT-methodology in the drought case. • The practical approach is further highlighted by the fact that the SIC is formed by practitioners and researchers. Preliminary findings and research results are therefore regularly discussed internally and reviewed for their practical suitability.
With scientific community

- A scientific paper on the development of the DCT-schema was accepted for the conference on Information Systems for Crisis Response and Management (ISCRAM³) in 2021.
- During the review process, useful feedback was obtained on the comprehensibility of the methodology and categories. This feedback has led to a revision of the DCT-schema.

2.2 Ongoing Desk Research

The main objective of Deliverable 4.1 was to gain a basic understanding of SMCS technologies and their use in disaster situations. In order to achieve this, a systematic and structured analysis of various sources was conducted. The sources include:

- Scientific literature,
- Processes and guidelines,
- Good practices and
- Related projects.

This was supplemented by a structured BMA. The results are the basis for the research gaps, and they provided the impetus for the development of the DCT-schema (for a more detailed description see D4.1).

The research gaps identified in D4.1 indicated that DMOs lack relevant information for the selection of appropriate DCT. This starts with the lack of a structured and systematic overview of DCT. But this gap does not only refer to the technologies themselves, but also to their possible application scenarios as well as their functional scope. For example, there is no structured elaboration on which DCT are used in specific disasters and which DMOs have already successfully implemented DCT in their work. More importantly, policies, processes, and guidelines steering the use of SMCS are also rare and difficult to find. As a result, there is very little guidance on how to regulate SMCS in disasters at national and regional levels (see D3.1 and D4.1). This absence of a systematic overview has the effect of discouraging stakeholders who lack both the time and human resources to properly and effectively address the use of social media in disaster management processes (safety innovation center e.V., 2020) (Rao, Plotnick, & Hiltz, 2017). This can lead to DCT being used very hesitantly or not at all.

For the DCT-methodology in D4.2, an update of the literature analysis, and the BMA was carried out. The updating was done using the keyword list and the criteria for selecting papers described in D4.1. As a result, new DCT were identified. For example, the DCT 'Dataminer' acquires its data from more than 100.000 public sources, including social media. It provides real-time event and risk detection. The newly found DCT 'FloodTags' specializes on the analyses of online media and user generated content for water management and food security. It also uses a variety of sources like

³ ISCRAM is an international community of researchers, practitioners, and policy makers around the development and use of information systems for crisis response and management (<https://iscram.org>).

online news articles, Twitter, Facebook, and also connects to instant messenger such as WhatsApp and Telegram.

Furthermore, the DCT KB could be refined regarding the collection of tasks performed by DCT. In D4.1 three strategies of SMCS engagement are described (see Section 4.1.2-4.1.3 in D4.1) ranging from information dissemination to data monitoring and lastly to coordinated action. These three levels could be expanded to include extended communication, police-related tasks as well as miscellaneous tasks (see Section 2.4). Part of the planned research will therefore be to test the validity of these identified categories and adjust them if necessary.

In addition to updating the literature review and the BMA, parts of the existing literature from D4.1 were analysed again. The focus was on empirical surveys on the use of SMCS in disaster situations - especially interviews and surveys. In relation to the aforementioned level of SMCS engagement, the extent to which the quality of this application is taken into account was examined. It was noted that the studies dealt extensively with issues of barriers to use, such as proper training, lack of resources, or more generally whether SMCS is used at all. A qualitative assessment of the respondents' SMCS use did not play a role and therefore remains a research gap.

Filling the gaps described could have several positive effects for the use of DCT. A structured mapping and representation of the factors relevant for DCT in the DCT-schema and DCT-landscape could support both the implementation and the use of DCT in disaster situations. The identification of capabilities offered by DCT, and the analysis of good practices can help DMOs and other stakeholders to identify their own needs and to streamline internal processes accordingly. The self-identification and comparison with other stakeholders could create mutual learning effects and thus ultimately unlock potentials.

The desk research described is an ongoing process and will be relevant for all of the case-base assessment. It serves to develop the DCT-landscape and it will also lead to an update of the DCT-schema. . Functions that cannot be clearly assigned can thus lead to changes in the structure. Besides the development of the DCT-landscape and the updating of the DCT-schema, the results of will be highly relevant for the preparation of the field research instruments as well as the case-based assessment. The findings from the desk research are the scientific basis for the formulation of the questionnaire for both the online survey and the interviews. On the other hand, the results of the field research will also support the desk research. Following the explorative approach, they can highlight new aspects and thus help to determine the direction of the desk research.

2.3 The DCT-landscape

While the structure and overview provided by the schema is an important step in addressing the research gaps, it still leaves a critical gap unanswered. Practitioners often lack both time and human resources to properly and effectively address application in SMCS. A key objective of this KB must

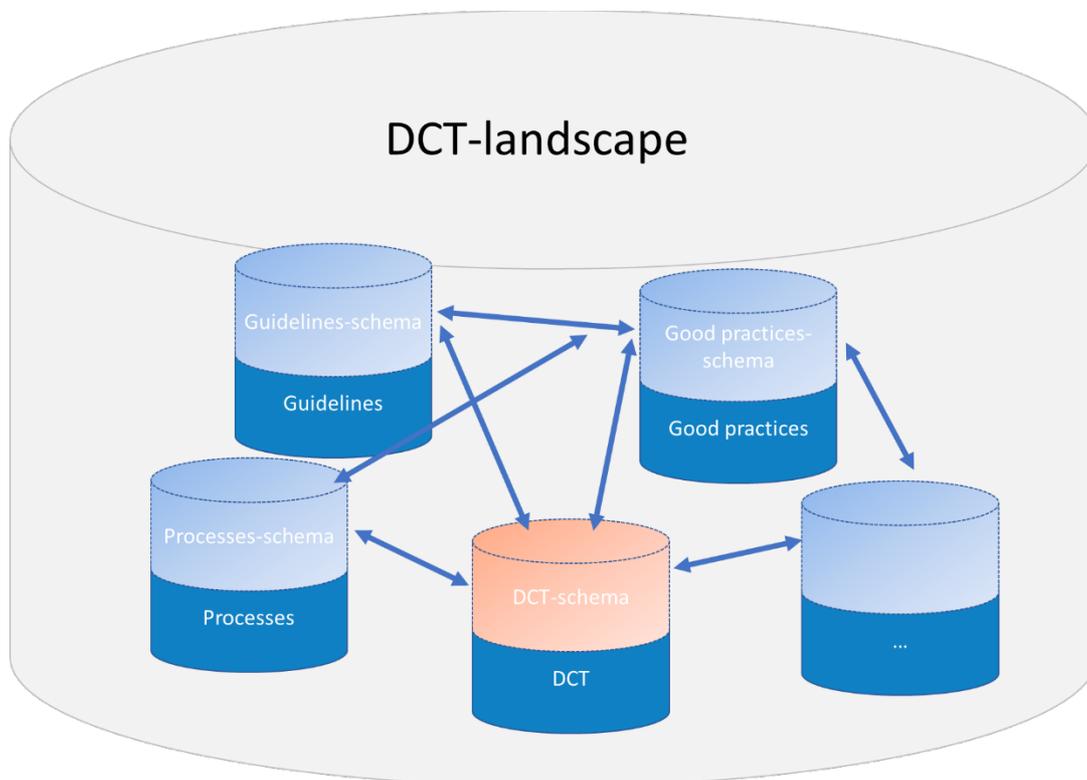
therefore be to support the entire process from identification to implementation and application of DCT.

For this purpose, the DCT-landscape is introduced. The foundation of the DCT-landscape was laid in D4.1. The concept behind the DCT-landscape is to organise **elements** identified and analysed in D4.1 such as:

- existing DCT,
- good practices/practical examples,
- related projects and
- guidelines for the implementation and usage of DCT

and connect them with DCT (and each other, see Figure 4). This will provide stakeholders with an accessible and comprehensive overview of knowledge about DCT.

Figure 4: Draft of the DCT-landscape



Source: Author's contribution

By collecting, categorising, analysing, relating, interpreting, and understanding the multitude of information, a comprehensive and consolidated understanding of the DCT emerges and thus the development of potentials. The DCT-landscape will allow a DMO or any other stakeholder working in disasters to gain a comprehensive understanding of DCT. For example: In order to improve its SMCS engagement a stakeholder working in disaster management could turn to the DCT-landscape, to get information on specific functions of DCT. So, when looking for a DCT that provides real-time

analysis of social media communication, a stakeholder might choose a specific DCT providing that function. The landscape could provide additional information like guides on the implementation of the DCT or practical examples by stakeholders already using the DCT. The latter could be an opportunity to further network and facilitate mutual learning through the exchange of experiences through, for instance, the LINKS Framework and LCC. This process could also allow to compare approaches with other stakeholders and thus be an important step in identifying potentials. In that sense the DCT-landscape is a knowledge resource which provides combined and interlinked information, which support the decision making of stakeholders in disaster management regarding DCT. The DCT-landscape and the DCT-schema – once further developed – should be considered as learning material and they will eventually be presented in the LCC to be accessible to stakeholders.

2.4 Stakeholder Analysis

The goals of the LINKS project in general and the DCT-landscape in particular are aimed at practical application in DMP by stakeholders. This requires a needs assessment of the stakeholders, which in turn requires a prior identification of said stakeholders as they are the basis for further development of the DCT-landscape and the DCT-schema. It is intended to actively involve them in the process, which also includes evaluation and testing.

Additionally, the comprehensive identification of relevant stakeholders in the context of DCT in disaster situations is the prerequisite for a systematic selection of research participants. This ensures adequate representation of stakeholders.

