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Barriers and facilitators of information sharing in interregional crisis management networks

Comparing the 2011 Chemie-Pack and the 2019 MSC Zoe containership crises.

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Table of Contents

Table of figures

Table of tables

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Abstract

Complex and intertwined systems fueled by globalization have brought humanity revolutionary opportunities. However, researchers notice an emerging risk of an impactful type of crisis. The transboundary crisis often crosses both geographical and functional boundaries and affects all kinds of organizations and infrastructures. The need for additional research into the collective emergency response on transboundary crisis stems from the need to minimize impact and promote an effective response. In this particular research, a comparative case study aimed to analyze two Dutch interregional cases in order to identify the barriers and facilitators of inter-organizational information sharing. The 2011 Chemie-Pack chemical fire received a negative evaluation from credible sources. Governmental organizations made predominantly positive remarks on the 2019 MSC Zoe container loss response. Through content analysis of reports and conducting two interviews, this research attempted to identify which of the five composed causal factors could rationalize the different outcome in evaluation. The result section showed that the responsible Safety Region, in which territorial boundaries the Chemie-Pack fire took place, demonstrated low reachability and inadequate use of the interoperable technological instruments. In contrast to MSC Zoe, where credible sources were very pleased about all causal factors. In both cases, the organizational structures illustrated deviations in the regulative administrative levels. The results seem to indicate that deviances often resulted in organizational haziness. However, when organizations in the network properly aligned deviations and decision-makers took the right position, deviant administrative structures did not seem to inhibit the information sharing.

Keywords: transboundary crises, information sharing, barriers, facilitators, interregional crises, network, Dutch crisis management, network collaboration, functional diversity, co-location, role knowledge, alignment, inter-organizational contact, crisis communication and technology.

List of abbreviations

Since most abbreviations concern Dutch organizations or Dutch crisis management teams, the addition of short explanations aims to inform readers that are not familiar with the predominantly Dutch abbreviations.

BOT-MI	Beleidsondersteunend Team milieu-incidenten (environmental services)
CoPI	Commando Plaats Incident (crisis management team introduced in GRIP-1)
GBT	Gemeentelijk Beleids Team (crisis management team introduced in GRIP-3)
GHOR	Geneeskundige Hulpverleningsorganisatie in de Regio (public health)
GMK	Gemeenschappelijke Meldkamer (dispatch centre)
GRIP	Gecoördineerde Regionale Incidentbestrijdings Procedure (administrative levels)
IFV	Instituut Fysieke Veiligheid (Institute for Safety)
IOISS	Inter-Organizational Information-Sharing Systems
IOOV	Inspectie Openbare Orde en Veiligheid (Dutch safety institute)
LCMS	Landelijk Crisis Management Systeem (interoperable technical system)
MWB	Veiligheidsregio Midden en West Brabant (one of the Dutch Safety Regions)
RBT	Regionaal Beleids Team (crisis management team introduced in GRIP-4)
RIVM	Rijksinstituut voor Volksgezondheid en Milieu (environmental services and health)
ROT	Regionaal Operationeel Team (crisis management team introduced in GRIP-2)
RWS	Rijkswaterstaat (organization focused on infrastructure)
ZHZ	Safety Region: Zuid-Holland Zuid (one of the Dutch Safety Regions)

1. Introduction

On a cold winter day, the Swedish police officer Saga Norén and Danish officer Martin Rohde got both notified of a dead body on the Oresund Bridge. Arrived on scene, a deceased female was left behind on the streets and ripped into pieces. This murder was the start of a series of killings, conducted by a symbolic terrorist that intended to create awareness for societal misunderstandings. Some Netflix fanatics might recognize this scenario as the start of the Scandinavian series 'The Bridge.' It won a Golden Nymph award in 2014 for the best European Drama series (Kroon, 2016). As a reader, you might wonder what this is referring to?

The Oresund Bridge is sixteen kilometres long and connects Sweden and Denmark. As the human remains belonged to a Danish citizen and the dumped body was located exactly at the middle of the Swedish-Danish border, intense law enforcement cooperation of both countries was inevitable. The fictive storyline identifies typical tensions in interregional cooperation. Throughout the process, various difficulties concerned with decision-making, implications of different procedures, sense-making and communication came to light. Broadly speaking, the difficulties mentioned above might apply to every multi-disciplinary performance (Uitdewilligen & Waller, 2018). Since the Dutch crisis structure consists of 25 Veiligheidsregio's (from now on: Safety Regions), it is reasonable to imagine and expect scenarios in which the impact area involves multiple Safety Regions (The Dutch Safety Board, 2012). This scenario applied to the Chemie-Pack crisis of 2011 for example. In this major fire caused by accident, the cloud of smoke passed the canal and therefore affected the inhabitants and vital infrastructure of Safety Region Zuid-Holland Zuid (Boin, Kuipers, & De Jongh, 2018). In 2019, the MSC Zoe lost 342 containers in the North Sea, which led to an extensive salvage of washed-up goods along the northern Dutch coastline partners (Institute for Safety, 2019[c]). The container loss affected multiple Safety Regions. In contrary to Chemie-Pack (IOOV, 2011), researchers of the Institute for Safety (IFV) that investigated the MSC Zoe case were predominantly positive about the information sharing processes of Safety Regions and the collaborative partners (Institute for Safety, 2019[c]). This difference makes the cases interesting to compare.

Although an intense chemical fire seems to differ a lot from a container loss, both cases had a long-term aftermath. Furthermore, the crises demanded exceptional collaborative combinations in terms of numbers and specializations. The two incidents described above have in common that they share the concept of transboundary crises as described by Ansell, Boin and Keller (2010). The transboundary crisis is a particular type of crises that exceeds a varying number of distinctive borders. The acknowledgement of Chemie-Pack and MSC Zoe as a transboundary crisis is mainly due to its geographical location that crossed political boundaries horizontally. In these cases, this concerns the involvement of multiple Safety Regions that enabled horizontal coordination.

When we zoom in on the collaborative component of transboundary crises, an interesting tendency appears. According to Deverell, Alvinius and Hede (2019), the state of the art stems from

studies that focus on collaborations operating in a contemporary setting. In contrast to normal circumstances, crises generally involve a high degree of uncertainty (Rosenthal & Kouzmin, 1993). It pools resources that never operated or even met in practice. Additionally, the little empirical research available on challenges in inter-organizational information sharing does not focus on the level of interregional collaboration (Bharosa, Lee, & Janssen, 2009; Waring, Humann, & Dawson, 2019).

Seen explicitly from a Dutch perspective, commission Noordanus evaluated interregional collaboration of multiple Safety Regions in 2012 (Veiligheidsberaad, 2012). An up-to-date comparison with a more recent interregional crisis is lacking, which could give this comparison an evaluative twist. Conducting this research could also shed light on the technological and organizational developments that occurred in recent years.

The increasing risk and impactful consequences of interregional crises confirm the need for additional research into this topic (Kalkman, Kerstholt, & Roelofs, 2018; Institute for Safety, 2019[a]). Our dependency on technological infrastructure and culture of 'thinking big' could produce some severe effects if unwanted events escalate (NCTV, 2019). The list of potential interregional incidents as identified by the Institute for Safety (2019[a]) concerns all types of modern-day threats: climate change, terrorism, cybercrime, outages, etcetera. As a prominent example, COVID-19 showed that viruses will not stop at regional borders and will inevitably demand intensive collaboration to manage these complex crises (Christensen, Danielsen, Laegreid, & Rykkja, 2015). As stated by Kapuchu (2006, p. 209): "The effective flow of information across organizational boundaries is critical for an organization's ability to remain effective in a dynamic disaster environment." Since information sharing belongs to fundamental keys in collaborative crisis management (Institute for Safety, 2019[b]), it would be interesting to analyze in which way information sharing was promoted or hindered during remarkable cases. In that way, it might contribute to a better understanding of the pitfalls when collaborating with other actors.

This study aims to compare two interregional crises based on facilitators and barriers of information sharing. Through content analysis of reports and conducting two interviews, the researcher attempts to identify which of the five proposed causal factors could explain the difference in evaluation outcome. The research sought to answer the following research question:

> *Why did the information sharing of the collaborative crisis response differ between the 2011 Chemie-Pack fire and the 2019 MSC Zoe containership loss interregional crises?*

Since the main concepts in this research cover a wide range of researchable assets, the following demarcations will outline the specific focus of this research. Sharing information occurs at different levels of analysis: between different actors and for different purposes. Figure 1 should clarify which general information paths are part of this study. As illustrated in the figure, the research question involves information flows between Regions and selected actors from the functional chain. The exact interplay in crisis communication towards society is not part of the analysis.

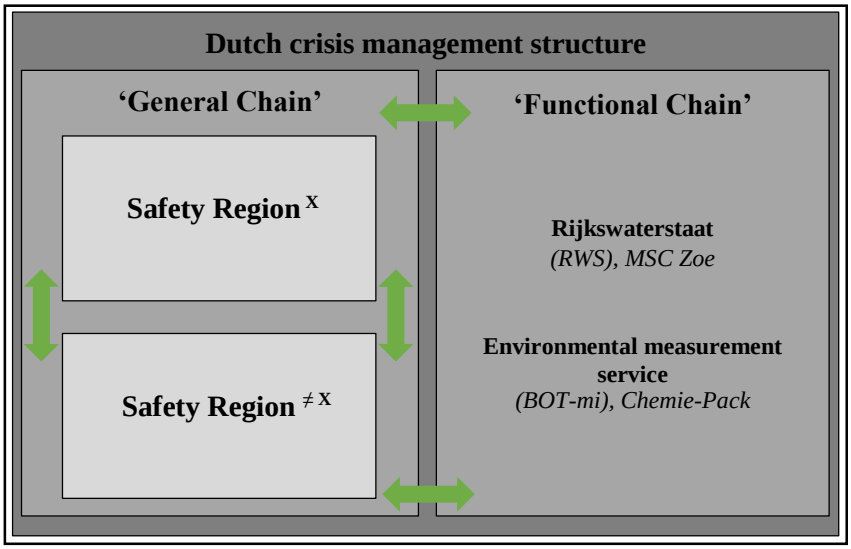

Figure 1: Demarcation of analyzed information flows.

The theory section aims to narrow down from the general concept of crisis to the primary subject of study. As discussed, the selected cases fulfil the requirements of transboundary crises. After scrutinizing what this particular type of crises entails in terms of characteristics and implications for crisis management, an elaboration on the network marks the start of analyzing organizational relationships. This collaborative structure builds upon a few fundamental pillars in order to generate an appropriate response (Kapucu, 2006). Communication connects actors in the transboundary network and enables them to collaborate (Kapucu, 2006). Some processes impact inter-organizational information sharing positively or negatively. The comprehensive set of barriers and facilitators, as composed by Waring, Humann and Dawson (2019), will eventually shape the framework for analyzing the cases.

The methodology section describes the actual research design and aims to illustrate in which way the researcher selected the two cases from the numerous crises the Netherlands faced in the past. Furthermore, it presents the approach taken to conduct the analysis and justifies the selected concepts by connecting them to the cases. At last, the limitation section aims to discuss the validity and provides alternative explanations.

The analysis presents the relevant storyline in both cases and analyses the examined barriers and facilitators of inter-organizational information sharing. At the end of the analysis, a comprehensive table aims to summarize the findings before heading to the conclusion and discussion.

The conclusion and discussion summarize the essential outcomes found in the analysis. Moreover, it connects statements made in the theoretical framework to the results and presents avenues for further research. With an eye on the policy documents that were conducted right after Chemie-Pack by the Veiligheidberaad (2012), it would also be interesting to dedicate a part of the discussion the way in which crisis management in MSC Zoe case was responsive to the recommendations made at that time.

2. Theoretical framework

2.1 Definition of crisis

Although various scholars attempted to define the concept of crisis comprehensively, many elements remain debatable (Kešetović & Milašinović, 2008). In the study of Rosenthal and Kouzmin (1993), the researchers attempted to identify the key characteristics of crisis. Eventually, they stated that a crisis forms: "a serious threat to the basic structures or the fundamental values and norms of a social system, which - under time pressure and highly uncertain circumstances - necessitates making critical decisions" (1993, p. 280). In this definition, three core elements become evident. First, the incident should form a serious threat to fundamental values. This concerns a non-exhaustive list of significant disruptions, varying from physically observable threats to less tangible crises (Kešetović & Milašinović, 2008). To illustrate, both an industrial fire and political conflict could evolve into a crisis situation. Second, crises imply a significant degree of uncertainty. According to Chen, Sharman and Rao (2008), crises usually entail uncertainty about the hazard, its impact over time and organizational haziness. In order to manage the first two uncertainties, the latter could occur when the number of organizations involved increase. Third, connected to the previous element, crisis management actors face complex issues which they have to decide on. In practice, deciding on many of these issues is a complex balance of interest. Drastic decisions could have drastic consequences for society, both positive or negative.

In terms of crisis management, these unpredictable and potentially escalating incidents demand a holistic and intensive reaction from responsible actors. Crisis management is "not an exact science but, rather, more of a practice guided by theory" (Kešetović & Milašinović, 2008, p. 179). In crisis management, the sum of activities contributes to minimizing impact under stressful circumstances and with missing or contradictory information. While dealing with significant disruption, identifying the threats and pooling scarce resources to tackle them should bring the system back to a normal state (Kapucu, 2006; Kešetović & Milašinović, 2008).

In literature, most researchers distinguish three core phases in crisis management (Bharosa, 2011; Institute for Public Relations, 2007; Pipek, Liu, & Kerne, 2014; Smith, 1990). In the pre-crisis phase, actors try to prevent and prepare for crises. Prevention measures intend to minimize risk. Safety checks by the fire department and declaration of permits are examples of how crisis management actors try to determine and reduce risks in society (Institute for Safety, 2019[a]). In terms of preparedness, actors accept that crisis will occur. It is the sum of measures and procedures to activate in order to minimize impact when crisis strikes. Before heading to the actual crisis response, scholars argue that some cases demand detection of being a crisis first (Pipek, Liu, & Kerne, 2014). Not every crisis is apparent. Brecher (1979) emphasized the possible discrepancy between the actual threat and the perceived threat. Climate change is an excellent example of a perceived crisis that entered the political agenda in recent years. Some constructs seem to struggle with receiving enough support from decision-makers to be dealt with as an actual crisis. Therefore, the perceived seriousness of a less tangible crisis might change through

time. Another example of a potential crisis that needs detection first could be an unknown crisis. Cybersecurity incidents could be severe without anyone noticing (Institute for Safety, 2019[a]). The unfolding crisis might expose itself, or experts detect the deviant condition on time.

In the hot phase of the crisis, the prepared set of resources and knowledge comes into play. Multi-disciplinary actors are deployed on scene to mitigate the effects and communicate the consequences of the crisis to residents. This phase theoretically ends when professionals declare the situation under control (Bharosa, 2011).

The last phase is the recovery phase, where the imminent danger passed. In this stage, evaluating the operational response and often 'cleaning up the mess' belong to the core activities of crisis management (Bharosa, 2011). After the recovery phase, investigations often lead to policy adoptions, which brings us back to where it all started: reducing the risk of a crisis to occur.

Within crisis management literature, many researchers agree that a rising number of threats has become transboundary in kind (Ansell, Boin and Keller, 2010; Christensen, Danielsen, & Laegreid, 2015; Blondin, 2016). The complexity of systems makes it harder to isolate this type of crisis and minimize its impact on life-sustaining structures. Consequently, it generates significant challenges for critical decision-making by crisis management teams (Kalkman, Kerstholt, & Roelofs, 2018).

2.2 Transboundary crises

Besides numerous natural disasters that threatened humanity for ages, globalization and interdependencies pushed all kinds of boundaries in recent decades (Blondin, 2016). In this specific type of crisis, an accumulation of factors creates a potential for destructive events. In some cases, it might be the intertwined systems that cause a transboundary crisis. In others, our urge to further develop, produce and store high-risk products could cause an extraordinary disaster. An example of the latter manifested itself in the Chernobyl explosion, since the nuclear radiation spread across large parts of Europe (Zablotska, 2016). Also a smaller accident could obtain transboundary characteristics due to its unfavourable location. A train accident or wildfire near regional or national borders might demand a wide variety of interregional or international actors (Horrichs, 2020; Waring, Humann, & Dawson, 2019).

Ansell, Boin and Keller (2010) discussed transboundary crises and distinct three levels of analysis which indicate a crisis fits the profile of being transboundary. According to the researchers, these three dimensions determine the level of being transboundary in kind and extent.

At first, the dimension of political boundaries encompasses two notions. The geographical boundaries concern the borders found on a geographical map. Intertwined systems with a high degree of cross-border dependencies, such as Internet nodes or the financial system (Blondin & Boin, 2020), could achieve a very high score on this dimension. Pandemics or nuclear radiation are also threats that do not stop at geographical borders. The second political boundary, as described by Ansell, Boin and Keller (2010), focuses on the vertical/hierarchical relationships in governmental bodies. In

transboundary incidents, it is likely that higher authorities step in and take a more prominent role in coordination and alignment with other parties. Hierarchical relationships in transboundary crises take place when public services of the same governmental level operate have to act on a crisis.

The second dimension of functional boundaries entails the incorporation of multi-sectoral organizations in crisis management. The effects of significant crises could spread across different sectors independently and spread as result of a domino-effect (Institute for Safety, 2019[a]). A large chemical fire affects the environment, public health and could also disrupt critical infrastructure at the same time (IOOV, 2011). Ansel, Boin and Keller also relate this dimension to the engagement of public and private parties, such as Liander and the Dutch emergency services in a power outage (Inspectie Veiligheid en Justitie, 2015). As a result of multi-sectoral impact, collaboration of multi-sectoral organizations usually faces structural challenges (Ansell, Boin, & Keller, 2010; Deverell, Alvinius, & Hede, 2019). Although some organizations met each other frequently in daily life, the interoperability of systems and divergent priorities might become major obstacles in high-pressure and fast-changing settings.

The third dimension involves the demarcation of timespan. In terms of duration, the typical transboundary crisis has a long significant impact on multiple vital sectors (‘t Hart, 2014). The effects on society or nature could also come to light on different moments in time. Relating this to the Chernobyl disaster, human beings around the nuclear reactor experienced genetic modifications long after the initial crisis response came to an end (Dubrova et al., 1996). Also in relation to crisis management, a relatively long duration of active mitigation measures has implications. According to Ansell, Boin and Keller (2010), long crises put immense pressure on first responders in both worktime and uncertainty. Furthermore, the researchers argue that some key figures left or change throughout the process. It might hinder an effective response if the composition of actors at the table changes frequently, due to a long period of crisis (Berchtold, Müller, Sendrowski, & Grigoleit, 2017).

As proposed in the second dimension, complex transboundary crises demand an interplay of specialized actors. Together, they attempt to make the right critical decisions based on the information available (Kapucu, Arslan, & Demiroz, 2010). To achieve the shared goal of minimizing multi-sectoral impact, responsible actors form a network in order to collaborate (Kalkman, Kerstholt, & Roelofs, 2018).

2.3 Network collaboration

This section focusses on the general concept of networks. Networks, as discussed by Whelan (2011) and Provan and Kenis (2008), are a set of actors that are connected by ties and form relationships. The network could establish on any geographical scale, varying from local public initiatives to Interpol.

The latter remark suggests that there are different types of networks. Provan and Kenis (2008) embedded the position of ´the network´ into governance literature. The authors distinguish four variations: market, organization, collaborative relationships and the network as proposed. Although governance is often related to the organizational structure of government institutions, the definition also

incorporates the private domain. Since a network is not explicitly a governmental collaboration, this research interprets governance as ´´the sum of the many ways individuals and institutions, public and private, manage their common affairs´´ (Weiss, 2000, p. 796).

Within the overarching concept of governance, the 'market' takes account of individual actors that act based on the financial market and their competitive position. The 'organization' encompasses the hierarchical relationship of actors, bound by rules. The 'collaboration' appears to have many similarities with the network, but it is very self-centred. The actors in this type of governance need each other to achieve their own goals.

What remains is the governance-variation of interest. The network builds upon a holistic approach and argues that the independent effort of actors is necessary to achieve a collective and complex goal (Provan & Kenis, 2007). In this form of governance, the collective outcome is always more important than individual goals. More specifically demarcated, Provan and Kenis (2007) stated that network governance encompasses at least three organizations that together try to achieve a collective goal, based on sharing information, skills and resources. Furthermore, the establishment of a network enables an efficient pooling of resources, enhance learning and brings different areas of expertise to the same table.

Since many issues are too complex to handle alone, different specialized disciplines work together to achieve their own and common goal in crisis management (Deverell, Alvinius, & Hede, 2019; Treurniet, Wolbers, & Van Buul-Wesseling, 2012). Networks across commercial and public safety sectors establish for different purposes and a variation in designs. Compared to other networks, networks in crisis management have to deal with rapidly changing and life-threatening situations (Kapucu, Arslan, & Demiroz, 2010). Decision-making that generates implications for multiple sectors is a balance of interest, which usually takes times to come to a thought-out decision. In crisis management, this considerable amount of time is often lacking. When actors are familiar with each other and used to collaborate, this tends to speed up the decision-making process of directly engaged actors (Ansell & Gash, 2007). In essence, "collaboration is at the heart of crisis management" (Deverell, Alvinius, & Hede, 2019, p. 4).

2.3.1 Networks structures and dynamics

Two perspectives exist when focusing on network dynamics (Whelan, 2011). The first academic angle concerns a network as an organizational form which includes size and design of the network. It emphasizes that there are variations of structure within networks. For example, multi-disciplinary teams of firefighters, medics and police officers form a network within the network of multiple Safety Regions that are involved in the selected cases of this research. In terms of design, one of the most prominent characteristics concerns its organizational system of information sharing. Networks could either have an all-channel or central hub approach. Central hub networks have a central actor in the internal governance structure that coordinates the information sharing. In all-channel networks, actors are all

tied to each other in an equal manner. Besides, networks could be self-initiated or mandated (Provan & Kenis, 2007). The size of the network also impacts the organizational structure. Provan and Kenis (2007) conclude that if the number of participants grows in an all-channel network, also the number of potential relationships increases drastically. Possible negative consequences could occur when networks organize frequent meetings that include all members.

The second point of view does not involve the organizational structure, but rather zooms in on the relationships itself (Whelan, 2011). Within the relational perspective, trust among actors involved plays a central role. The horizontal relationship of parties requires a certain degree of mutual trust. Provan and Kenis (2008) argue that in a network based on trust, actors expose themselves to vulnerabilities since they become dependent on other's behaviour and intentions. As a fundamental pillar in collective goal achievement, a central and strong leader organization could compensate for the lack of mutual trust.

2.3.2 Different types of networks

Although a business network might have other goals compared to youth protection networks, both networks share various administrative and inter-organizational features. Within network governance, Provan and Kenis (2007) distinguish three types of network: shared governance, lead organization and network administrative organization. Each of these subsets represents different degrees of intimacy in relationships, dependency on mutual trust, network size, degree of leverage and other characteristics.

The shared governance, or self-regulating network, has equally assumed participants. Although organizations involved might differ in resources, all actors take part in the collective decision-making process. In public services, this variation is common in the health sector where different disciplines specialized in specific health complaints form a network. In the private sector, a set of construction companies that transform an old building into a hotel with relatively equal effort and influence result in a form of shared governance.

In lead organization networks, there is one central actor in the middle of the network. The key actor takes account of the most important decisions while other actors have a more serving role. Appointment of this actor could be self-initiated by the network as a strategic consideration or established through power, fueled by resources or legal mandate.

At last, the network administrative organization acts as an external administrative body to steer the collaborating actors. This leading actor is not part of the network itself and does not have a shared goal in terms of why the actors initially formed a network. The network administrative organization focusses purely on the network performance itself. It supervises the quality standard and can act as an arbitrator.

2.3.3 Networks in times of crises

As proposed, networks exist in both the private and public sector. In times of crises, complex issues demand an intensive effort of multiple stakeholders that have to face incomplete and changing requirements. According to Kenis and Provan (2008), a crisis management network is a perfect example of network governance, since an effective response is only possible when all actors that need to be involved align and collaborate (Treurniet, Wolbers, & Van Buul-Wesseling, 2012). To illustrate, almost every thinkable crisis involves a combination of actors specialized in public order, safety and health. This network has to communicate developments of the crisis and its response internally and externally (Quarantelli, 1988).

Moynihan (2009) put forward two conflicting perspectives within the network governance of crisis. The command and control perspective praises the benefits of a hierarchical and centralized network. The coordination and communication approach, by contrast, rejects this centralized model and primarily support this by stating that collaborative relationships are key in having an appropriate crisis response. Furthermore, proponents of the coordination and communication approach criticize the command and control model by arguing that close inter-organizational relationships deal with large scale crisis the best. Moreover, the spontaneous inter-sectoral response that stems from the consequences of crises demands flexibility. Decentralization and non-hierarchical relationships promote relatively flexible responses.