The identification of relevant stakeholders working in the disaster situation was done in an iterative process. In a first step, creative techniques were used. In an associative process, all relevant stakeholders were listed and provisionally categorised. The still preliminary results were then supplemented with the help of a literature search. This research included scientific publications as well as projects and events related to disaster. This was followed by a snowball approach to tap into further sources and stakeholders. The review of scientific literature, related projects and events was accompanied by short interviews. The interviews were conducted with practitioners and academics and aimed to identify further relevant stakeholders. The stakeholder groups were initially derived from the work in D8.1 (Philpot & Reuge, 2020). The stakeholder groups include:

- Practitioners
- Industry
- Policy/Decision Makers
- Scientific Community (researchers, networks and related projects)
- Citizens (civil society and vulnerable groups)

Based on the five categories, potential stakeholders were identified one level deeper. The following sources were used for this purpose: (Macapayag & Gorana, 2015) (Lee, Preston, & Green, 2012)

(Schäfer, et al., 2017) (Tagarev, et al., 2017). The result of the stakeholder identification is presented in Table 6 in Annex I.

In addition to identifying the stakeholders, a consolidated collection of tasks that the stakeholders can fulfil with DCT was drawn up based on D4.1 and further sources (Gizikis, et al., 2017) (Bundesamt für Bevölkerungsschutz und Katastrophenhilfe (BBK), 2016) (Wukich, 2015). The identified tasks are summarised within six categories:

- Dissemination of crisis related information
- Extended communication
- Monitoring and analysis of information from social networks and related technologies
- Coordination and cooperation
- Typical Police tasks
- Miscellaneous tasks

The sub-activities of the categories are shown in Table 7 in Annex II.

The next step of the stakeholder analysis is to examine to what extent the task profile of the stakeholder matches the listed tasks above. For this purpose, the tasks are plotted across the stakeholders in a matrix (Figure 10 in Annex III) and classified in the three categories:

- strong use (green)
- occasional use (orange)
- no use (red)

The assessment process has been initiated at this stage of the project and aims to identify the relevant stakeholders for DCT and the ongoing analysis and application of the DCT-methodology. It is also important to include and map the stakeholders in the DCT-landscape. A section of the matrix is shown in Figure 10.

3. RESEARCH QUESTIONS

The aim of this methodology is to advance and further elaborate this process of structuring and mapping DCT and DCT-related elements started in D4.1 and updated in Section 2.2. As this process is not only about mapping elements on the DCT-landscape but also about the analysis and understanding of the use of DCT in disasters, this research is guided by three research questions (RQ):

- RQ1:** How are DCT applied in disasters?
- RQ2:** What are the limits and potentials of the application of DCT?
- RQ3:** How can the implementation and application of DCT be further facilitated?

The RQs will guide both the cross-case and the deep dive assessments as the DCT-methodology aims for comparability across the cases.

The first RQ aims at describing the status quo of DCT and mapping it on the DCT-landscape in the context of DMOs. The goal is to understand by whom, why and how DCT are used. This requires identifying and categorising elements that are relevant to the use of DCT in disaster. This process as already explained was initiated in D4.1 and will be further developed in the course of this methodology. It is important to note, that the list of elements that can and should be mapped on the landscape is not yet exhausted. An integral part of the DCT-methodology is therefore dedicated to the identification of further, not yet identified elements, that are important for understanding DCT. The already identified elements have to be filled with their respective contents. This, the identification and the filling of the content, is seen as a continuous process. The compiled elements have to be therefore regularly checked for changes and updated if necessary.

In addition to the elements identified in D4.1 (see list above), the following additional relevant elements have been identified through further analysis and the consultation process described in Section 2.1:

- Stakeholders who use DCT
- Contexts and scenarios in which DCT are applied
- Processes that describe the technical aspects for the implementation and usage of DCT

The second RQ aims to provide a comprehensive and consolidated understanding of DCT and its application. This involves two tasks: First, analysing and linking the identified elements both in terms of content and in their relationship to each other. In particular, the analysis of policies, processes and guidelines regarding their technical aspects is key to understanding DCT in DMP as they guide

its application. Secondly, the analysis will be supported by the collection of empirical data. It aims to learn first-hand narratives, experiences and practices of stakeholders working in disasters.

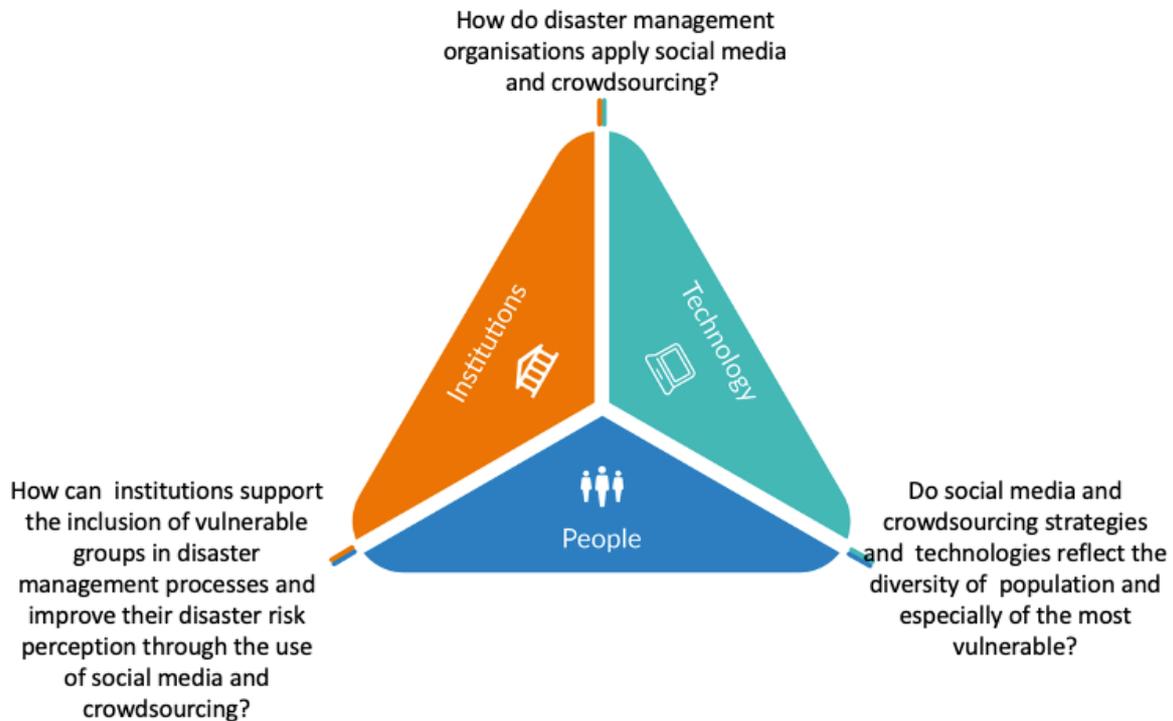
The object is to identify the key needs and challenges of stakeholders in using DCT. Building on the work done in D4.1 and the update described in Section 2.1, a key part will be to determine the level of SM engagement of participants and what level they aspire to classify them accordingly. This will enable the comparison of the application of DCT across different stakeholders and scenarios, thus enabling cross-learning. The basis for this is provided by the stakeholder analysis presented in Section 2.4. There, the application possibilities with DCT can be assigned to the respective stakeholders. This approach aims to facilitate the application of DCT and is the basis for discovering potential.

The third RQ serves to identify how the implementation and application of DCT can be supported and further facilitated. The comprehensive overview of DCT (RQ) and an understanding of the limits and potentials (RQ2) of their application will be an essential step in making recommendations on the implementation and application of DCT and thus answering this RQ. This RQ is also an umbrella within which the DCT-schema and DCT-landscape will be assessed and further developed as a means to promote the understanding of DCT and thus support the implementation and application of DCT. This again underlines the importance of the DCT-schema and DCT-landscape as learning material.

The RQs that have been described and the resulting objectives are closely linked to the research efforts described in D3.2. Both the DMP and the DCT knowledge domains research the application of DCT. But the domains differ in a crucial aspect. While the DMP domain is mainly interested in the formal governance processes that steer the application of SMCS in DMP, the DCT domain focuses heavily on the technical aspects of the application of DCT. Both aspects are necessary to understand DCT in DMP. The interconnectedness of the two domains is further illustrated by the development of the DMP-landscape through the DMP knowledge domain. The DMP-landscape aims to map governance processes and policies, while the DCT-landscape aims to map the elements (*e.g.* processes, guidelines, practical examples, etc.) that describe and guide the technical implementation and deployment DCT. The development of the two landscapes will be closely coordinated and eventually merged to provide a fully consolidated overview of DCT.

The interconnectedness of the KB is the cornerstone of the LINKS project and is further illustrated by the common research interests of the DRPV and DCT knowledge domains. In this respect, both areas assess the extent to which SCMS strategies, and the technologies used for them take vulnerable groups into account. These overlapping interests are illustrated in Figure 5.