As is often the case for networks in times of crisis, the composition of actors changes throughout various incidents. Andersen and Moynihan (2016) call this inclination functional diversity, which could be related to the transboundary dimension of functionality (Ansell, Boin, & Keller, 2010). According to Andersen and Moynihan, the inclusion of new collaborative actors to a network or organization might produce mixed effects. Actors with different backgrounds could foster "greater innovation, creativity, and performance" (2016, p. 1). Although diversity contributes to the higher purpose of comprehensive problem solving, critics argue that the expansion of knowledge and diversity fosters conflict (Andersen & Moynihan, 2016). The inclusion of heterogeneous actors fuels conflict, since the addition of actors could demand an adaption in procedures of already attendant actors. Especially in the beginning of an unfolding crisis, unfamiliar parties first have to screen each other competencies and actual position in the network.

Besides diversity in functioning or mutual familiarity of actors, there are different ways how organizations form and operate from an individual perspective. Dynes and Aguirre (1979) distinguish four types of organizational responses that could develop when responding to crises. 'Established' organizational behaviour encompasses the use of old structures and dealing with everyday tasks; a hospital that takes care of the injured. 'Extending' organizational involvement sticks to its old structure but adapts to non-regular purposes. A construction company is likely to keep its old structure by digging for survivors with excavators during a natural disaster. 'Emerging' organizations have both new structures and new tasks, which could be illustrated by citizens cleaning up the beach after extensive

waste drift ashore. Lastly, 'expanding' organizational structures serve regular tasks, but in a new and unfamiliar structure. Approaching transboundary networks as one organization, the expanding organizational response approach seems to be the most suitable. The expanding network consists of predestinate crisis management actors. However, the difference with the extending variation is that the composition of the network operates on a reactive basis. The nature and extent of the crisis determine which actors compose the temporary network (Pramanik, 2015). Especially collaborative actors with a different functional background that take seat sporadically increase the need for time and effort to understand each other capabilities (Ekman & Uhr, 2015). Ekman and Uhr (2015, p. 5) regard this as an interplay of "external adaption and internal integration."

2.4 Information sharing

Information flows are of utmost importance since they enable decision-making and improve making sense of a situation within the network (Choo et al., 2006). Since communications occur within and between actors, Kapucu (2006) speaks of inter- and intra-organizational communication. Choo et al. (2006) researched knowledge-intensive organizations and identified the building blocks of information behaviour. Information behaviour is the interplay of three influences: information management, information culture and information use.

In information management, the way in which information spreads throughout the organization plays a central role. It resolves questions around the actual purposes of sharing information in a particular organization and how individuals deal with power and control. Some information flows are one-way designed; others demand feedback. Educated staff facilitates information sharing. These employees, internally located or working at an external company, designed a contemporary structure of how information flows should run. The features of this contemporary information structure often arise from a socio-technological perspective (Bharosa, Lee, & Janssen, 2009; Bram & Vestergern, 2011).

Information culture refers to the norms and practices within an organization when it comes to sharing information (Choo et al., 2006). There should be a common belief in the importance of sharing information. The norms represent the respected standard. Information should be reliable, preferably formally obtained, promote interim evaluation and be transparent as possible. Furthermore, members should be willing to share information and be proactive in obtaining information to detect deviations in the situation or organization (Choo et al., 2006).

The last dimension encompasses the use of information. Choo et al. (2006, p. 495) define useful information as: "information which leads to a change in the individual's capacity to make sense or to take action." Information is not useful if it does not actually answer the question or does not fit the context. Choo et al. (2006) distinguish various intended goals of information sharing. Respectively, sharing information intends to make sense of a situation; understand problems, assign tasks, share facts, verify information, motivate, share predictions and maintain or develop relationships.

2.4.1 Information sharing in crisis management

Although Choo et al. (2006) based the three dimensions on a single organization, many findings could relate to information sharing in a close inter-agency network. Crisis management networks actually reflect one overarching organization with different organizational actors. In this case, the dimensions would concern the interplay of inter-organizational parties instead of intra-organizational individuals.

During the crisis response, information sharing plays a vital role in coordinating resources as the crisis evolves every second and updates should regularly inform other partners (Bharosa, 2011; Kapucu, 2006). The information sharing usually starts at the dispatch centre were the centralist receives the first call from the reporter (Dilmaghani & Rao, 2008). The different disciplines that respond use the dispatch centre as a hub to report findings in the first place, but also communicate with each other on scene. Contact builds on real-life contact and through conventional or specially developed technological means, the latter defined by Bharosa, Lee and Janssen (2009) as IOISS: Inter-Organizational Information-Sharing Systems.

Intra-organizational information flows usually relate to achieving appointed goals by law and practice, that contribute to the collective goal (Bharosa, Lee, & Janssen, 2009). For the fire department, this concerns information about hazards and strategic firefighting techniques. Inter-organizational information encompasses what other actors need to know for an effective collective response. Some intra-organizational acts need alignment with collaborative actors before carried out (Bharosa, Lee, & Janssen, 2009).

Emergency services also distil information from outside the crisis to construct the best possible overview. With an eye on the impact of social media nowadays, lots of crisis management actors track social media to pick up essential signals from the public (Berchtold et al., 2020). This could be information about the incident itself, or any complaints about crisis communication that might need attention. Fischer, Posegga and Fischbach (2016) warn, however, that the spread of social media rumours can lead to distribution of false information within and between organizations. The researchers argue that the use of social media findings involves major challenges in terms of reliability and verification.

Actors involved should always be aware of biases that potentially stem from information sharing deficiencies. According to Cao and Nijholt (2008), the stress and uncertainty in crisis increase the risk of tunnel vision. Tunnel vision is closely related to confirmation bias (Bram & Vestergern, 2011). If certain hints seem to form a pattern that can take away some uncertainty, information that aligns with this notion deserve more priority than contradictory information (Schraagen & Van de Ven, 2008). In this sense, information flows drastically impact our perception of observations and can stimulate cognitive overload (Price, Tewksbury, & Powers, 1997). Inadequate messages in both information flows could result in wrongful or non-efficient usage of resources. Studies of media constructivism teach us that biased information input could induce problematic consequences (Price, Tewksbury, & Powers, 1997; Udeze & Uzuegbunam, 2013; Vallone, Ross, & Lepper, 1985). People make judgements based

on the information available. In extreme forms of framing, media carefully select pieces of information which provides a distorted view of reality. Since this research focusses on crisis management, actors that share information are on the same sides. Intended biases are not at stake, but the example illustrated a prominent takeaway for sharing information. The theory put forward how important it is to share accurate and critical information in the network. The process of decision-making is based on a balance of interest, facilitated by the information available (Kapucu & Ustun, 2017). As discussed before, this information is often incomplete or contradictory. Information sharing, therefore, provides actual guidelines to decision-makers on how to react to life-threatening situations (Kapucu, 2006; Uitdewilligen & Waller, 2018; Waring, Humann, & Dawson, 2019).

2.4.2 Barriers and facilitators of information sharing in crisis management

As discussed in this research earlier, many factors inhibit or facilitate information sharing. Most literature on this particular topic identifies these factors as two contradictory terms. Barriers could have different meanings in different contexts. In terms of industrial safety, barriers concern the attendance of one or multiple safety systems that minimize the risk of hazards to evolve into incidents (Janssens, Talarico, Reniers, & Sörensen, 2015). In this study, barriers entail a more negative load. The research will use the definition held by the study of Gilja (2013), in which barriers indicate obstacles that hinder positive and desirable information sharing. Facilitators, on the other hand, denote supportive elements that contribute to the achievement of adequate information sharing. To clarify, the consideration of categorizing a factor as a barrier or facilitator changes due to its presence of absence in a particular case (Berchtold et al., 2020).

To structure this section into clear categories without randomly presenting all types of barriers and facilitators, a framework put forward by Waring, Humann and Dawson (2019) will be leading. This division of main categories will also return in the analysis in order to break down the cases structurally. Each paragraph will briefly outline why this independent variable is both relevant and significant for information sharing. Although Waring, Humann and Dawson classified the main overarching factors, the empirical findings and general thoughts only shape the core. Findings of other researchers enable further verification, justification and generalization.

To clarify the demarcation and meaning of the causal factors ‘collaboration’ and ‘communication,’ the researcher changed this into ‘alignment of procedures’ and ‘inter-organizational contact.’ Lastly, each core factor ends with hypotheses about the causal factor derived from the literature.

2.4.2.1 Co-location

Waring, Humann and Dawson evaluated a large-scale international exercise, and established a team of 131 evaluating practitioners on the sideline. Analysis of the empirical findings made clear that "being physically assembled in a single location was important for improving the exchange of information" (2019, p. 14). In crisis management centres, operational leaders share information on pre-arranged times to make sense of the situation and make decisions. The presence of multi-disciplinary briefings for actors involved also promotes information sharing (Waring, Humann, & Dawson, 2019). The centres are usually specially made for crisis management purposes and possess many technological applications in order to increase the effectiveness of the meetings (Bram & Vestergern, 2011). Appropriate centres reside enough space for actors that should attend the meetings and lower potential noise of the incident, if applicable.

However, utilizing regular meetings in fancy locations is not inherently equal to success. Researchers stated that the attendance of key figures was vital for effective information sharing and that over attendance of representatives could hinder conversations. Furthermore, not every partner that belongs to the management team has to attend every meeting. Practitioners in Waring, Humann and Dawson (2019) their evaluation stated that some individuals irrelevant for the topic interfered with the discussion. Having the most comprehensive team with many specializations does not improve the quality of each meeting.

H1: Having appropriate circumstances to physically meet and discuss crisis management activities promotes the information sharing. These circumstances arise from individual inputs and physical surroundings.

2.4.2.2 Role knowledge

The preceding paragraph ended by concluding that not every party is necessary for each meeting. A factor that strongly relates to this observation is role knowledge. According to Waring, Humann and Dawson (2019), clearly defined roles and awareness of the responsibilities of others improve the information sharing. The researchers explain this observation by stating that actors with appropriate role knowledge have shorter communication lines. Therefore, the actor needs less effort to get in contact with the right person for the information it belongs to. Additionally, actors receive the information they need to fulfil their tasks effectively (Kapucu, Arslan, & Demiroz, 2010). This puts less strain on the overall information exchange.

As discussed in this paper before, crisis management encompasses various scenarios which each involve a unique set of collaborative actors. Functional diversity, therefore, finds a connection with role knowledge. The traditional emergency services work together in everyday incidents. Luckily, events that disrupt vital infrastructure and demand critical decision-making occur less often. This entails that the infrequency of unique events create less familiarity with the unique set of actors it demands (Waring, Humann, & Dawson, 2019).

Although each actor has its own roles and responsibilities appointed by law, the complexity of crisis could cause inter-organizational haziness. For example, the fire department is accountable for extinguishing fires. However, the addition of parties from national ministries when the administrative level rises usually change the distribution of tasks among actors involved from the first moment (Treurniet, Wolbers, & Van Buul-Wesseling, 2012). Additionally, since involvement of the national level is the norm in transboundary crises, different organizational structures could collide. Schraagen, Huis in 't Veld and De Koning (2010) conducted an experimental study to expose differences between network teams and hierarchical organizations. They concluded that network structures need significantly less time to come to a critical decision in crisis management. The researchers found an explanation in the observation that it took time to get the consideration upwards. Hierarchical teams lose most of their time in waiting for a response of their key leader, high up in the organizational chain. Translating this to barriers or facilitators, it is not a surprise that understanding the background of collaborative organizations benefit the information sharing.

Lastly, a case study conducted by Gilja (2013) found that actors were not always aware of the importance of sharing particular information. Actors that were responsible for measuring toxic gasses and examination of the dangers of fire did not adequately inform other actors. More specific, paramedics on scene need information immediately when the fire department observe emerging hazards. In that way, collaborative actors need input from other specializations to carry out their individual tasks more effectively and even more important: safely (Bharosa, Lee, & Janssen, 2009; Fischer, Posegga, & Fischbach, 2016).

H2: An adequate level of role knowledge in the network strengthens the connection between the offer for- and needs of information to achieve intra- and inter-organizational goals.

2.4.2.3 Alignment of procedures

In crisis management networks, aligning procedures with other actors is part of the collaborative relationship. Although partners have their own roles and responsibilities, their common goal is to bring the situation back to a normal state (Pipek, Liu, & Kerne, 2014). Moerschell and Novak (2019) use the following working definition of alignment: "Alignment is achieved when each part of the system, actor or event, is synchronized with the whole system" (p. 31). In crisis management terms, alignment concerns whether actors accurately decided on the best adopted comprehensive approach to tackle the crisis. For example, a set of multi-sectoral actors could take a uniform crisis communication strategy. In a broader sense, alignment does not necessarily indicate that actors perform all activities in an equal manner. Actors could also mutually align their own procedures with collaborative actors to improve the collective response (Uitdewilligen & Waller, 2018).

Waring, Humann and Dawson (2019) noticed two tendencies in their evaluation report. First, crisis management actors actively seek contact from the beginning. The actors seemed to be motivated to handle the many hazards and priorities of the train accident collectively. The contradictory variation

is known as organizational silos; actors working almost independently, focused on individual tasks. Bharosa, Lee and Janssen (2009) acknowledged the observation of organizational silos as a significant barrier to inter-agency communication sharing. According to the researchers, these organizations lack "the incentives for horizontal information sharing" (2009, p. 52).

To conclude, alignment is often about motivation (Waring, Humann, & Dawson, 2019). Actors actively have to feel the urge to align their procedures and take a holistic approach.

H3: A high degree of alignment enables a deliberate response, which benefits the information sharing through convergence. .

2.4.2.4 Inter-organizational contact

In complex crises with many affected, information flows accumulate to keep all parties up-to-date (Bharosa, Lee, & Janssen, 2009). As one might expect, processing considerable amounts of data takes time and effort. In terms of inter-organizational contact, Waring, Humann and Dawson (2019) focus on the way information gets shared. Before even thinking of the content of information, the establishment of communication lines itself deserves a first rank role as barrier or facilitator. In various man-made or natural crises of the past, pre-determined technological devices that enabled emergency communication did not work correctly. Kapucu (2006) showed that inter-agency communication was nearly impossible during the 9/11 terror attacks. The communications antenna on top of the North Tower caused trouble after the plane hit the tower (Simon & Teperman, 2001). Such inauspicious collateral damage could result in an outage, which also occurred during hurricane Katrina (Dilmaghani & Rao, 2008; Fischer, Posegga, & Fischbach, 2016). Gilja (2013) noticed issues with technological capacity due to high strain on frequencies in a Norwegian case. Especially the unique kind and extent that transboundary crises usually entail forms a breeding ground for network congestion. Limited reachability then stems from technological shortcomings or organizational overload. This observation might be an obvious finding, but reachability due to fragile systems or understaffing drastically affects the information sharing (Gilja, 2013).

In terms of the content in information flows, one of the barriers actors might face is information overload (Fischer, Posegga, & Fischbach, 2016). In order to minimize this phenomenon, organizations should carefully take care of the workload and set up auxiliary systems to increase situational oversight. However, reducing cognitive overload starts at the side of the messenger (Waring, Humann, & Dawson, 2019). In order to anticipate on our limited capacity to process information, receiving information that is precise and relevant lessens information overload (Bharosa, Lee, & Janssen, 2009). In other words, organizations should try to rule out all the irrelevant noise. Like other factors, this barrier is related to appropriate role knowledge among actors. Clearly defined roles and responsibilities provide insight into which information a particular collaborative partner needs.

Furthermore, information sharing between actors runs more fluidly when parties limit the use of non-shared terminology (Waring, Humann, & Dawson, 2019). Teams from different disciplines or

geographical origin develop their own internal language. As one might expect, individuals have to keep in mind that they align the use of professional language with the responder. Non-adapted terminology in communication results in unnecessary feedback loops for clarification, wrongful interpretation or underutilization (Gilja, 2013; Waring, Humann, & Dawson, 2019). Waring, Humann and Dawson (2019) describe two types of terminology biases. The first variation stems from information asymmetry in specific knowledge, where actors use words or abbreviations that are not familiar to another actor. The second type concerns expressions or abbreviations that have different meanings in different organizations (Gilja, 2013). This type might even be more dangerous since they can sneak in unnoticed (Gilja, 2013).

H4: Low reachability of inter-organizational actors inhibits the information sharing.

H5: Information overload acts as a barrier in information sharing, since it keeps delivered information underutilized or could cause misinterpretation of information.

H6: Using discipline-based terminology could negatively affect the inter-organizational information sharing, since it triggers additional information flows for clarification or causes wrongful interpretation..

2.4.2.5 Technology & tools

Waring, Humann and Dawson (2019) demarcate technology and tools as two separate facilitators. Technological systems that enable inter-organizational communication in the first place belong to technology. When it comes to tools, the researchers speak of objects or adjustments that support the technological systems. To illustrate, specially designed colour tabs, whiteboards or automatic translators in multi-language collaborations belong to tools.

Technology plays a crucial role in sense-making, taking account of the unpredictable and sometimes rapidly evolving character of crises (Bharosa, Lee, & Janssen, 2009; Pipek, Liu, & Kerne, 2014). Many technological improvements facilitate emergency services nowadays through databases that provide situational oversight in both images and written words (Kapucu, 2006). Dutch firefighters even use live-streamed drone footage to adapt operational strategies from the local command centre (Brandweer Nederland, 2019).

In order to exchange information effectively across organizations, actors benefit significantly from a central technological system (Fischer, Posegga, & Fischbach, 2016). Kapucu (2006) defines this facilitator as interoperability. A high degree of interoperability implies that actors from different sectors and disciplines aim to align the technological instruments. Relating this to the example of 9/11, police officers had a hard time communicating with the fire brigade since their tools were not compatible, regardless of the outage. Kapucu (2006) concluded that the motivation to share information was there, but the technological instruments fell short.

Having interoperable technological systems is only the first step in connecting transboundary network actors. Limited necessary skills could form a significant barrier in information sharing (Fischer, Posegga, & Fischbach, 2016). Gilja (2013) stated that actors that use specific technological means rarely, often face issues with operating the prescribed devices. Stressful situations act as a catheter when actors find out devices work not as they thought. Besides, the most stressful stages in crisis management usually demand the most information sharing to support critical decision-making. Berchtold et al. (2020) proposed to incorporate crisis management tools in everyday operations in order to get familiar when crisis strikes. Related to appropriate skills, actors also have to be motived to use the invented systems (Dilmaghani & Rao, 2008; Fischer, Posegga, & Fischbach, 2016). Berchtold et al. (2020) found that many participants in their research preferred traditional phone calls and that specially designed systems only had a minor facilitating role. Bharosa, Lee, and Janssen (2009) interviewed Dutch crisis management leaders and asked why they ignored the technological systems. The leaders used the traditional paper map because they had some negative experiences with the implemented technological systems. Therefore, a lack of motivation could arise from a lack of trust in the system. In this context, rejection of the system does not implicate that it always affects the crisis management operation negatively. The same as for collaboration, also the use of technological systems could both be seen as a structure and a mindset that has to correspond (Kapucu, Arslan, & Demiroz, 2010).

Unwillingness to share information by technological devices could also arise from political restrictions or potential blaming since data-sharing is trackable (Fischer, Posegga, & Fischbach, 2016). Berchtold et al. (2020) argue that laws or inter-agency procedures could restrict information sharing; think of judicial information of terrorist that might be of interest for collaborative actors (Navarrete, Gil-Garcia, Mellouli, Pardo, & Scholl, 2010).

H7: Having interoperable technological systems promotes the inter-organizational information sharing.

H8: Limited skills with interoperable technological systems act as a barrier in information sharing, as well as low motivation to use the devices properly.

3. Method

In this particular study, the examination of barriers and facilitators found in literature aims to expose why the information sharing did differ in the Chemie-Pack and MSC Zoe case. By consulting evaluation reports and conducting semi-structured interviews, the researcher tries to form a sufficient answer. After the assessment of the scientific positioning in methodology and case selection, this section moves on to adopted data analysis and data collection. The operationalization translates the last part of the theory section into applicable methodology, specifically designed for this research. Lastly, the limitation section describes its implications for validity and reliability. Furthermore, it provides alternative explanations out of the scope of the taken approach.

3.1 Overall research design

The starting point of this methodology section is to examine its embeddedness in methodical literature. Section 3.1 aims to provide an outline of the overall research design. This part of the methodology argues why this research shapes the form of a comparative case study design and how the case selection process unfolded. The latter includes why Chemie-Pack and MSC Zoe remained as suitable cases taking account of the composed scope conditions. Furthermore, the case selection elaborates on the selection of actors from the functional chain.

3.1.1 Comparative case study and research goal

Since this study aims to compare multiple cases, a comparative case study design applies. As a theoretical legitimation, this study tries to establish an in-depth analysis of both cases and scrutinize similarities and differences in similar empirical phenomena (Rohlfing, 2012). The research matches the conceptualization of Rohlfing, since it encompasses the empirical analysis of a small-N set of non-controllable events from the same population.

Since the second case has been selected based on theory (positively perceived information sharing), this research comes closest to a most-likely case study design (Levy, 2008; Rohlfing, 2012). In most likely-cases, expectations about the probable results match with the general theory found in the literature. According to Levy (2008, p. 12), most-likely case studies "can be useful for testing certain types of theoretical arguments." Furthermore, concrete findings that reject the theory-based hypotheses could do damage to state of the art literature. In this particular study, barriers and facilitators derived from both international and multi-sectoral studies shape the core of the independent variables. In this way, it aims to fit the context of both researched crises as good as possible: an interregional response that included actors from another governmental chain. Namely, the set of independent variables take care of both geographical and functional boundaries (Ansell, Boin, & Keller, 2010). The most-likely cases have a high probability of confirming the hypotheses drawn, which leads to further verification of the theory. There is no research found on this specific selection of cases and the theoretical assumptions

they share. The little research on barriers and facilitators in Dutch crisis management do not cross both geographical barriers and functional barriers. For example, the study of Bharosa, Lee and Janssen (2009) limits to the multi-disciplinary performance of traditional emergency services. Although this crosses some functional barriers, it occurs in a relatively narrow sense.

However, the objective of this research is not to verify an existing framework but to shed light on what barriers and facilitators differ in these two prominent cases. Although the actual goal is not to test or evaluate the theoretical framework, it comes close to a 'testing hypothesis' research goal (Rohlfing, 2012). Namely, the results generated in the study will secondarily accept or reject the theoretical assumptions of mechanisms being a barrier or facilitator. The general aim of this research is to give a clear overview in which way causal factors differed between Chemie-Pack and MSC Zoe. Furthermore, it could expose whether Safety Region learned from the negative evaluation of Chemie-Pack.

In case it turns out respondents at Safety Region Fryslan are very negative about the information sharing during MSC Zoe and disagree with the IFV, it would not impact the answer to the research question. It still provides the reader with an overview of similarities and differences in the information sharing of the Chemie-Pack and MSC Zoe crisis response.

3.1.2 Case selection

In order to answer the research question, the research question already indicates the first scope condition to establish the pool of cases. Since this research focuses on crises which involved multiple Safety Regions, the administrative level of escalation had to reach a certain degree. In Dutch crisis management, incidents minimally escalate to administrative level GRIP-4 to actively involve multiple Safety Regions in most cases (Ministry of Security and Justice, 2010). GRIP is a uniform set of crisis management procedures for services embedded in the Dutch general chain (Institute for Safety, 2017[a]). In everyday operations, the general chain consists of the police, fire department and medicals services. In the Netherlands, the police operate nationally, and the 25 Safety Regions take care of appointed fire department and medicals services tasks regionally (Gemeente Moerdijk, 2014). For these actors, GRIP provides a consistent framework when incidents demand a particular degree of administrative coordination (VRFryslan, 2018). GRIP-0 is the lowest level and represents a state of relative normalcy. Throughout all levels, various multi-disciplinary teams take the lead to perform all types of operational and strategic crisis management tasks (Institute for Safety, 2017[b]). Till GRIP-3, the major is responsible. In GRIP-4, events have a supra-local appearance, although the motivation to move on to GRIP-4 could also derive from a need for additional administrative clout (Ministry of Security and Justice, 2010). Moreover, the responsibility goes from the major to the chairman of the responsible Safety Region. In the light of this essay, GRIP-5 is an interesting notion. The discussion on this subject will follow in the analysis since it relates to the selected cases. Appendix B describes the GRIP structures that will return in the analysis.