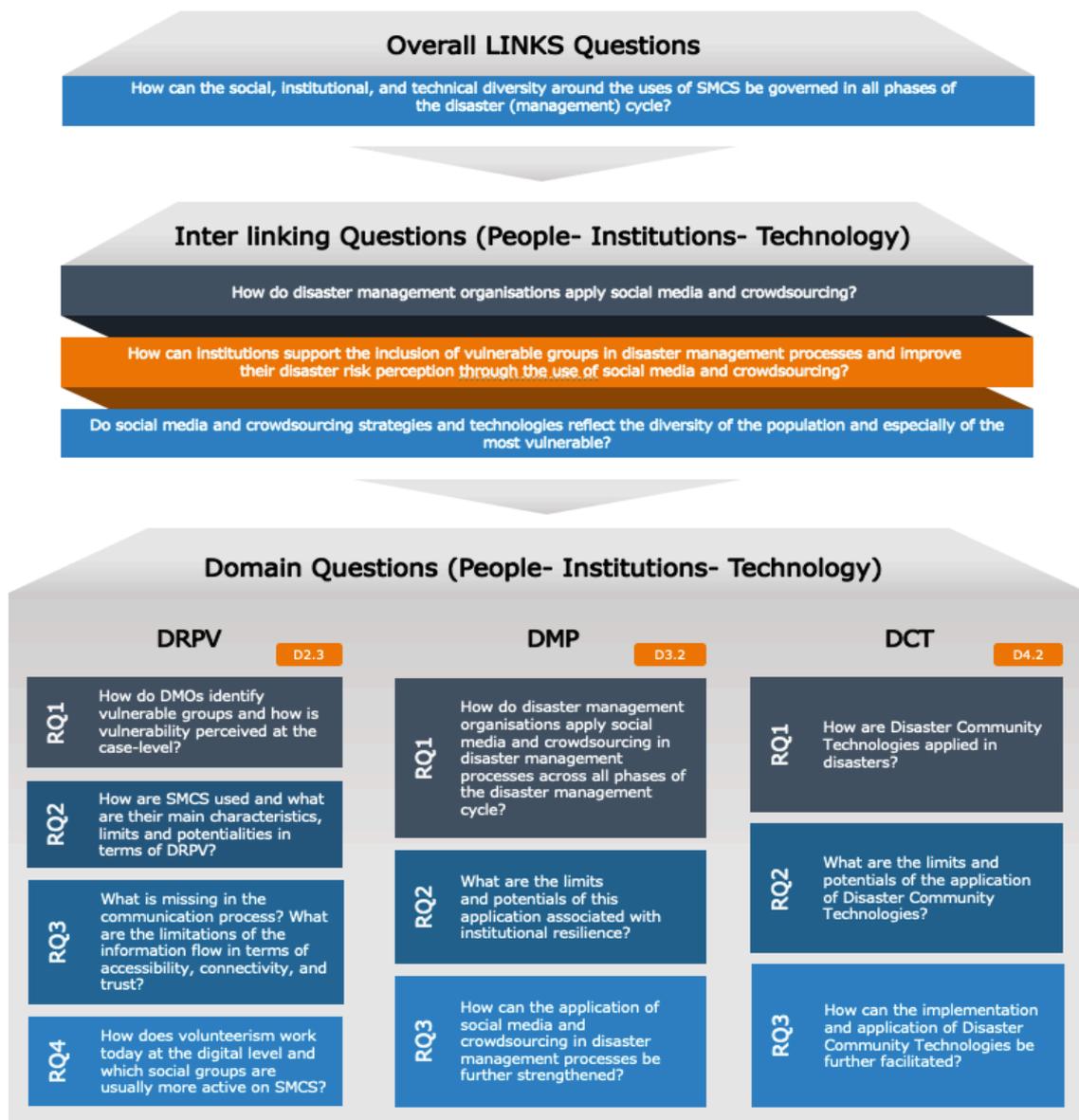
Figure 5: Interconnected Research Questions



Source: WP3's contribution in collaboration with WP2 and WP4

This next figure (Figure 6) summarises all the research questions presented across the three methodologies (DRPV, DMP, and DCT). It provides an overview of how different layers of research questions feeds into achieving the overall objective of the LINKS project. While these are not strict hierarchies, there are a number of cross-cutting questions which will be approached from the respective domains.

Figure 6: Overview of Research Questions for the First Case-Based Assessments



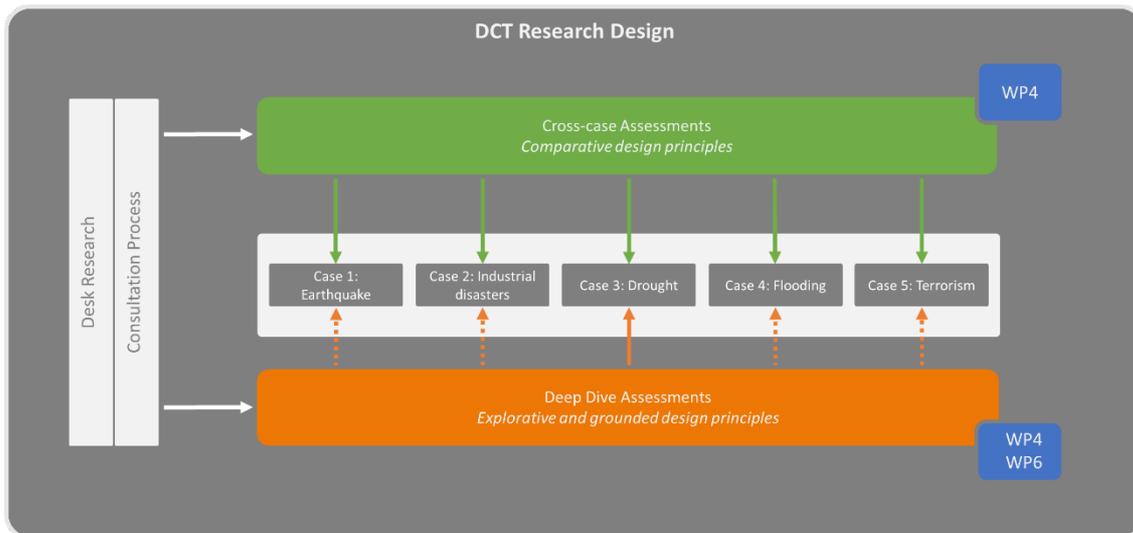
Source: WP3's contribution in collaboration with WP2 and WP4

In order to achieve useful results a robust research design as well as the use of different research instruments are required. After outlining the research questions and aims, the remainder of this deliverable presents the research design consisting of the concept of cross-case assessment and the deep dive assessment.

4. RESEARCH DESIGN FOR THE DCT-METHODOLOGY

This chapter describes the overall research design of the DCT-methodology. Essential to this design is the concept of case-based assessment presented in D6.1 (Fonio & Clark, 2021). The concept is visualised in Figure 7

Figure 7: DCT Research Design



Source: WP3's contribution and adapted by WP4

The first round of the case-based assessment will address the research questions and identified gaps for DCT and the other KB, by applying specific research instruments that address the gaps. This is done through a two-pronged approach:

- A *cross-case assessment* designed around comparative multi-sited design principles
- A *deep dive case assessment* designed around in-depth design principles.

A distinction must be made between the cross-case-level assessment and the deep dive assessment. The **cross-case assessment** includes commonly defined questions and research instruments that address all three knowledge domains across all cases. The aim is to generate comparable results across domains and cases.

The deep dive assessments on the other hand allow a KB to conduct more contextual research into their domain. Conceptually, the deep dive is guided by the respective knowledge domain. In collaboration with the CATs the knowledge domain provides guidance based on the case specificities. Therefore, the research interest is more closely aligned with the questions and objectives formulated by the individual KB. The close interconnectedness of the KBs ensures that the overarching perspectives will play a role. Thus, the DRPV and DMP KBs are consistently taken into account in the planning and application of deep dive research. Nevertheless, the focus will be tailored to the KB as well as the local specificities of the case at hand.

The deep dive assessments bring two main advantages: Firstly, the deep dive allows for the approach of different participants than within the cross-case assessments. The selection of stakeholders can be made more granularly than through the comparative perspective. Secondly, field research instruments are often heavily tied to resources (time, labour, etc.). For example, interviews should not exceed a certain length. If they do, the participants' willingness to participate decreases. Considering all KBs in the selection of instruments will therefore be at the expense of either the depth of the questions asked or the willingness to participate. From the KBs' point of view, the thematic concentration of research interest on one knowledge domain is a necessary extension of the cross-case approach and enables a more detailed level of analysis.

The deep dive is assigned to a specific case but not necessarily limited to it. Wherever necessary, stakeholders and information from other contexts or even countries will be included. For this reason, and in line with the exploratory nature of this methodology, a case-driven approach is also envisioned. The case-driven approach takes into account that CATs can approach KBs with interesting research opportunities. The reason may be that they need expertise from the respective KB or just seeks synergies. Nevertheless, this opens up flexible possibilities for collaboration to improve the KB.

The cross-case, as well as the deep dive assessments of the DCT-methodology, are both guided by the RQ presented in Section 3. To this extent, both approaches are very similar in their focus but differ in depth.

The aim is to capture the current state of DCT application in the respective scenario. In line with RQ1, strives to understand understand in-depth who is using which DCT for what purpose. The results of the current state of DCT can then be further assessed in the cases and analysed for limits and potentials (RQ2). Additionally, this methodology aims to assess the technical background of personnel working with DCT. This follows the assumption that it is important to understand the technical background and related processes in order to fully grasp the possibilities and limitations of DCT (RQ2).

The ways in which the DCT-methodology will be applied in the different levels of case-based assessments is described in the sub-sections below. Section 4.1 is dedicated to the concept of the cross-case assessment. Section 4.2 discusses the specificities of the deep dive assessment.

4.1 The Cross-Case Assessments

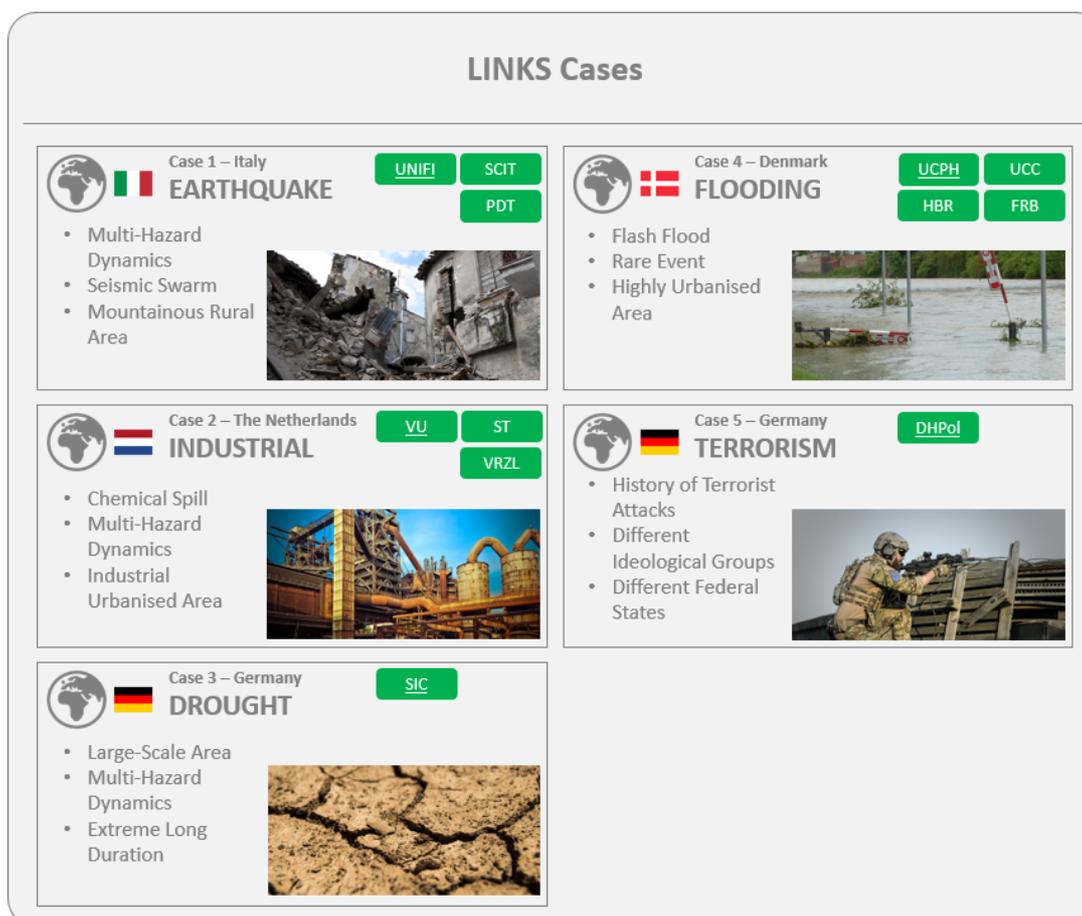
The cross-case assessments are joint efforts between WP2-4 and investigate the specific knowledge domains across different contexts while exploring interacting themes. The cross-case assessments are thus both an attempt to explore the RQs through a comparative lens and to explore interdependent questions cutting across knowledge domains. Five cases in four different countries

were selected for all three knowledge domains and thus represent the empirical testing ground for the entire LINKS project.

The five cases are:

- Earthquakes in Italy;
- Industrial disasters in The Netherlands;
- Droughts in Germany;
- Floodings in Denmark;
- Terrorisms in Germany.

Figure 8: LINKS Cases



Source: (Grant Agreement, 2019)

The findings from the cross-case assessments are context-specific, meaning that the outcomes will be analysed and framed within specific socio-cultural, technical, and institutional contexts (and constraints) and in relation to the hazard scenarios in each case. For this reason, the methodologies are not designed to provide a strict comparative analysis across the cases but rather additionally allow for a qualitative in-depth research approach. Such approaches are well documented in grounded and exploratory research. Here the objective is not to generalise the findings across the

cases, but rather to create a discussion around potential connections, similarities, and difference in light of the diverse contexts in which the research has taken place. A key dimension of the case selection concerned the characteristics of the specific hazard in specific countries. We selected the case to represent ideal-typical hazard scenarios in those countries, which are theoretically constructed situations capturing empirical realities that, despite variations, show similarities on key aspects that are meaningful for SMCS in hazardous environments and at times of disasters⁴. Our selection of ideal-typical scenarios thus enables the generation of insights that are potentially valuable to other situations in similar contexts.

The research instruments for the case-based assessment are described in Section 5. The online survey and the qualitative interviews are the mandatory instruments and are intended for cross-case use in the LINKS cases (the cross-case assessments). The survey and the interviews were identified and will be further developed in close collaboration between WP2-4. To roll out each of these instruments across the five cases, guidelines will be shared with the CATs. These are developed by WPs 2-4 and WP6. These guidelines will provide the CATs with detailed information on each of the research instruments and a process map for the next steps after data collection. A brief timeline for the upcoming cross-case assessments is given in Section 5.1.4.

4.2 The Deep Dive Assessments

While the online survey is intended exclusively for cross-case assessment, the qualitative interviews will be used at both levels. In addition, workshops are planned for the deep dive. The cross-case and deep dive assessments are closely interlinked. Findings from the online survey for example will be used to identify key, previously unknown, stakeholders and to prepare some of the deep dive interviews. When the online surveys are conducted, most of the interviews will already be set. As the online surveys will already run from August to September, it is intended that the (preliminary) results of the surveys can be used to identify interesting participants who, for example, make use of DCT but were not previously known. This approach highlights the explorative approach taken in this methodology. The results of both the online survey and the interviews will be used to prepare the workshops and of course will be reflected in the desk research.

The deep dive of the DCT knowledge domain takes place in the scenario 'drought' in Germany. Germany experienced two years of extreme drought and heat in 2018 and 2019. The drought severely damaged agriculture and caused significant economic losses. It affected several large areas and many citizens. It also led to secondary effects such as local water shortages, forest fires and health problems (especially for the most vulnerable citizens such as the elderly and children).

⁴ On theory building based on case studies, see, *inter alia*: Eisenhardt, K. M., & Graebner, M. E. (2007). Theory building from cases: Opportunities and challenges. *Academy of Management Journal*, 50(1), 25-32; Dooley, L. M. (2002). Case study research and theory building. *Advances in developing human resources*, 4(3), 335-354.

Drought risk is projected to increase globally. Improvements in mitigation, prevention, response and recovery are therefore urgently needed, especially in areas that have not been affected by droughts in the past. The drought scenario deep dive therefore aims to assess the application of DCT in drought management and for drought mitigation.

The hazard scenario was selected with regard to various aspects. The relative novelty of the phenomenon in Germany makes it an exciting field of study, especially with regard to the implementation of new and innovative mitigation strategies such as the application of DCT. In this context, SIC has specialised in digitalisation in civil security. Due to the practice-oriented research of SIC and the close cooperation to local authorities and first responders such as the fire brigade, there is direct access to important stakeholders and data for the 'drought' scenario.

As already mentioned, the RQs discussed in Section 3 are analysed across the cross-case as well as the deep dive assessment. The RQs used in the deep dive are similar in focus but differ in depth. Therefore, the deep dive interviews will focus more on technical aspects of DCT. This also concerns the selection of stakeholders. Interviews with industry representatives who are actively working on the development of DCT are planned. Furthermore, the deep dive assessment will be essential for the evaluation and further development of the DCT-schema and the DCT-landscape (RQ3). This assessment will address both the content and structure of the schema and also assess its comprehensibility. In this context, the LINKS Community Workshops (LCW) provide a good platform to get an interdisciplinary perspective that includes participants from different countries. With sustainability as the goal, it must be usable by stakeholders without direct, personal support.

5. RESEARCH INSTRUMENTS

In this section the research instruments are presented. A distinction can be made between the cross-case (Section 5.1) and deep dive instruments (Section 5.2).

The online survey is intended exclusively for the cross-case and will therefore be rolled out across all five LINKS cases. The qualitative interviews are both intended to be used in the cross-case as well as the deep dive assessment. The cross-case qualitative interviews will consequently be rolled out across all LINKS cases while the deep dive interviews will be mainly conducted in the 'drought' case. The workshops are intended for the deep dive assessment and will also be the frame for some of the LINKS Community Workshops (LCW).

5.1 Research Instruments for the Cross-Case Assessments

The section presents the two research instruments for the cross-case assessments that will be used across all five LINKS cases. The research instruments are developed in collaboration with WP2-4 and consist of an online survey and qualitative research interviews. The instruments are to be translated by the CATs and applied to their local cases. The application will be guided by WP2-4. The instruments presented below are specifically tailored to the needs of the DCT knowledge domain. Similarly, the instruments for DRPV and DMP are presented in 2.3 and 3.2, respectively.

For application in the five LINKS cases, the assessment guidelines are shared with the CATs. The guidelines are developed jointly by WP2-4 and WP6. They will provide the CATs with detailed information on each of the instruments and a process map for the next steps after data collection.

5.1.1 Online Survey

Table 2: Description of the Research Instrument Online Survey

Online Survey	
An internet-based data collection method consisting of a set of questions sent to a strategically selected sample. Applied across all LINKS cases to collect a broad level of information on DCT application.	
Envisaged Number of Participants	Research Participants
40+ per case 200+ overall	• Practitioners
Case Relevance	Language
all cases	English, Danish, Dutch, German, Italian
Lead	Data
WP4	quantitative
Level of Information	Participants Engagement
broad	low
Total Questions	Runtime
(approx.) 30	4-6 weeks

Benefits	
<ul style="list-style-type: none"> • No interviewer effects • No effects of social desirability • No errors due to manual recording • Highly standardised • Low financial cost • Expansion of the participants only requires minor effort 	
Research Objectives (WP4)	
<ul style="list-style-type: none"> • Identification of DCT • Identification of stakeholder relevant for DCT • Identification of contexts and scenarios in which DCT are applied • Identification of processes and guidelines relevant to the technical implementation and use of DCT 	
Risk	Mitigation
<ul style="list-style-type: none"> • High non-response rate • Problems of intersubjectivity 	<ul style="list-style-type: none"> • Help by trusted research institutes or umbrella organisations • Pre-testing

Source: Author's contribution in cooperation with WP2 and WP3

Online surveys are particularly suitable when it comes to interviewing a large group of research participants (Wagner & Hering, 2014). Once they have been designed and the questionnaire is created, they can be scaled as desired. Furthermore, they are not bound to specific locations or times (Wagner & Hering, 2014). Having in mind the characteristics of the online survey like scope of possible participants, the effort required during the implementation as well as the depth level of the questions some research questions are more suitable than others. Due to its broad approach, this online study focuses on the determination of the status quo of DCT by identifying the elements relevant to the DCT-landscape.

Answering the research objectives in Table 2 is an important step in answering RQ1. The identification of stakeholders, their use of DCT and the processes that steer the technical application is an important building block for understanding how DCT are used. It will also allow determining at which level of SMCS engagement the participants are. The findings from the online survey will provide additional information for developing the research questions for the qualitative interviews within the deep dive.

5.1.1.1 Process and Guidance

Once initiated, the online survey should run almost by itself. The analysis of the survey data is also timesaving compared to qualitative methods thanks to automated procedures. Nevertheless, some preparation is crucial to obtain good data from the online survey. The design and set-up of the survey comprise two different processes:

First, a process that takes place across WP2-4 where a questionnaire is designed (June 2021). Here, the WP4 team led by SIC is responsible for the general design and set-up of the online survey, while

the questionnaire is designed in close consultation with WP2 and WP3 to ensure that interconnected thematic areas are thoroughly addressed. The questionnaire is then discussed with the CATs and adapted accordingly. An important aspect for the success of the online survey is that the questions do justice to the complexity of the research instrument. This means that the depth level of the questions and thus also of the answers should be rather straightforward (Wagner & Hering, 2014).