The Institute for Safety (2017[c]) composed a list of GRIP-4 cases in 2017. Together with manually added cases after 2017, the left column in figure 2 sums up the cases that are compatible with the first assumption of escalating to a GRIP-4 incident. As stated in the preceding paragraph, GRIP-4 does not necessarily imply interregional effects and organizational involvement. Some incidents reached the level of GRIP-4 purely for administrative purposes, but did not exceed supra-local levels or regional boundaries (IFV, 2017[c]). These incidents, such as the social crisis of Fort Oranje, did not participate in the list of contenders. Fort Oranje and others might have reached GRIP-4 status, but did not involve multiple Safety Regions. This is the first scope condition to rule out cases.

Instead of selecting cases from the starting point of a theoretical construct, Chemie-Pack has been the starting point due to personal interest through significant leverage in Dutch crisis management. A positive evaluation after 2011 as a counterweight to Chemie-Pack would legitimize the search for differences, as stated in the research question.

Many other cases could take this position, which resulted in adding more scope conditions to increase the homogeneity of cases (Rohlfing, 2011). Some cases contained core crisis management processes that were not within the capacity of Safety Region. The power outage of 2015 illustrated such an incident. Firefighters did not receive training to fix technological issues of Liander, a national electricity distributor (Inspectie Veiligheid en Justitie, 2015). Firefighters and medics are well-trained and capable of dealing with a broad range of incidents. Still, a power outage should be fixed by specialized mechanics that work for the responsible company.

At last, the possible flood of Groningen in 2012 remained in its stage of preparedness and did not reach an actual hot phase (Van Duin, 2012). The theoretical framework speaks of three stages: pre-crisis, the hot phase and the recovery phase, the aftermath. When threatening situations generate multiple alarming signals, actors could decide to heighten the administrative level in order to be prepared. Other situations that could require this response is the sudden notification of a passenger plane hijacked heading towards the capital, or a combination of heavy weather and weakened dykes. However, when the potential crisis turns out to be a 'false alarm,' involved actors do not experience the hot phase they were preparing for. Adding this as last scope condition further improves the homogeneity of cases (Rohlfing, 2012).

From the incidents that remained, Chemie-Pack is a well-known crisis with interregional information sharing as a significant problem (IOOV, 2011, p. 21). Researchers from the Institute for Safety praised the communication among interregional actors in the MSC Zoe case (van Nieuwenhuizen Wijbenga, 2019, p. 3; Institute for Safety, 2019[b], p. 81). The process of case selection takes place in figure 2.

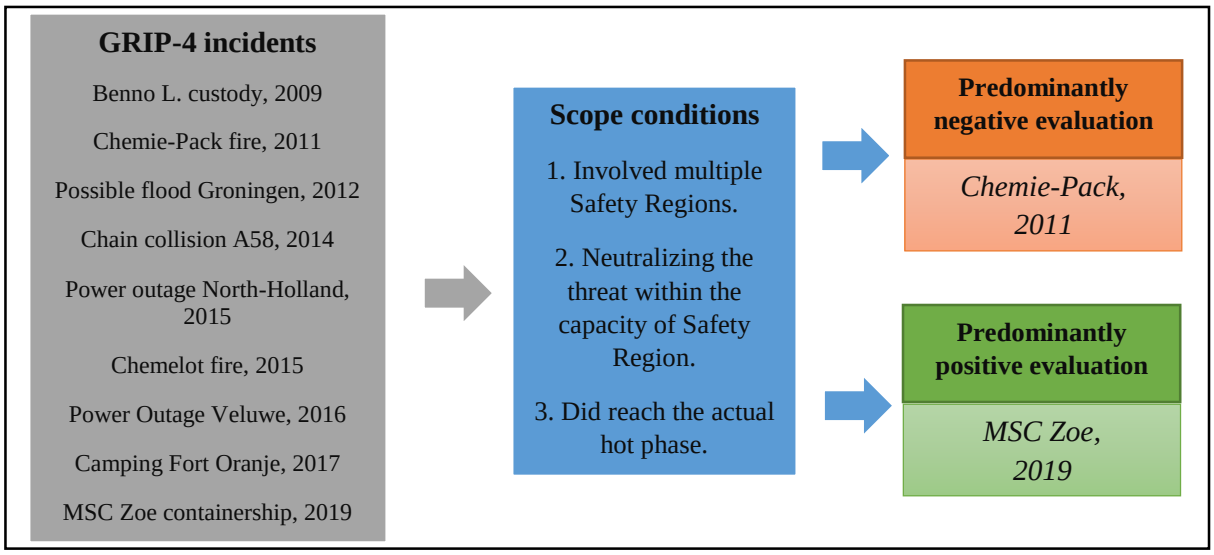

Figure 2: Illustration of the case selection process.

A further justification of case selection occurs through the examination of the case characteristics. By studying both cases thoroughly, a list of similarities and differences provides insight into the degree of homogeneity of this comparative case study. The similarities and differences in table 1 elaborate on the three scope conditions mentioned in figure 2. The case characteristics show that the two cases that are on first eye very different have a lot in common. When it comes to the differences, it deserves attention that some differences in crisis response relate to the independent variables. Obviously, these differences probably return in the analysis or alternative explanations and could be partly explanatory for the different evaluation outcomes. Therefore, there is no need to include these differences in the overview.

Similarities

- *A level of significant media-attention and leverage in the history of Dutch crisis management cases.*

The Dutch ministry stated that Chemie-Pack was a significant crisis in both kind and extent (IOOV, 2011). The involvement of multiple Safety Regions and central organized governmental parties did not often occur (Gemeente Moerdijk, 2014). The massive cloud of smoke caused by the imposing fire, which was about one and a half football field, generated terrifying footage. Moreover, the evaluations initiated clarifications of procedures and workgroups to improve management of comparable incidents in the future (Veiligheidsberaad, 2012).

The pollution that the MSC Zoe caused across the shoreline led to many confronting pictures in the media. The pictures presented a nature reserve on the UNESCO heritage list, transformed into a junkyard (Institute for Safety, 2019[c]). The MSC Zoe container incident illustrated how many organizations can come together and confirmed that also Dutch crises could reach an extraordinary extent.

- *Long remediation aftermath with indemnification*

On-going crisis management decision-making lasted for multiple weeks in both two cases. The long aftermath in cleaning operations and judicial accusations for financial compensation characterize both Chemie-Pack and MSC Zoe. The assembled team responsible for aftercare took over control a few days after the initial fire during the Chemie-Pack crisis (Gemeente Moerdijk, 2011). This team remained active for half a year (IOOV, 2011). GRIP-4 lasted for more than a month in the source region and kept many individuals occupied (Crisisplan, 2011).

Also the GRIP-4 phase of MSC Zoe lasted a month, till Safety Region Fryslan decided to scale down but keep close contact with actors involved about the further salvage of washed-up goods (Institute for Safety, 2019[c]).

- *Inclusion parties from the functional chain, such as BOT-mi and RWS*

In the Netherlands, the crisis management structure globally consists of the general and functional chain. The general chain is responsible for public safety and disaster relief. It holds a decentralized administration. The functional chain has a national organized administration and takes care of vital disciplines, such as public health, water supply and the financial sector (Waterschap Vechtstromen, 2015). Both crises in this study involved multiple actors from the functional chain. As illustrated above, both chains have a different organizational background which could cause implications when the two chains congregate (Dingenouts-Koops, 2017). The evaluations about both crises spent a considerable amount of words on two collaborative actors: BOT-mi in Chemie-Pack and RWS in MSC Zoe.

- *Severe pollution/ecological consequences*

In both cases, the environmental damage done by the crisis itself was significant. When the fire department finally extinguished the fire in the Chemie-Pack crisis, the water used for controlling the hazards turned out to have caused severe consequences (Gemeente Moerdijk, 2014). Whether to use water to cool down the explosive containers was one of the main dilemmas in this crisis (Omroep Brabant, 2011). The contaminated water filled the internal sewer of the company completely, so the chemicals mixed with water seep into surrounded canals. Furthermore, the fire itself obviously caused severe air pollution.

Volunteers, the military and many other actors had to clean the beaches, after the 342 containers filled with end-products and raw materials fell off the MSC Zoe in heavy weather. Besides the unknown damage done to the North Sea, small plastic pellets are still there across the dunes of the affected areas (Institute for Safety, 2019[c]; Van Poppel, 2019).

Differences and their rejection

- Chemical fire versus container loss.

The first difference might be perceived as the most significant difference between both cases. However, crisis management could be traced back to a few fundamental pillars that remain the same throughout diverse crises (Mikušová & Horváthová, 2019). The Institute for Safety (2019[s]) acknowledges that no crisis is the same and each significant crisis has its unique conditions. Therefore, there is no reason to disapprove this comparison based on its kind.

- Extensive deployment of traditional emergency services on scene in Chemie-Pack

As opposed to MSC Zoe, the chemical fire in the Chemie-Pack case inevitably led to extensive deployment of emergency services on the accident site. However, the units on scene receive instructions from their commanders. The supervisory individuals and teams on strategic and operational level were the actors that had to establish inter-organizational communications. Since the same supervisory teams were in place during MSC Zoe, this difference does not reject the comparison.

Table 1: Similarities and differences in the selected cases

To clarify, this research focuses on collaboration in interregional crises, where the involvement of multiple Safety Regions is only part of the selection criteria. However, it does not exclude organizational actors that played a significant role in this collaboration. Researching parties such as Rijkswaterstaat and BOT-mi could provide additional insights into the extraordinary dynamics of interregional crisis collaboration. Ansell, Boin and Keller (2010) stated that one of the dimensions of transboundary crises encompasses the functional boundaries. Including an actor from the functional chain in the analysis could illustrate which barriers and facilitators occur when parties with a 'different' background take place on the table. Furthermore, many barriers and facilitators found in inter-team responses on both multi-disciplinary or international level do not perfectly fit the Safety Regions. In the prominent research of Waring, Humann and Dawson (2019), the researchers investigate barriers and facilitators of information sharing between multi-disciplinary teams of multiple countries on the intra-organizational level. Although there are multiple Regions involved in each incident, the operational and strategic teams are part of the same overarching organization. Therefore, they adopted the same nationally implemented means and organizational structures. Lots of causal factors on interoperability of systems would then not be applicable. Adding an actor from the functional chain makes the analytical framework more applicable, while still being realistic. In other words, both Rijkswaterstaat and BOT-mi are part of the comparison to create the 'foreigner' dynamics that would probably generate noteworthy insights into these transboundary crises. The assumption that Rijkswaterstaat and BOT-mi played a significant role as collaborative actor stems from the amount of evaluative information available and commitments of key documents.

Rijkswaterstaat played a prominent role in crisis management during the MSC Zoe crisis (Institute for Safety, 2019[c]). Furthermore, the evaluative organization argued that collaboration between the general and functional chain was inevitable, specifically the relation between Safety Region Fryslan and Rijkswaterstaat (Institute for Safety, 2019[c], p. 63). In the evaluation conducted for the responsible ministry of Rijkswaterstaat, one of the respondents from Safety Region acknowledged the key role of Rijkswaterstaat in this incident (Institute for Safety, 2019[b]).

BOT-mi was responsible for providing advice about hazardous substances during the Chemie-Pack crisis (RIVM, 2013). This advice was of utmost importance for crisis communication and well-being of emergency services personnel (IOOV, 2011; RIVM, 2013). The Dutch ministry for public health considered BOT-mi as central government actor in fulfilling this task during Chemie-Pack (RIVM, 2013, p. 19). Out of all involved actors besides Safety Region, this organization from the functional chain was often mentioned in the reports. To relate this choice to the other crisis, Rijkswaterstaat had a way less prominent role in the evaluations available and deserved little attention.

The analytical framework will elaborate more on both the tasks appointed by law and relationship with Safety Region.

3.2 Data analysis

After selecting the cases and actors of interest carefully, the data analysis outlines the processing of gathered data. This approach is twofold and consists of content analysis and process tracing. The selected methods serve a different purpose. Content analysis, on the one hand, provides guidelines for the gathering and processing of data in general. Process tracing, on the other hand, gives direction to the structuring of the conceptualization and analysis.

3.2.1 Content analysis

By utilizing a content analysis approach, the researcher aims to identify contextual pieces of information, using a set of specifically designed features. According to Krippendorff (2004, p. 20): “It implies that content is contained in messages, waiting to be separated from its form and described.” Instead of reading relevant texts in a usual manner, the researcher tries to pick up certain signals that point in a particular direction. Relating different categorizations to this study, the research question demands a problem-solving analysis (Krippendorff, 2004). In problem-solving content analysis usually stems from formulating an answer to real-world issues. The researcher aims to solve a particular research question, and assumes a critical analysis of relevant qualitative sources will provide answers into the subject matter (Krippendorff, 2004). Data that provides evidence for assumed correlations between potential independent variables and the outcome obtain a high priority in the analysis. To make sense of the enormous amount of information that contains critical and supportive evidence, the researcher should take a certain strategy to make it manageable.