Second, since the survey is conducted in the respective national language of the LINKS cases, the questionnaire will be translated after its completion and given to the CATs. The translations are carried out in cooperation with the CATs to prevent the wrong usage of terms (July 2021). Following the design and set-up of the survey, the survey needs to be rolled out across the five different cases in four different countries. To ensure CATs are responsible for rolling out the survey locally, however, in close consultation with WP4 which supports the entire process. To guide this process, assessment guidelines are developed by the three knowledge domains and in collaboration with the CATs. They consist of concrete instructions on how to conduct the cross-case assessments.

The online survey is conducted in all five LINKS cases in four different countries. This means that four different surveys are conducted - one per language. However, the surveys are identical except for the differences in language. To ensure that the online survey runs smoothly, it will be pre-tested in cooperation with the CATs. This is anticipated to happen at the end of July.

5.1.1.2 Selection of Participants

The survey is intentionally broad and intends to reach as many organisations as possible. Due to this explorative approach, the online survey is scheduled relatively early for the LINKS project and will run from August to September of 2021. The participants of this online survey from a DCT perspective are those positions in organisations that are entrusted with external or social media communication as well as the digitalisation of communication. Positions leading the development of communication strategies are also highly relevant. Relevance from the perspective of DCT would be given if, for example, DCT is actively used or the participants state that they are interested in using it. However, the aim of WP4 is also to identify the potentials of DCT. Therefore, a participant's negation of both the use and interest in DCT does not automatically render the participant irrelevant. The selection of participants is done in a structured procedure within the criteria defined by the stakeholder analysis presented in Section 2.4.

At the same time, it is also important to identify stakeholders who are not participating in the survey, but who could act as distribution networks for the survey. These should lend emphasis to the survey and simultaneously help to identify previously unknown stakeholders.

While the information gained from such an extensive survey is extremely valuable, it is not without its challenges. One major issue for surveys, in general, is the non-response rate. This rate will likely be increased, due to the cross-case and cross-knowledge domain perspective. To counteract those

effects, it can be helpful to use recognised institutions as distribution networks to lend weight to the survey. Project partners as the Disaster Preparedness and Prevention Initiative of South Eastern Europe (DPPI SEE) and the Federation of the European Union Fire Officer Associations (FEU) serve as excellent examples. Additionally, a serious, well-crafted cover letter that clarifies the seriousness of the request and the research objective as well as the relevance for the stakeholder, if applicable, can also reduce the effect of non-response and dropouts. According to the study results, the number of dropouts varies greatly depending on the recruitment method. If recruitment takes place via an internet pop-up, the dropout rate is up to 45 per cent. In comparison: If recruitment takes place via email, only 15 per cent of participants drop out prematurely (El-Menouar & Blasius, 2005).

Moreover, surveys are associated with the problem of intersubjectivity. Participants might misunderstand or misinterpret some questions and therefore answer incorrectly or inadequately. This is particularly problematic with surveys compared to interviews, as it is an unsupervised research instrument. A possible mitigation strategy for this aspect is a careful pre-test of the questionnaire. However, it will be difficult to represent the diversity of stakeholders in this test. Conducting a pre-test within the cases is also logistically challenging. Even though not all risks could be fully addressed, a successful outcome of the survey should be likely if the strategies are taken into account.

5.1.2 Qualitative Interviews

Table 3: Description of the Research Instrument Qualitative Interviews

Qualitative Interviews	
A method based on qualitative questions and responses facilitated by a semi-structured guide. Applied across all LNKS cases to generate in-depth on people's opinions, thoughts, experiences, and feelings towards DCT.	
Envisaged Number of Participants	Research Participants
10-20	<ul style="list-style-type: none"> •Practitioners •Industry •Policy/Decision Makers •Scientific Community
Case Relevance	Language
All cases	English, Danish, Dutch, German, Italian
Lead	Data
WP3	Qualitative
Level of Information	Participants Engagement
Deep	High
Type of interview	Time
Semi-structured	45-60 minutes
Benefits	

<ul style="list-style-type: none"> • Generation of rich and contextual knowledge • Flexibility to explore emerging topics • Access to experts can be difficult • Low financial cost 	
Research Objectives (WP4)	
<ul style="list-style-type: none"> • Understand how DCT are applied • Understand the limits and potentials of this application • Determine the participants' needs for the application of DCT • Determine the technical requirements and skills of the personnel • Understand what technical processes and guidelines are relevant to the implementation and use of DCT 	
Risk	Mitigation
<ul style="list-style-type: none"> • Time demanding in terms of preparing and organising • Requires experience and knowledge to go beyond the popular narrative • Risk of "polished" talk 	<ul style="list-style-type: none"> • Open and narrative approach • Thorough preparation for the interview situation and the interview participant

Source: Author's contribution in cooperation with WP2 and WP3

Through interviews, it is possible to gain insights into how people make sense of social phenomena, their experiences, opinions, their memories, and perceptions (Brinkman and Kvale, 2014). In social sciences, the qualitative interview is commonly used when aiming for in-depth and rich accounts of a social phenomenon (Yin, 2009). Having these benefits of the qualitative research interview in mind, the interview study supports the data-collection done through surveys and deep dive approaches by adding in-depth insights to barriers and opportunities of SMCS use and their implications on DCT.

While some research aims described in Table 3 are inherently descriptive the main focus of the qualitative interviews is to provide in-depth narratives about the use of DCT to assess limitations as well as barriers of use and, of course, potentials. The qualitative interviews are designed to get an understanding of the context in which DCT are deployed. Therefore, the interviews are used to determine, for example, the level of SMCS engagement of the participants as well as the technical requirements for personnel. The interviews are also used to learn about the needs of the participants.

5.1.2.1 Process and Guidance

Assessment guidelines provide for the interviews will be provided by WP3 during the preparation phase. The guidelines will be designed in consultation with WP2-4 and the CATs. This process is facilitated through the respective methodological taskforces and takes place from June to September 2021. The assessment guidelines will provide examples of open-ended questions agreed on between WP2-4 that then needs to be tailored to the local contexts and each interview situation.

The questionnaire for the interview will be translated by the CATs who will also conduct the interviews. A more detailed view for this process can be found in D3.2.

5.1.2.2 Selection of Participants

The qualitative interviews will be designed as semi-structured conversational interviews with people representing various stakeholders important for understanding DCT. In terms of the number of interviews, no firm rules can be appropriately applied. In relation to the cross-case assessment the volume of interviews also depends on the time and resources available for the CATs, which need to be balanced with other research activities associated with the survey and the deep dives.

The strategy for selecting interview partners is similar to the selection process in the online survey. Here, too, the participants should be positions in organisations that are responsible for external or social media communication as well as the digitalisation of communication. While the online survey aims for the largest possible number of participants, the selection here is made under stricter criteria. Therefore, positions that guide the development of communication strategies are highly relevant. Here, the stakeholder analysis will also support the process.

5.1.3 Complimentary Research Instrument: Focus Groups

Due to the COVID-19 emergency, in agreement with the other methodological partners, it was decided to avoid the mandatory use of research instruments (especially participatory research instruments) that could be affected by restrictions or whose results could be biased in case they cannot be adequately carried out in all the local cases. Thus, in the first case-assessments phase focus groups are planned to be a complementary instrument to follow-up the data carried out through qualitative research interviews and the survey.

The focus groups will be organised and carried out directly by the WP2 team at a cross-national level. WP3 and WP4 will support the process, providing inputs to identify the subjects to discuss and the research participants. CATs will be consulted on defining the purposes as well as research participants. Accordingly, the focus groups will follow the other two methods and at the moment they are planned to be carried out between February and March 2022. The preparatory phase is expected to take place between December and January when the survey results are available along with some first results from the qualitative research interviews.

5.1.4 Timeline for Cross-Case Assessments

A detailed cross-case timeline to ensure smooth planning across WP2-6 has been collaboratively defined and agreed (see: Table 4). The main elements of the timeline are:

- the methodological design and the necessary steps at cross-case level (e.g. designing the survey(s), interviews and their respective roles and responsibilities);

- the development of assessment guidelines and templates that will be included in D6.2 (e.g. guidelines for conducting surveys and semi-structured interviews as well as templates to report on the data collected);
- the case assessments. It is worth considering that the preliminary timeline for the case-based assessments included in D6.1 will be adjusted based on the decision to begin data collection earlier than originally planned (in August-September instead of November). The reason behind it is to ensure that CATs have enough time both for data collection and for translations.

Table 4: Timeline for Cross-Case Assessments

Date	Activities	WPs
June 2021	Detailed planning at case level (mid -June)	WP2-6
	Design of the online survey	WP4 in collaboration with WP2-3
	Design of the semi-structured interviews	WP2-3 in collaboration with WP4
	Identification of the online platform for the survey (ethics/data management)	WP4
	Identification of research participants, expectations setting, minimum requirements at case level	WP2-6
June – August 2021	Operationalisation of the semi-structured interviews in local cases	WP2-6
July 2021	Translations of the survey and pre-test in all languages/countries	WP6
	Refinement	WP2-4
	Guidelines for conducting surveys and cover letters in all languages	WP2-4 with the support of WP6
August-September 2021	Online survey rolled out in all five cases	WP6
	Identification of interviewees, expectations setting, minimum requirements at case level	WP2-6
	Case-specific Covid-19 mitigation strategies	WP6
	Translations of semi-structured interviews and pre-tests in all languages/countries	WP6
	Guidelines for conducting semi-structured interviews; templates for data collection, informed consents	WP2-4 with the support of WP6
October 2021	Translation of the survey results	WP6

	Draft version of the LINKS Framework (D5.3) and of the second work plan for the five cases (D6.2 guidelines and templates)	WP5-6
October 2021-January 2022	Semi-structured interviews carried out in all cases	WP6
November 2021	Delivery of the first version of the LINKS Framework (D5.3) and of the second work plan for the five cases (guidelines and templates: D6.2)	WP5-6
January- February 2022	Translations of the semi-structured interviews	t.b.a
February – March 2022	Data analysis of the semi-structured interviews	WP2-4
April 2022	Analysis sent to WP6	WP2-4
May 2022	Consolidation of results in the first LINKS case report (D6.4)	WP6

Source: WP6's contribution and adapted by WP4

5.2 Research Instruments for the Deep Dive Assessments

The section presents the research instruments that will be used in the deep dive assessment. The research instruments are developed by the DCT knowledge domain and consist of qualitative research interviews and workshop. There is also a section in which additional research instruments are discussed. The application of these instruments depends on some criteria which are described in more detail in the respective section (Section 5.2.3).