Krippendorff (2004) put forward a conceptual framework to structure a case analysis that adopts a content analysis approach. The sources of data in this research include high-quality government evaluations and interviews with knowledgeable individuals. In this way, the context of information is in accordance with the proposed research question in terms of purpose. Both the evaluations and this particular study aim to evaluate a certain performance from an independent perspective. Second, the research question itself aligns with a problem-solving approach, which is one of the suitable content analysis approaches (Krippendorff, 2004). Third, an analytical construct that assumes a degree of knowledge about the phenomenon of interest generates factors that could contribute to a suitable answer. Fourth, the operationalization of the analytical constructs provides the researcher with indicators. Krippendorff (2004) regards these indicators as inferences, since they confirm a piece of the analytical constructs. This helps the researcher to come to his conclusion. The last element concerns validation. The assessment of information and interpretations could be a dangerous process. Validation through verifying the findings in interviews could correct for interpretation biases of the researcher.

What remains is the exact approach adopted to distinguish and categorize the valuable pieces of evidence from the less relevant information. Taking the different causal factors and the specific operationalization of appendix A in mind, the aim is to carefully select words, phrases and themes that belong to one of these categories (Prior, 2014). Selection of this information occurs through a process called coding. For the reports, the researcher composed a comprehensive Word-file that contained all relevant information, colour-coded for each author. In this way, the analysis of each new source of information that provided additional insights contributed to the analysis. In terms of interviews, computer program Inqscribe assisted with the transcription of the interviews. Together, this resulted in many opinions and events that reflect in which way a causal factor its presence or absence affected the outcome. The sum of categorized information forms a coherent or incoherent pattern, that directly led to the conclusion.

3.2.2 Process tracing

In order to illustrate how barriers and facilitators affect the outcome, process tracing could be an excellent tool to get this structured and more tangible. Composing a set of independent variables to break down the information sharing seems analytically valid for process tracing. According to Blatter and Haverland (2012), process tracing could be an excellent tool in small-n studies to trace the causal processes that led to a particular outcome. This outcome already presents itself in the evaluation documents as a more general answer to whether the information sharing was sufficient. Blatter and Haverland (2012) distinguish three types to illustrate the way causal factors affect an outcome. The causal sequence applies when the researcher aims to map out the historical sequence of a particular topic. The causal mechanism, not to confuse with the general application of the word ‘mechanism,’ provides an insight into micro-macro relations. Lastly, the causal conjunction functions as a set of independent variables that should theoretically be explanatory for the outcome. The latter is best

applicable to this research and unfolds in figure 3. The proposed barriers and facilitators are different, but still interrelated, causal factors that affect information sharing.

Process tracing literature provides various tools to analyze the data gathered systematically. The notion of analyzing two storylines within a case from a different lens had been the original approach in the study. Blatter and Haverland (2012) advise writing a precise case narrative with proper depth to examine all relevant events within the case. This comprehensive overview should give insight into structural aspects and the critical moments of the case over time. The narrative has to clearly illustrate the transformation process throughout the case and expose which events were responsible for this transformation. The second analysis shed light on the narrative from an analytical point of view in terms of the assumed causal factors. In this section, the researcher tries to identify empirical evidence to support the causal factors and try to reach a satisfactory explanatory outcome. In this particular study, this would concern the overview of identified barriers and facilitators in relation to the positive or negative evaluation. Since this type of process tracing is not necessarily interested in writing down the case in terms of describing each minute, the case narrative implies a brief composition of considerable events and how the incidents evolved overtime.

Since the study tries to trace down the causal mechanisms in both cases as part of causal inference, the case study itself belongs to a within-case level of analysis (Blatter & Haverland, 2012). The purpose is to draw lines between these actors and identify why the information got stuck or resulted in wrongful interpretation. Connecting both cases by revising differences and similarities is, however, a cross-case strategy (Blatter & Haverland, 2012; Goertz & Mahoney, 2012). Due to the COVID-19 crisis, one of the obstacles was to achieve enough depth to comply with process tracing standards; being sufficiently explanatory. Although the MSC Zoe case lacked data to examine the presence of multiple barriers or facilitators, the addition of interviews contributed to fill the gap in accessible data.

3.3 Conceptual model and operationalization

As discussed in the overall research design, the analysis of both cases will be twofold. After writing the case narrative with an eye on the research question, the analysis that follows is interested in the application of the analytical framework. By consulting the literature, multiple causal factors suggest having an impact on information sharing. The mechanisms, therefore, affect information flows positively or negatively that should have reached the receiver, reached the receiver 'successfully,' or reached the receiver but with critical side notes for understandability.

The selected barriers and facilitators will be briefly explained and guide the researcher in its analysis as an analytical framework. This framework had to fulfil the requirements of taking account for dealing with transboundary actors. Waring, Humann and Dawson (2019) presented five typical barriers and facilitators, which they applied to an inter-team response in an EU-funded crisis management exercise. The generable factors, as described by Waring, Humann and Dawson (2019), played a central

role in analyzing the information sharing of crisis management actors from different disciplines and countries. Although this study focusses on both geographic- and functional transboundary crisis, most barriers and facilitators also apply to 'lower levels.'

Since using all mechanisms found in the literature on information sharing is not feasible and practical, the researcher focused on five primary causal factors that were prominently identified as barriers or facilitators by researchers (Bharosa, Lee, & Janssen, 2009; Kapucu, 2006; Waring, Humann, & Dawson, 2019). Leshem and Trafford (2007) stated that it is common to narrow down the focus to a few variables, which represent considerable theoretical relevance. The analysis needs a proper depth which cannot take shape if dozens of mechanisms add to the conceptual framework.

The mechanisms needed to be appropriately specified and verified by multiple authors. The analytical framework is complemented specifically for Dutch performances with findings from Bharosa, Lee and Janssen (2009). The researchers revised obstacles in multi-agency emergency responses by using the current literature available, and conducted an empirical study on a Dutch emergency response case in Rotterdam. It sounds reasonable to support the operationalization of Waring, Humann and Dawson (2019) their constructed framework. After all, the findings of Bharosa, Lee and Janssen (2009) result from a Dutch case with a Dutch crisis management structure involved. Furthermore, Kapucu (2006) wrote on challenges crisis management actors faced during 9/11. Most issues concern multi-agency barriers that stem from IT interoperability issues, degree of collaboration and in obstacles caused by limited reachability of actors.

The causal factors as proposed by Waring, Humann and Dawson (2019) could be both seen as barriers or facilitators since the theory describes them as relatively neutral causal factors (Berchtold et al., 2020). Not necessarily the presence or absence determines to be a facilitator or barrier for all factors. Figure 3 illustrates the relevant mechanisms that have been extracted from Waring, Humann and Dawson their analytical framework supported by empirical evidence (2019). Moreover, it demonstrates the assumed relationship between the independent variables and the dependent variable. The outcome consists of positive and negative effects that relate to information sharing. For example, the barriers presented can cause misinterpretation, delay or nuisance (Choo et al., 2006; Waring, Humann, & Dawson, 2019). Figure 3 represents a causal conjunction, as supported and legitimized by process tracing literature (Blatter & Haverland, 2012).

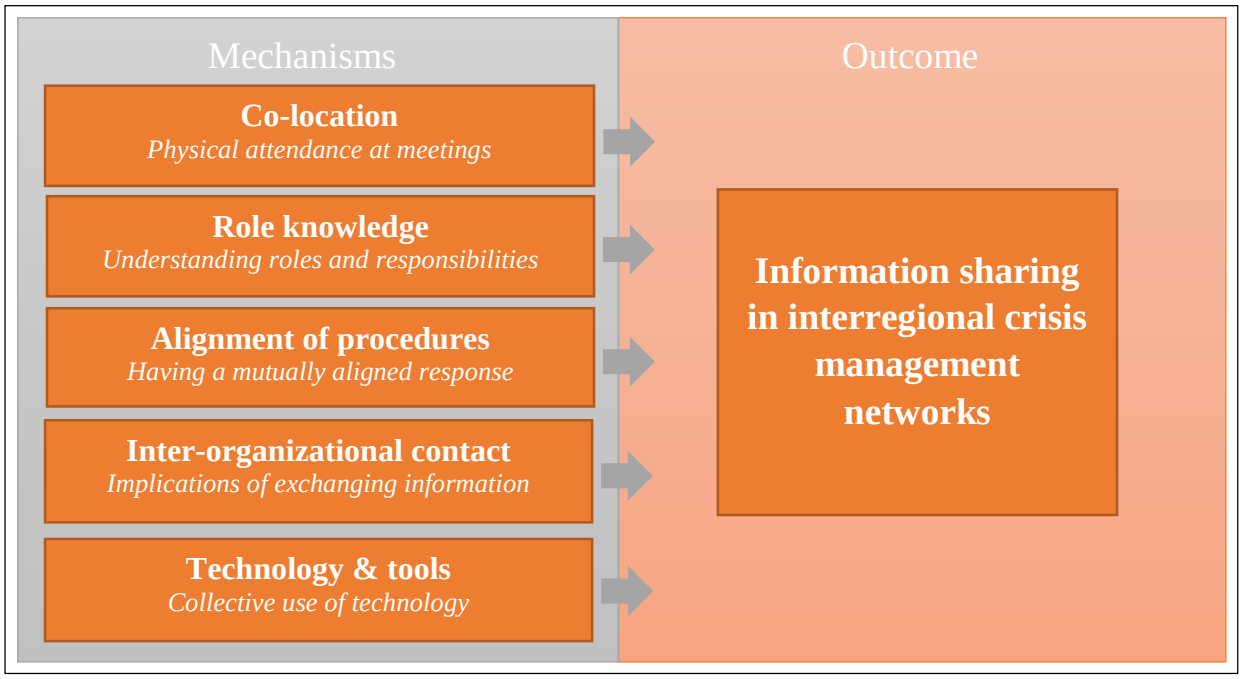

Figure 3: Overview of the selected independent variables and the dependent variable.

Since these transboundary barriers and facilitators of inter-organizational relationships are not directly applicable to the selected cases, they need further specification. Table 2 outlines the operationalization of the five causal factors. The left column includes the widely applicable factors, as proposed by Waring, Humann and Dawson, 2019. The right column presents the operationalization of causal factors; indicators that show to which extent a barrier or facilitator was present. Appendix A further describes observable indicators that can guide the researcher in content analysis.

Causal factor as part of the conjunction (Waring, Humann, & Dawson, 2019)	**Operationalization / how to measure?** Based on the literature, the indicators in this column are related to the independent variables (Bharosa, Lee, & Janssen, 2009; Waring, Humann, & Dawson, 2019). Appendix A provides an elaboration.
Co-location [1]	**Physical attendance of key figures at meetings**[1] - The attendance of liaisons, sent by collaborative Regions or vital organizations such as BOT-mi or RWS. **Over attendance of irrelevant figures at meetings**[1] - Disciplines being overrepresented or attendance of 'irrelevant' parties that could distract the meetings from its actual purpose. **Appropriate circumstances to have a meeting**[1] - Noisy or too small rooms could hinder the information sharing.
Role Knowledge [1]	**Be aware of each other's roles and their background** [1/2] - Proper understanding of the capabilities of collaborative actors. - Sharing information that could be of interest for collaborative actors. This is also linked to collaboration, but specifically associates with evidence that explicitly relates to clear or unclear roles in the network.

Alignment of procedures [1]	**Having a mutually aligned response** [1/2] - Overall awareness of the appropriate level of emergency (GRIP).[2] - Alignment in crisis communication.[1]
Inter-organizational contact [1]	**Reachability** [2/3] - Reachability of actors that stems from workload or failures. **Information overload** [2] - Individual actors stating that collaborative partners uploaded too much information to portals, which made it hard to distil what was relevant and important. **Understandable terminology** [1] - Actors from other disciplines that made use of professional terms that are unfamiliar to other actors.
Technology & Tools [1]	**Degree of interoperability** [2] - The degree to which actors made use of the same tools (LCMS, right composition of Whatsapp-groups). **Familiarity with technological systems** [2] - Individuals that indicate a) they never worked with the tools; b) they did not see its benefits; c) they did not properly fill the system with information.

[1] = Derived from Waring, Humann and Dawson (2019). *Table 2: Operationalization table.*
[2] = Derived from and supported by Bharosa, Lee and Janssen (2009).
[3] = Supported by Kapucu (2006).