5.2.1 Qualitative Interviews

Qualitative interviews are key research instruments for this knowledge domain. Therefore, in addition to the cross-case assessment, they are also used in the deep dive assessment. Conceptually, the interviews build on the same approach and differ only in scope (see Section 4).

Due to the greater depth offered by the deep dive assessments, the qualitative deep dive interviews focus more on technical questions. In addition to more detailed questions about the technical training of the personnel responsible for SMCS tasks, questions are asked that highlight the techniques used by DCT. This serves to provide an insight into the technologies most commonly used by DCT. The deep dive interviews will also target different participants. In particular, organisations developing DCT will be of interest. A key objective of the interviews will be to assess the DCT-landscape and the DCT-schema.

The qualitative interviews are supported by the online survey. In turn, the qualitative interviews support the data-collection of the survey and workshops by adding in-depth insights to limits and potentials of DCT used in disasters.

5.2.1.1 Process and Guidance

Two independent guides are needed to conduct the qualitative interviews as part of the deep dive assessment. One covering the themes related to RQ1 and RQ2 and one that is suitable for the discussion and evaluation of the DCT-schema and DCT-landscape (RQ3). Both questionnaires will be designed taking into account the development of the online survey questionnaires and the qualitative interviews in the cross-case assessment. This is done in order to prevent redundancies and question gaps. The questionnaire will be developed in consultation with the CAT for the 'drought' case and thoroughly pre-tested.

5.2.1.2 Selection of Participants

The strategy for selecting interview partners is similar to the selection process in the online survey. Here, too, the participants should be positions in organisations that are responsible for external or social media communication as well as the digitalisation of communication. While the online survey aims for the largest possible number of participants, the selection here is made under stricter criteria. Therefore, positions that guide the development of communication strategies are highly relevant. Here, the stakeholder analysis will also support the process.

5.2.2 Workshops

Table 5: Description of the Research Instrument Workshops

Workshops	
A qualitative method based on discussion among participants to explore one or more topics. Applied in the LINKS case 'Drought' to generate in-depth knowledge on people's needs and experiences.	
Envisaged Number of Participants	Research Participants
10-20 per case	<ul style="list-style-type: none"> •Practitioners •Industry •Policy/Decision Makers •Scientific Community
Case Relevance	Language
Drought and Terrorism	German
Lead	Data
WP4	Qualitative
Level of Information	Participants Engagement
Deep	High
Time	
Max. 2 hours	
Benefits	
<ul style="list-style-type: none"> • Generation of rich and contextual knowledge • Facilitates discussions among different stakeholders • Access to experts can be difficult • Low financial cost 	

Research Objectives (WP4)	
<ul style="list-style-type: none"> • Understand how DCT are applied • Understand the limits and potentials of this application • Determine the participants' needs for the application of DCT • Determine the technical requirements and skills of the personnel • Understand how different stakeholder can learn from each other • Understand what technical processes and guidelines are relevant to the implementation and use of DCT • Assessment of the DCT-landscape and DCT-schema 	
Risk	Mitigation
<ul style="list-style-type: none"> • Time demanding in terms of preparing and organising • Requires experience and knowledge to go beyond the popular narrative • Some participants are more vocal than others • Risk of “polished” talk 	<ul style="list-style-type: none"> • Open and narrative approach. • Local knowledge of circumstances and events. • Actively engage more quiet participants • Apply cooperative learning methods

Source: Author’s contribution in cooperation with WP2 and WP3

In principle, workshops are good means of knowledge transfer and collection. They enable the active and direct exchange of know-how and thus contribute to a better mutual understanding of the participants. Furthermore, depending on their design, they allow for an in-depth discussion of complex issues and are thus an indispensable method of data aggregation. Above all, the direct involvement of participants from different fields and disciplines provides an interdisciplinary understanding of the problems at hand.

Similar to interviews, workshops are well suited to generate rich information with a high density. In addition, they provide the opportunity to involve a wide range of stakeholders from different backgrounds. The interaction of the stakeholders with each other as well as the collectively elaborated and shared positions and outcomes can bring insights to the surface that are impossible to achieve through a survey and difficult to obtain through interviews.

The participation of stakeholders from different fields and disciplines makes workshops an ideal breeding ground for the evaluation of the DCT-schema. The discussion from different angles and perspectives allows both opportunities and challenges arising from the schema to be identified and discussed. In this way, the schema can be tested for structure, internal logic and comprehensibility. Ideally, the workshops would result in a revised version of the DCT-schema.

To reflect the diversity of the LINKS community and also to actively involve it, some of the workshops are planned within the context of the LINKS Community Workshops (LCW). The LCWs are an important resource for the LINKS community to engage with project partners. They serve to improve the exchange of information and knowledge between actors in the local cases with relevant actors and experts in the wider LINKS community. They also serve to disseminate project developments

and results among case participants. In accordance with D8.1 LCWs will be collaboratively planned with EOS.

5.2.2.1 Process and Guidance

Workshops also require extensive preparation and processing in order to obtain useful and applicable results. Experience has shown that in workshops there is often a tendency for only a few participants to take an active part in the discussion and thus not all those present contribute to the outcome. As a result, important insights are not shared and can thus be lost. To counteract this problem, a mixed-methods approach to cooperative learning is used. The methods used so far, Think-Pair-Share and 3-6-5, have already proven effective and will therefore presumably be used again. Which method is ultimately used, however, depends on the respective topic and the objectives of the workshop.

5.2.2.2 Selection of Participants

The advantage of a workshop is to bring together various stakeholders with different social and professional backgrounds to get their different perspectives on specific topics. This opens up interesting and valuable prospects with regard to the research objectives. The selection is therefore made under consideration of the thematic priorities. Similar to the online survey and the interview, the selection of participants will be guided by the stakeholder analysis described in Section 2.4. Due to the close coordination with the partners, the preparation of a guideline is not necessary here either.

5.2.3 Additional Research Instruments

The research instruments presented are sufficiently suitable to address the research gaps and questions. Nevertheless, the repertoire of possible approaches must not be completely exhausted. Part of the case-preparation phase will be therefore the evaluation of further approaches and instruments. This emphasizes the explorative approach taken.

The main objective of this WP is to produce practical and applicable results. The connection to the stakeholders working in their respective fields is of great importance for the research. Therefore, the participation in a training exercise by a fire brigade is planned for the coming autumn. The exercise is to take place in the field of SMCS and thus has a direct relation to this domain of knowledge. Observations in this regard could build a bridge between the desk research and the findings from the qualitative interviews and workshops. They help to further develop and consolidate the practical relevance of this KB.

Complementary to the observations, the monitoring and evaluation of social media communication are also planned. Part of this will be the quantitative as well as the qualitative analysis of messages on social media platforms of DMOs during a drought. The analysis includes an examination of how

much of the total messages relates to the issue of drought. This can give an impression of how much relevance is given to the issue. It is also of interest to examine who the communication is aimed at. Is it addressed to the population or also to other organisations? Which role vulnerable groups play? As droughts are characterised by their long-term duration, it is relevant to examine the extent to which communication is maintained when the acute drought subsides. This analysis complements the other research instruments and enriches the resulting narratives with empirical findings. The analysis is to be planned to take place in the scenario 'drought'.

Nevertheless, some limitations have to be made. At present, it is unclear to what extent the two approaches can be carried out in practice. Whether the training exercise can take place and be participated in is unclear due to the current Covid-19 pandemic. Furthermore, the monitoring of social media communication depends naturally on the occurrence of drought.

In addition, there is also the possibility that unexpected research opportunities via the case-driven approach may necessitate new research instruments. This approach is described in more detail in Section 4.2. In such a case, the described catalogue of research instruments needs to be expanded. Here, research instruments introduced by WP2 and 3 can be used, if necessary. If not, further research instruments will be developed and described in D4.3.

6. LIMITATIONS AND ETHICAL CONSIDERATIONS

The DCT-methodology is associated with a number of limitations. Two main concerns are important to highlight.

First, the COVID-19 pandemic continues to pose significant limitations to most research activities that require on-site engagement (*e.g.* workshops, and interviews). Because the vaccination campaign in the different countries involved in the project is at different stages, it is not possible to estimate how the emergency will impact the research in the next months. Further considerations will be provided in Deliverable 6.2 (forthcoming). Since COVID-19 could make it difficult to do interview activities as planned in the DCT-methodology, interviews may also be done using online platforms and tools.

Second, this methodology sets out an ambitious plan for conducting research across several locations using various research instruments. The feasibility of the methodology thus depends on a timely and detailed planning and implementation process that is well-structured and well-coordinated. To ensure such a process, we set up a methodological taskforce, which provides an infrastructure for planning and coordination across the many work packages involved in the implementation of the methodology.

In carrying out research with the community members, LINKS partners have the responsibility to ensure that, at all times, measures have been put in place to protect the health, safety, and well-being of the people participating in the surveys, workshops, and other project's events (Bonati & Morelli, 2020) (Bonati & Graziani, 2020). This implies that minimum standards and procedures must be respected in all phases of the project, from planning to execution and during the monitoring and evaluation of the work done. This also includes the required steps taken by partners for the management and security of research data as defined in the LINKS Data Management Plan (DaMP). For guidance and uncertainty for the ethical requirements related to the application of the instruments and procedures defined in this deliverable, LINKS partners should contact the LINKS Ethics Advisory Board.