Some sub-factors are debatable in terms of their actual categorization, since some barriers or facilitators overlap. Waring, Human and Dawson (2019) regarded 'reachability' as a causal factor that belongs to 'communication,' which is 'inter-organizational contact' in this research. Proper reachability enables inter-organizational contact. On the other hand, reachability mostly stems from technology, which is the fifth causal factor. As a rule, the researcher tried to stick to the framework and categorization as proposed by Waring, Human and Dawson (2019), but is aware that particular factors strongly relate to each other.

3.4 Data collection

For this study, the main source of data resulted from written reports and interviews by the organizations that carried out the evaluations. Since both crises reached a GRIP-4 level and led to significant societal impact, multiple evaluations appeared months after the events. The range of evaluations varied from independent government reports to internal evaluations from the actors involved. Furthermore, information from ministries, Safety Region information sheets, governmental letters and news articles contributed to the analysis. Lastly, the exclusive book from the municipality of Moerdijk provided additional insights of key figures involved in the Chemie-Pack fire response.

Social media platform LinkedIn made it possible to find participants for the interviews. Searching relevant names in any related reports generated a list of potential interviewees. Intensive contact with various potential participants resulted in two valuable interviews for the MSC Zoe crisis. During the search for data, it turned out that much information was missing on the specific topic to answer the research question. A possible explanation could relate to the relatively short period till the moment of writing and the overall positive reaction about the incident and its crisis management response. It is more likely incidents that went terribly wrong deserve more attention. When it comes to the interviewees, Sonja de Bruin writes evaluations for Safety Region Fryslan and enabled verification of findings from the reports. Vina Wijkhuijs conducted many interviews to write the main MSC Zoe evaluation and had much inside information about the incident and its consequences for crisis management.

The addition of interviews aims to clarify and tries to bypass the limited capability of data-interpretation from the researcher. To illustrate, the interpretation of written evaluations that certain information got stuck among actors is relatively crystal clear. Other researchers concluded this, hopefully correctly. The problem interpreting reports is the validity of concluding that actors did not share data. A possibility is that RWS did put its findings in LCMS, but Safety Region did not read it. Another scenario could be that it seems like information was not shared, but did reach the targeted actor in another way that had not been documented. Thus, interviews could definitely add value to this research in terms of content and verification. Therefore, both primary and secondary data (Bijleveld, 2015) will contribute to the formulation of a generated answer to the research question.

In selecting information to conduct the analysis, Bijleveld (2015) distinguishes two types of methodological sampling. In probability sampling, each source of information has an equal chance to become unit of analysis. This makes the sample of information representative and therefore generable to a bigger population. In non-probability sampling, it is not needed or practically impossible to select sources of information at random. Both literature, reports and interviews relate to non-probability sampling in this particular study. Specifically, this type of research focusses on purpose sampling, which applies, according to Bijleveld (2015), to studies in which the researcher needs specific key pieces of information that contribute to the answer on the research question. In terms of interviews, the researcher tries to find respondents with the most and comprehensive knowledge about the subject matter. Second, the researches should get the impression that after finishing the last interview, an additional interview would not significantly add to the already established set of gathered information. Bijleveld calls this theoretical validity, which brings us to the last paragraph of the methodology section.

3.5 Limitations: validity, reliability and alternative explanations

Conducting research and the application of methodology involves multiple side notes in terms of validity and reliability. Bijleveld (2015) distinguish multiple types of validity. At first, remarks about the construct validity answer whether the measured constructs are accurate and adequately interpreted.

Reliability is part of the construct validity spectrum and expresses whether observations are accurate. The ´validity of the operationalization´ clarifies these statements since it focusses on whether the researcher measured the right observations to come to an adequate and fitting answer. In that sense, observations could be accurate, but measured the wrong intended unit of analysis. To illustrate this point, a newspaper stating that there are less cannabis production sites, because the police discovered less, is not valid. Although the number might be accurately measured, the decrease in discoveries is not equal to a decrease in existence. To summarize, construct validity concerns whether the findings really reflects the constructs measured.

Besides construct validity, external and internal validity aim to conduct research critically. Regarding internal validity, Bijleveld (2015) argues that causal factors and the outcome also should have a causal relationship. Some relationships could give the impression two variables correlate, better known as a spurious relationship. External validity takes account for the generalization of findings. It questions whether the found results could be related to the bigger picture, outside the researched cases.

In terms of reliability, reports from governmental organizations that act in the public interest could be assumed to present reliable findings. However, preventing blame and media reactions might be an obstacle in reports telling the actual truth. Interviews could provide a more neutral explanation on certain topics. On the other hand, accuracy also stems from the researcher's cognitive capabilities (Krippendorff, 2004). The researcher could overlook important aspects of the case or put too much emphasis on not-important matters (De Bruin, personal communication, April 30, 2020). Interviews with respondents from Safety Region and the IFV helped to verify information about the MSC Zoe crisis response. This process of triangulation intended to increase validity (Blatter & Haverland, 2012).

Applying a pre-established framework to a dataset might exclude variables that in practice had a serious impact on the dependent variable (Bijleveld, 2015). This suggests that this research potentially excluded valuable causal factors, which weakens the answer to the research question. On the other hand, when reading all the reports and conducting the interviews, alternative causal factors with significant impact would possibly appear somewhere. In that case, the researcher would have adjusted its approach if the composed framework did not turn out to fit. Therefore, the ´validity of the operationalization´ is considered appropriate.

In terms of internal validity, the effects of barriers and facilitators on information sharing already perceived theoretical support, based on empirical evidence in other studies. Furthermore, process tracing tries to untangle what actually occurred in a particular case. This should improve internal validity (Blatter & Haverland, 2012). The government reports described step by step what occurred during both crises and aimed to expose the deficiencies and strengths of the crisis response. Knowledgeable sources in written and spoken words explicitly stated the presence of certain causal factors. In combination with the empirically supported correlations between causal factor and outcome, the internal validity is considered appropriate by the researcher.

As a general rule, process tracing literature argues that this method primarily focusses on internal validity and not external validity (Blatter & Haverland, 2012). Still, the consistency of structures in Dutch crisis management could generate a considerable degree of generalization. To clarify, the presence of barriers could be deeply rooted in the contemporary procedures of Safety Region. With an eye on the extremely low frequency of interregional events, and potentially structural crisis management processes, there is a significant chance many barriers will be present in any other similar transboundary cases (Rohlfing, 2012).

Hopefully, the conclusion will give a convincing answer to the research question. Still, it is not possible to say beyond a reasonable doubt that the answers generated in this study provide an irrefutable conclusion. To illustrate, two underlying reasons could cause the difference in information sharing. The first underlying rationale concerns the difference in time between the two crises. Respectively, there is a difference of eight years between both crises. For example, technological means that enable communication greatly improved since the Chemie-Pack crisis. Moreover, many evaluations and studies perceive Chemie-Pack 2011 as a wake-up call in terms of crisis management failures in a complex society (Gemeente Moerdijk, 2014; Van Duin & Wijkhuijs, 2015). A number of mayors dedicated a workgroup to supra-regional collaboration in order to enhance learning (Veiligheidsberaad, 2012). The recommendations and action points concern a few of the independent variables, which strengthen the alternative hypothesis that learning could be an underlying explanation for the difference.

Second, both crises emerged differently with regards to their kind. Alexander (1993) classified two types of disasters: Sudden-impact versus slow-onset. Events with a sudden-impact occur abruptly and provide relatively little time to weigh up all available options and its implications. This might cause stress, overreacting and an immense workload for individuals. A slow-onset is an event that takes more time to unfold, although this does not necessarily imply less impact. According to Alexander (1993), sudden-impact disasters usually account for high-threatening events in terms of (potential) damage and casualties. Slow-onset events often generate an extensive affected area and magnitude. Although Alexander (1993) speaks of a more creeping crisis, which does not apply to MSC Zoe, his classification seems to fit both cases globally.

The circumstances during the Chemie-Pack crisis put extraordinary pressure on crisis management actors as a ticking time bomb. The risks were immense and actors had to act fast to prevent surrounded high-risk facilities from getting involved. As one might expect, this has had consequences for the information sharing. The MSC Zoe container loss, on the contrary, might have produced less acute threatening situations. The situation unfolded on the open sea with less tangible consequences. After the responsible actors informed ships of the danger of collision with floating containers, the main priority was the potential of hazardous containers washed up ashore. This crisis unfolded differently with a different onset, which might be an underlying rationale for overall improvement in the information sharing among transboundary actors.

5. Analysis

Following the structure as proposed in the methodology section, the analysis follows a twofold structure of analyzing the cases. In the first part of each case, a case narrative describes the development of the crises. The selected organizations concern the Safety Regions involved, BOT-mi for Chemie-Pack and Rijkswaterstaat in the MSC Zoe case.

For readers that are not familiar with Dutch crisis management structures, related abbreviations and technological systems, appendix B provides the most important need-to-knows and promotes a proper understanding of the analysis (Institute for Safety, 2017[a]; Gemeente Moerdijk, 2014).

5.1. The storyline of the Chemie-Pack fire of 2011

As an acknowledged high-risk company that worked with dangerous substances, society and authorities might expect from Chemie-Pack to be extremely cautious running their business (The Dutch Safety Board, 2012; Van Duin & Wijkhuijs, 2015). The facility was specialized in the packaging and distribution of chemical products. It was located on industrial area Moerdijk, in Safety Region Midden- and West Brabant (from now on: MWB). On the 10th of January 2011, culpable mistakes caused a disastrous chain of events. An employee attempted to defrost a methane pump using a gas torch (Gemeente Moerdijk, 2014). The sump tray caught fire and lit the storage of goods on the courtyard. Since the permits did not allow Chemie-Pack to do so, the fire emerged out of reach from the automatic extinguishing system (IOOV, 2011). Although the incident did not cause any fatalities, the ecological damage, societal impact and judicial aftermath characterized this crisis for long (Boin, Kuipers, & De Jongh, 2018). Not to forget, the Chemie-Pack crisis led to a stain on many organizations their reputation (Van Duin & Wijkhuijs, 2015).

The dispatch centre received a disturbing call on 14:26 from one of Chemie-Pack's employees that their courtyard was burning (IOOV, 2011). The commander that headed towards the emerging crises adjusted the perception of the incident multiple times and designated GRIP-2, even for his arrival (IOOV, 2011; Omroep Brabant, 2011). As a response, the police, the municipality and GHOR (population health care during incidents) started relevant processes and prepared for the first ROT-meeting. The fire, fueled by liquid chemicals, spread across the terrain which caused other containers to collapse (Omroep Brabant, 2011). The cloud of smoke passed the nearby canal and approached Safety Region Zuid-Holland Zuid (from now on: ZHZ). Operational challenges concerned a 16000-litre container of acetone and the balance of interest to suppress the fire with water, or evacuate and wait for foam extinguishers to arrive (IOOV, 2011; NVBR, 2011; Veiligheidsregio Midden- en West-Brabant, 2011). Water would cause the sewer to flood, but waiting was not an option with the numerous containers and surrounded companies threatened by the fire hazard (Omroep Brabant, 2011). Around midnight, the actors involved decided to deploy the foam extinguishers to create a massive foam blanket to smother the fire. Before deployment of the foam trucks, the fire department had to align with

organizations that take care of crisis communication, shipping lanes, roadblocks and toxic measurements (IOOV, 2011). Ten hours after the first call, the emergency services declared the situation under control. During and after the crisis, many criticized the performance of the actors involved (Klein, 2011). This varied from the flawed crisis communication, poor alignment and inadequate information sharing (Boin, Kuipers, & De Jongh, 2018).

5.2. The storyline of the MSC Zoe container loss of 2019

Heavy weather caused high waves at the North Sea the night of 1 to 2 January, 2019 (Institute for Safety, 2019[b]). At 1:30, the captain of MSC Zoe notified the German coastguard that his ship probably lost multiple containers near the Wadden Islands. At the moment of writing, it is still unclear what caused the container loss. Researchers suggest that the ship took a too shallow route and bumped the bottom during the heavy weather (De Boer, 2019). Three hours after the call, German colleagues informed the Dutch Coastguard, to align with Rijkswaterstaat that ships in Dutch territory might face some bad surprises. It turned out that MSC Zoe lost 342 containers. Shorelines littered with toys, clothes, kitchen devices and car parts and reflected perfectly what unfolded at the Wadden Island (Institute for Safety, 2019[c]).