Following the LINKS **Ethics Strategy** (D1.5) (Bonati & Morelli, 2020) this methodology is designed and will be implemented based on sound ethical principles for conducting research with human participants. This includes (and are not limited to):

- Participation is transparent and aware. All participants are sufficiently informed about the program so that they can consciously choose whether and how to participate. The information is shared in a language that is friendly and easy to understand; the roles and responsibilities of all the people involved are also well explained.

- Participation is voluntary. The participation to projects' activities is voluntary and all the participants must receive relevant information and have the time to decide whether to participate or not.
- Participation is respectful. The research carried out respects the commitments, values and cultural practices of all.
- Participation is relevant. All the topics addressed must have an effective relevance in the life of the participants and the proposed activities must be in line with their interests and abilities.
- Participation is accessible and friendly. The methodology used is applied on a friendly basis and in an accessible manner, to increase self-confidence and between participants of different sexes and ages, furthermore the activities are accessible to people with disabilities.
- Participation is inclusive. The activities are respectful of gender and age differences and accessible to people with disabilities. The opportunity to participate is given to people of different genders and ages and from different backgrounds, including the youngest, the disabled and other marginalized groups. The participation process is inclusive and non-discriminatory: participants are encouraged to address the issue of discrimination through their participation.
- Participation is supported by training. The staff is competent and able to facilitate and support the participation of everyone.
- Participation is safe and sensitive. All participants feel safe when they participate, risks and countermeasures are identified, and they know where to turn if they feel in uncomfortable while involved in participation activities.
- Participation is responsible. Participants are supported in monitoring and evaluating their path, researchers take their point of view seriously and implement their proposals.

The next step in terms of ethical considerations is to discuss them contextually with the CATs.

7. CONCLUSION

7.1 Summary

Based on the findings from D4.1, a DCT-methodology was developed and presented in this document. This methodology aims to develop guidance and support for the case-based assessment of the LINKS Framework (WP5 and 6). It is primarily aimed at addressing the gaps in the existing knowledge that have been identified in D4.1.

To this purpose the DCT-schema and DCT-landscape will be further developed. This includes the identification, structuring, mapping and analysis of DCT and DCT-relevant elements. The elements identified so far include:

- Existing DCT
- Stakeholders who already use DCT
- Good practices/practical examples
- Scenarios in which DCT are applied
- Guidelines for the implementation and usage of DCT
- Processes for the implementation and usage of DCT
- Related projects

For this purpose, the literature review and BMA conducted in D4.1 is continued and extended to the case level of the cross-case assessment. This is seen as an ongoing process and will therefore be continued.

This DCT-methodology also provides and discusses a set of research instruments that will be used for the cross-case and the deep dive assessments to address research gaps and questions across different scenarios. This set includes an online survey, qualitative interviews, focus groups as well as workshops.

The research approach described this methodology will be conducted in close consultation with stakeholders across cases. The LINKS Community Workshops will be essential to discuss initial results as well as evaluate the DCT-schema and the DCT-landscape. This methodology aims to achieve an updated and improved version of the DCT KB.

7.2 Future Directions

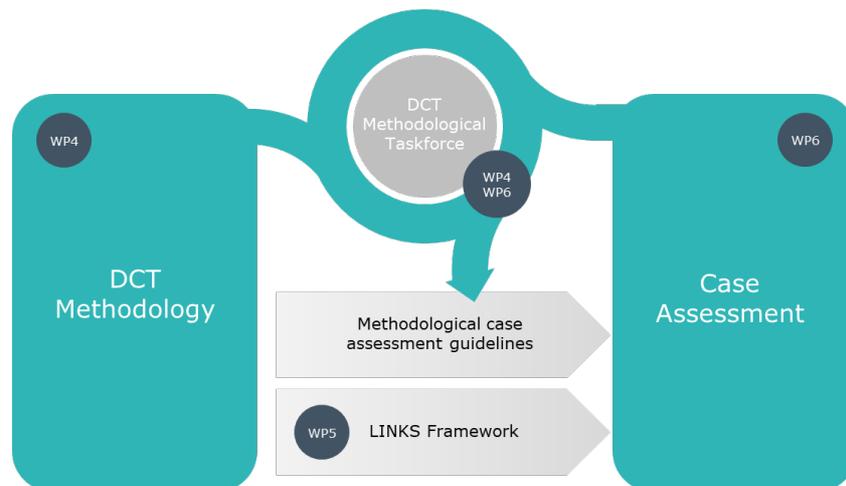
The results of this methodology will inform the refinement of the research instruments as well as the second version of DCT-methodology. While this round of case-based assessments is mainly about testing assumptions and addressing identified gaps in knowledge domain, the second round of assessments will focus on the usefulness of learning materials. Therefore, the development of

learning materials must be considered at an early stage. Two major steps forward have already been taken with the development of the DCT-schema and the DCT-landscape.

The second case-based assessment will therefore focus on the further evaluation of the DCT-schema and the DCT-landscape. This must include a cross-national and interdisciplinary approach to ensure deployment through a diverse set of stakeholders and scenarios. This process will also be accompanied by a continuous monitoring effort to identify new elements for the DCT-landscape as well as the identification of new DCT. The aim is to provide a consolidated version of both the landscape and the schema that allows stakeholders to use them without personal guidance and supervision.

After the DCT-schema and the DCT-landscape have been thoroughly tested and evaluated they have to be translated into the Links Community Centre (LCC) described in D7.1 (Kiehl, et al., 2021) and D7.2 (Kiehl, et al., 2021). The translation into the LCC will be further guided by the LINKS framework. The active involvement of consortium partners as well as a variety of practitioners will be key. One main concern will be the aspect of usability. The result is envisioned as a comprehensive and accessible resource of information for the implementation and application of DCT that will be of use to a variety of stakeholders.

Figure 9: Future Directions for the DCT Knowledge Domain



Source: WP3's contribution and adapted by WP4

7.3 Future Directions for the LINKS Framework

The knowledge bases and the methodological deliverables (developed in WP 2, 3 and 4) are the building blocks of the LINKS Framework (WP5). Moving forward, dedicated workshop activities are planned to discuss how each of these domain specific methodologies are consolidated for the first version of the LINKS Framework. As shown in Figure 9 above, the methodological

deliverables provide the foundation for supporting the assessment guidelines (WP6) and for developing the first version of the LINKS Framework by:

- Operationalising the theoretical concepts identified in the knowledge bases deliverables;
- Identifying central research questions for improving all knowledge bases;
- Creating a research design for answering the RQs through the first case-based assessments of the LINKS Framework.

Consequently, these methodological deliverables inform an overarching research design applied across the LINKS cases. This research design is also part of the first version of the LINKS Framework.

The three methodologies, together with the knowledge bases and case-based assessments, feed into the key aim of creating outputs for sustainable advanced learning. The learning dimensions in the project will be addressed both at the overall project level and at the specific case level through the learning materials that will feed into the second version of the LINKS Framework. These learning materials are one of the backbones of the LINKS Framework and will be made available through the LINKS Community Center (LCC). The first version of the learning model for the Framework, including the learning objectives of the Framework, and the case-specific learning objectives will be part of D5.3.

Overall, the learning materials will be designed based on the knowledge gained in the first case-based assessments: the critical reflections on different social, institutional and technological elements will shed light on needs and challenges that the Framework aims to address. The outcomes from the cross-case and the deep dives will inform the future steps for the development of the Framework. Addressing both the cross-domain questions and the domain-specific questions explored through the deep dives will directly inform the design and the selection of the materials.

The knowledge gained in the first evaluation phase will be paired with the knowledge which has begun to emerge in the meetings and workshops (cross WP5-6) carried out with the practitioners involved in LINKS (more information and preliminary results are provided in D5.1 and D6.1). Common themes across the cases have been identified but more work is needed to understand how this knowledge can be implemented in the second evaluation of the Framework.

The knowledge and learning processes enabled through LINKS will be open to everyone and will also provide pathways for bridging institutional learning into interactions with other relevant groups for strengthening societal resilience, such as citizens and the private sector.

8. BIBLIOGRAPHY

- Bach Nielsen, A., & Raju, E. (2020). *DMP Knowledge Base – A Consolidated Understanding of Disaster Management Processes*. Deliverable 3.1 of LINKS: Strengthening links between technologies and society for European disaster resilience, funded by the European Research and Innovation Programme (No 883490).
- Bonati, S. (2020). *Disaster Vulnerability Knowledge Base – A Consolidated Understanding of Disaster Vulnerability in Social Media and Crowdsourcing*. Deliverable 2.1 of LINKS: Strengthening links between technologies and society for European disaster resilience, funded by the European Union's Horizon 2020 Research and Innovation Programme (No. 883490).
- Bonati, S., & Graziani, F. (2020). *H – Requirement No. 1*. Deliverable 10.1 of LINKS: Strengthening links between technologies and society for European disaster resilience, funded by the European Union's Horizon 2020 Research and Innovation Programme (No. 883490).
- Bonati, S., & Morelli, S. (2020). *Ethics and Societal Impact Strategy*. Deliverable 1.5 of LINKS: Strengthening links between technologies and society for European disaster resilience, funded by the European Union's Horizon 2020 Research and Innovation Programme (No. 883490).
- Bundesamt für Bevölkerungsschutz und Katastrophenhilfe (BBK). (2016, April). Rahmenempfehlungen für den Einsatz von Social Media im Bevölkerungsschutz. Retrieved from https://www.bbk.bund.de/SharedDocs/Downloads/BBK/DE/Publikationen/Broschueren_Flyer/Rahmenempf_Einsatz_Social_Media_BevS.pdf?__blob=publicationFile
- El-Menouar, Y., & Blasius, J. (2005). Abbrüche bei Online-Befragungen: Ergebnisse einer Befragung von Mediziner*innen. *Zentralarchiv für Empirische Sozialforschung*, 79-92.
- Fonio, C., & Clark, N. (2021). *First Work Plan for the Five Cases*. Deliverable 6.1 of LINKS: Strengthening links between technologies and society for European disaster resilience, funded by the European Union's Horizon 2020 Research and Innovation Programme (No. 883490).
- Gambo, N. A., Ayong, A., & Kashefi, A. (2020, 03). A survey of social media use in emergency situations: A literature review. *Information Development*, pp. 1-18.
- Gizikis, A., Susaeta, I. G., Habdank, M., Schubert, A., Reuter, C., Kaufman, M.-A., . . . O'Brien, T. (2017). Guidelines to increase the benefit of social media in emergencies. *FP7-Project Emergency Management in Social Media Generation*. Retrieved from http://www.fp7-emergent.eu/wp-content/uploads/2017/09/20170529_D7.3_Guidelines_to_increase_the_benefit_of_social_media_EmerGent.pdf
- Grant Agreement. (2019). Proposal of LINKS, European Union's Horizon 2020 Research & Innovation Programme under Grant Agreement No. 883490.
- Habig, T., Lücke, R., Sauerland, T., & Tappe, D. (2020). *DCT Knowledge Base – A consolidated understanding of Disaster Community Technologies for social media and crowdsourcing*. Deliverable 4.1 of LINKS: Strengthening links between technologies and society for

European disaster resilience, funded by the European Union's Horizon 2020 Research and Innovation Programme (No. 883490).

- Hoerger, M. (2010). Participant Dropout as a Function of Survey Length in Internet-Mediated University Studies: Implications for Study Design and Voluntary Participation in Psychological Research. *Cyberpsychology, Behavior, and Social Networking*, pp. 697-700.
- Kiehl, M., Lüke, R., Tappe, D., Gehlhar, S., Habig, T., & Marterer, R. (2021). *Concept for the LINKS Community Center*. Deliverable 7.2 of LINKS: Strengthening links between technologies and society for European disaster resilience, funded by the European Union's Horizon 2020 Research and Innovation Programme (No. 883490).
- Kiehl, M., Lüke, R., Tappe, D., Gehlhar, S., Habig, T., & Marterer, R. (2021). *Report about the needs and potentials of the LINKS Community Center*. Deliverable 7.1 of LINKS: Strengthening links between technologies and society for European disaster resilience, funded by the European Union's Horizon 2020 Research and Innovation Programme (No. 883490).
- Lee, B., Preston, F., & Green, G. (2012, January). Preparing for High-impact, Low-probability Events. (C. House, Ed.) Retrieved from https://www.chathamhouse.org/sites/default/files/public/Research/Energy,%20Environment%20and%20Development/r0112_highimpact.pdf
- Macapayag, N., & Gorana, M. (2015). Trends and Patterns in Natural Disaster Management in Europe and Central Asia 1993-2014. (C. E. Hungary, Ed.) Hungary. Retrieved from <https://cps.ceu.edu/sites/cps.ceu.edu/files/attachment/basicpage/143/ceu-policy-lab-ifrc-natural-disaster-mgmt-europe-and-central-asia-2015.pdf>
- Mauroner, O., & Heudorfer, A. (2016, 12). Social media in disaster management: How social media impact the work of volunteer groups and aid organisations in disaster preparation and response. *International Journal of Emergency Management*, pp. 196-217.
- Pazzi, V., Morelli, S., & Bonati, S. (2020). *Disaster Risk Perception Knowledge Base - A Consolidated Understanding of Disaster Risk Perception in Social Media and Crowdsourcing*. Deliverable 2.2 of LINKS: Strengthening links between technologies and society for European disaster resilience, funded by the European Union's Horizon 2020 Research and Innovation Programme (No. 883490).
- Philpot, J., & Reuge, E. (2020). *D8.1 LINKS Community Strategy*. Available at: <http://links-project.eu/deliverables/>: Deliverable 4.1 of LINKS: Strengthening links between technologies and society for European disaster resilience, funded by the European Union's Horizon 2020 Research and Innovation Programme (No. 883490).
- Rao, R., Plotnick, L., & Hiltz, R. (2017). Supporting the Use of Social Media by Emergency Managers: Software Tools to Overcome Information Overload. *Proceedings of the 50th Hawaii International Conference on System Sciences*.
- safety innovation center e.V. (2020). *Digitale Transformation in der zivilen Gefahrenabwehr*. Retrieved from <https://www.blaulicht.digital/wp-content/uploads/sites/6/2020/09/Studie-Digitale-Transformation-in-der-zivilen-Gefahrenabwehr.pdf>
- Schäfer, C., Sauerland, T., Pottebaum, J., Amelunxen, C., Marterer, R., Eisenhut, D., . . . Kavalieros, D. (2017, February). Deliverable 3.4: Final Publication of Inventory Results. *Deliverable of the Project SecInCoRe (Secure Dynamic Cloud for Information, Communication and Resource Interoperability based on Pan-European Disaster Inventory)*. Retrieved from http://www.secincore.eu/wp-content/uploads/2017/03/D3.4_Final.pdf

- Tagarev, T., Ratchev, V., Ivanova, N., Havlik, D., Stelkens-Kobsch, T., & Gala, F. (2017, December). D934.10 - Taxonomy of CM functions for classification of solutions. *Deliverable of the Project driver+ (Driving Innovation in Crisis Management for European Resilience)*. Retrieved from https://www.driver-project.eu/wp-content/uploads/2018/02/DRIVER-D934.10_Taxonomy-of-CM-functions-for-classification-of-solutions.pdf
- Wagner, P., & Hering, L. (2014). Online-Befragung. In N. Bauer, & J. Blasius, *Handbuch Methoden der empirischen Sozialforschung* (pp. 661-674). Wiesbaden: Springer Fachmedien.
- Wukich, C. (2015, July). Social media use in emergency management. *Journal of Emergency Management* 13(4):281-94. doi:10.5055/jem.2015.0242

9. ANNEXES

9.1 Annex I: Overview of Stakeholders

Table 6: Overview of Stakeholders

Practitioners			
Governmental organisations			
fire brigades (incl. their rescue services)	Police	other civil protection and disaster management organisations (e.g. THW)	
<i>from these stakeholders, the following type of actors are particularly interesting...</i> <ul style="list-style-type: none"> • their social media and IT-experts • their crisis management teams • strategic leadership positions 			
private aid organisations in the field of welfare (e.g. Red Cross)			
associations (e.g. vfdb in Germany)			
cyber security			
Policy/Decision Makers (top down)			
European Union & their organisations			
Federal Office of Civil Protection and Disaster Assistance (BBK in Germany)		Federal Ministry for the Interior	
crisis unit (cooperation with other crisis management teams and other federal agencies)			
authorities of the countries and districts			
local governments, municipal administrations (e.g. healthcare, public order office)			
Citizens			
Civil society			
educational/academic institutions (e.g. schools, universities)	social movements and networks (e.g. Friday for Futures)	organised volunteers' groups	NGOs (e.g. Doctors without Borders)
Crowdsourcing related (cf. D4.1 for more explanation)			
affected populations	diasporas	social networks	digital volunteer communities
Vulnerable groups (cf. D2.1 for more explanation)			
diversity	accessibility	connectivity	mobility
Scientific Community			
crisis management and civil security	social science	computer science	engineering, medicine, political science

academic networks, <i>e.g.</i> ISCRAM
universities, institutes
European Commission, national contact points for security
Industry
social media networks
developer of technologies and applications
companies involved in crisis processes
large industrial partners
operators of the critical infrastructure

Source: Author's contribution

9.2 Annex II: Consolidated Collection of Tasks performed by DCT

Table 7: Consolidated Collection of Tasks performed by DCT

Dissemination of crisis related information
<ul style="list-style-type: none"> • alerts and warnings • guidance on actions • location of resources (supplies) • raise awareness of risks/preparedness education • emotion and opinion-related messages • representation of the accessibility of the organisation
Extended communication
<ul style="list-style-type: none"> • dialogue-oriented communication with the population • dialogue-oriented communication with other authorities • dialogue-oriented communication with other organisations • communication within the organisation • search missing people • promoting and connection to relevant apps • receiving survivor's request for assistance / emergency calls (overstrained telephone network) • maintain contact with family/friends • search for witnesses • obtain and provide feedback • building a relation and trust between authorities and the public
Monitoring and analysis of information from social networks and related technologies
<ul style="list-style-type: none"> • accurate and fast assessment of the situation and damage pattern • effective management of the resources (man and machine) • public mood analysis • early detection of events
Coordination and cooperation
<ul style="list-style-type: none"> • encouraging volunteer helpers

<ul style="list-style-type: none"> • coordination of action and organizing volunteer helpers • increasing of the capacity for self-help among the population (increasing resilience) • crowdsourcing activities (e.g. crisis mapping)
Police-related tasks
<ul style="list-style-type: none"> • collecting clues to solve crimes and finding perpetrators • early detection of crimes • early detection of intentions to commit terrorism • terror-related dissemination of information • recognising and combating rumours
Miscellaneous tasks
<ul style="list-style-type: none"> • aftercare for victims and relatives (e.g. donations, other help)

Source: Author's contribution

9.3 Annex III: Matrix for Assessing the Importance of Stakeholders

Figure 10: Matrix for Assessing the Importance of Stakeholders

	Practitioner									
	Fire Brigades (incl. their rescue services)	Police	other Civil Protection and Disaster Management Organisation (e.g. THW)	Private aid organisations in the field of welfare	Associations	Cyber Security	European Union & their organisation	Federal Office of Civil Protection (Bund)	Federal	Assista
Dissemination of crisis related information										
alerts and warnings	strong use	strong use	occasional	strong use	no use	no use	no use	strong use	no use	no use
guidance on actions										
location of resources (supplies)										
raise awareness of risks/preparedness education										
emotion and opinion-related messages										
representation of the accessibility of the organisation										
Extendend Communication										
dialogue-oriented communication with the population										
dialogue-oriented communication with other authorities										
dialogue-oriented communication with other organisations										
Communication within the organisation										
search missing people										
promoting and connection to relevant apps										
receiving survivor's request for assistance / emergency calls (overstrained telephone network)										
maintain contact with family/friends										

Source: Author's contribution