The morning after the container loss, Safety Region Fryslan decided to designate GRIP-2. At this moment, there was no clarity about the number of containers and how many containers possessed dangerous goods (Institute for Safety, 2019[c]). The Wadden Islands launched the CoWa teams. A specially designed collaboration network of vital organizations operating at the islands that take care of multiple crisis management tasks. Interesting about this incident is that decisions led to upscaling and downscaling in GRIP levels. Eventually, the structure remained GRIP-4 for a month. The administrative team that gets involved in this level, the RBT, aimed to manage multiple facets: recovery of the containers, cleansing of the shoreline, the claim settlement and both societal and ecological impact (Institute for Safety, 2019[c]). A rare crisis management challenge was the number of volunteers that helped to clean up the shoreline (Omrop Fryslan, 2019; Van der Laan & Van Westhreenen, 2019). It goes without saying, that this needed alignment and some type of command and control. The possible presence of washed-up containers with hazardous substances might have caused dangerous situations, taking all the volunteers into account (Van der Laan & Van Westhreenen, 2019). Criticism about this 'incident,' organizations disputed the classification of being a crisis (Institute for Safety, 2019[b]), stems from lack of coordination by the national level and late designation of GRIP-4 (Institute for Safety, 2019[c]; Omrop Fryslan, 2019; Van der Laan & Van Westhreenen, 2019).

5.3 Barriers and facilitators of information sharing in the cases

This section analyzes the discovered barriers and facilitators in the consulted sources. For each independent variable, the analysis discusses both cases separately. After presenting the findings, the final part of each factor aims to compare the cases based on the gathered information. A comprehensive

overview at the end of this section aims to combine the results. Furthermore, it shows whether the findings are in accordance with the hypotheses composed.

The analysis primarily focusses on relations between Safety Regions, and between the Regions and selected functional actor. Still, the dynamics within a particular Region could have significant implications for the bigger picture. Although kept to a minimum, some intra-organizational findings could be of interest.

5.3.1 Co-location

H1: Having appropriate circumstances to physically meet and discuss crisis management activities promotes the information sharing. These circumstances arise from individual inputs and physical surroundings.

5.3.1.1 Chemie-Pack 2011

Since fire commander Martin Kats immediately designated GRIP-2, the establishment of both a CoPI and ROT occurred quickly (Omroep Brabant, 2011). In an office building in Tilburg, the ROT planned to take care of the effect-area (IOOV, 2011). Near the accident site, a specially designed CoPI-container with all kinds of tools intended to coordinate the on-scene response by the multi-disciplinary commanders. The fire department located the CoPI-container near a neighbouring company (Gemeente Moerdijk, 2014). The first CoPI-meeting took place at 15:05 and consisted of the commander from the police, fire department, public health, information manager and CoPI-leader (Brandweer Midden- en West-Brabant, 2011).

One and a half hour after the declaration of GRIP-2 in the less-affected Safety Region Rotterdam-Rijnmond, a commander joined the CoPI at the Moerdijk site to act as a liaison (IOOV; Veiligheidsheidsregio Rotterdam-Rijnmond, 2011). The Region that was directly affected by the cloud of smoke, ZHZ, also sent liaisons to MWB (PricewaterhousCoopers, 2012). Leaders represented ZHZ in the ROT by the deployment of a liaison fire commander. Additionally, The ZHZ-director visited the RBT regularly.

After the designating GRIP-4 in ZHZ, the authority shifted towards the chairman of the Region. The three directly affected mayors were satisfied with their position in the RBT-meetings (PricewaterhouseCoopers, 2012). Since the municipality of Moerdijk maintained the GBT, against GRIP procedures, the director of MWB went to the GBT to act as a liaison and kept contact with Region ZHZ. According to The Dutch Safety Board (2012) and Gemeente Moerdijk (2014), the director's physical attendance significantly increased the relationship and its information sharing between the GBT and RBT.

In this particular crisis, Safety Region MWB decided to designate GRIP-4 again a few days after the initial hot phase (The Dutch Safety Board, 2012). Safety Regions decided to prioritize continuity in the teams, but to be careful with the individual workload. Key figures and liaisons joined the crisis management teams, where their presence was necessary (Gemeente Moerdijk, 2014).

Taking everything into consideration, the reports do not suggest that the absence of intra-agency key figures or liaisons inhibited the information sharing. The affected Safety Regions nearby MWB adequately sent liaisons to the Region where the crisis unfolded initially. The fire commander solved a challenge in maintaining its physical attendance in the CoPI-meetings through improvisation. The fire commander served two functions: as part of the CoPI, and as a commander to coordinate its resources (NVBR, 2011). Since its position in the CoPI demanded much time, the commander instructed an officer to take over some coordination and be his 'eyes and ears' during CoPI meetings (IOOV, 2011).

Furthermore, reports indicate that the meetings also included other teams with a background in the functional chain, or key figures that could be of considerable interest. Throughout the hot phase of the incident, Chemie-Pack's safety coordinator and the Water Board facilitated the operational team with specific knowledge (IOOV, 2011; Van Stokkom & Thijs, 2012).

The IOOV report (2011) indicate that the inter-organizational staff could conduct the meetings in appropriate circumstances. As said, the CoPI-container constructed explicitly for this purpose facilitates the information sharing on both inter- and intra-organizational level. The Policy-teams operated from local offices, which usually possess all kind of tools to facilitate the leaders and coworkers. More specifically related to this case, there were information sharing deficiencies present between the RBT/ROT and GBT at the municipal level (IOOV, 2011). The circumstance of having both Regional teams at the same geographical location contributed to better information sharing between the inter-organizational RBT and ROT within MWB (IOOV, 2011).

5.3.1.2 MSC Zoe 2019

The isolated position of the Wadden Islands impedes the direct mobilization of all kinds of resources and administrative power from the mainland. Therefore, Safety Region Fryslan composed a comprehensive team that would take care of incidents at the Wadden Islands (VRFryslan, 2018). A CoWa-team aims to take care of crisis management the first critical hours on every island (CRW, 2016). The team represents members from the municipality, traditional emergency services and actors from the general chain, such as Rijkswaterstaat (Institute for Safety, 2019[c]). The initial response developed the morning after MSC lost 342 containers at sea. The team of Vlieland, for example, physically gathered all key figures of both general and functional chain at the town hall.

At the same time, Safety Region Fryslan designated GRIP-2. The first ROT-meeting took place at 11:00 at the fire department in Drachten. Since there is no clear accident location, the leader-CoPI joined the ROT (Institute for Safety, 2019[c]). Rijkswaterstaat sent a liaison to take a seat in the ROT. After Fryslan scaled down to GRIP-1, strategic decisions led to the declaration of GRIP-2 again. The mayor of one of the islands decided to act as a central hub for other municipalities. Furthermore, the fire department deployed the CoPI-container.

After extensive alignment through inter-organizational communication, the chairman decided to designate GRIP-4 on the 7th of January (Institute for Safety, 2019[c]). The RBT consisted of the mayors

from the Wadden Islands, a few mayors from the mainland, traditional services and actors from the functional chain, including RWS. Instead of designating GRIP-4 in Groningen, key figures joined the teams from Fryslan and established their own physical team that looked like a CoPI. Furthermore, representatives from Safety Region Noord-Holland Noord and Groningen participated in both the ROT and RBT. According to the chairman of Fryslan (Crone, 2019), the RBT conducted the meetings in the Wadden-office in Harlingen. De Bruin argued that this location was a strategic choice with regards to distance to the municipalities involved (personal communication, April 30, 2020). Some key figures that could not attend these meetings, established a video connection to join.

Based on the gathered information, the physical absence of key figures did not seem to be a barrier in information sharing during the MSC Zoe crisis response (De Bruin, personal communication, April 30, 2020; Wijkhuijs, personal communication, April 28, 2020). Operational Leaders from both Groningen and Noord-Holland Noord in the ROT added valuable knowledge and promoted alignment (Institute for Safety, 2019[c]). According to Wijkhuijs, key figures with specific knowledge about the organizational responsibilities in the Wadden Islands added to the teams. De Bruin stated that Safety Region Fryslan aimed to maintain continuity and uniformity in the critical functions throughout the teams.

5.3.1.3 Comparison of cases

In both cases, the reports and interviews do not indicate that essential key figures missed during the meetings. Both actors from the functional chain and collaborative Safety Regions sent liaisons to the Region that was primarily in charge of the crisis response in order to improve the information sharing. Furthermore, the specially designed rooms and containers provided all kinds of advantages to meet in appropriate conditions. To conclude, both cases support hypothesis one, but this causal factor does not seem to cause the difference in the evaluation outcome.

5.3.2 Role knowledge

> *H2: An adequate level of role knowledge in the network strengthens the connection between the offer for- and needs of information to achieve intra- and inter-organizational goals.*

5.3.2.1 Chemie-Pack 2011

Since the Netherlands consist of 25 relatively equally operating Safety Regions, there is a proper understanding of roles and responsibilities in most cases among the Regions (Institute for Safety, 2017[b]). Although this crisis exceeded regional boundaries, many roles and responsibilities remained the same. The most affected Regions, MWB and ZHZ, had both the obligation to take care of measurements and crisis communication (IOOV, 2011). It was the role of MWB to regain control over the actual threat, and other Regions offered or eventually provided resources.

All in all, the IOOV (2011) concluded that unclear roles and responsibilities are not unique in the hot phase of a crisis. This incident had an interregional appearance and came shortly after the implementation of a new law that prescribed the crisis management procedures and structures (Gemeente Moerdijk, 2014). Still, the IOOV stated that this had to improve significantly after the crisis unfolded.

Also actors from the functional chain joined the crisis response (Crisisplan, 2011). In contrast to the Safety Regions, these sometimes unfamiliar actors had a different organizational background. The exact responsibilities of both the measurement units from the fire department and BOT-mi took a while to fall into place (Boin, Kuipers, & De Jongh, 2018). The measurement teams from the regional and national level had comparable roles. Therefore, there was confusion about which actor had to provide the actual data for crisis communication with the public.

Moreover, offering complete reports with well-considered findings takes time. Since Safety Region had to deal with many questions, they published pieces of information in a very early stage to remain transparent (Gemeente Moerdijk, 2014; PricewaterhouseCoopers, 2012). Obviously, publishing incomplete reports does not help to limit the number of questions from the public and media. With an eye on role knowledge, BOT-mi should have known that Safety Region intended to publish the reports, and could have adapted the reports for direct publication. Later on, Safety Region and BOT-mi decided that Safety Region would slow down in distributing information and wait for more developed reports (PricewaterhouseCoopers, 2012). Therefore, a better understanding of each other roles and responsibilities possibly improved the information sharing.

5.3.2.2 MSC Zoe 2019

According to the Institute for Safety (2019[c]), multiple characteristics of this crisis led to difficulties in identifying each other's position in the network. Firstly, the number of involved organizations inhibited clear roles and responsibilities. Secondly, many disputed the classification of the incident. Did this incident primary belong to environmental agencies? Or safety at sea? Third, the centre of impact shifted throughout the days due to current at sea. Finally, role knowledge about the background of organizations generated difficulties.

Wijkhuijs (personal communication, April 28, 2020) elaborated on the latter in the interview. In the initial phase of the incident, the general chain had to get used to the organizational background of RWS. This actor belongs to the functional chain and has a vertical administrative structure. In lower levels, the mandate is not at the representatives at the table. This resulted in unequal relationships. Employees from Safety Region tried to align decision-making with RWS. However, there was no equal relationship with the representative from RWS in terms of authority. The representative(s) had to communicate with their ministry and receive permission for most procedures in the beginning (Institute for Safety, 2019[c]). Organizations involved noticed the barrier in limited role knowledge and tried to come to a solution (Institute for Safety, 2019[c]). To promote mutual role knowledge, the first RBT-

meeting in GRIP-4 spent time to get familiar with both organizations, in terms of organizational background and administrative levels.

Furthermore, multiple organizations felt responsible for measurements of toxic substances. Environmental services, public health actors and the fire department played a role in measurement of hazardous substances. According to Wijkhuijs (personal communication, April 28, 2020), the division of roles about this subject matter might need more alignment through clarification of the appointed roles and responsibilities by the national level. The researcher argues that the RIVM is primarily responsible and appointed to this task, instead of Safety Region.

5.3.2.3 Comparison of cases

In contrast to Chemie-Pack, the impact area of the MSC Zoe containers shifted across multiple Regions due to current. Chemie-Pack was a more demarcated and undisputed threat in terms of being a chemical fire located on the industrial area of Moerdijk. Therefore, the collective interpretation of the threat was more clear. The MSC Zoe evaluation report indicated that actors had to scan each other's exact roles during the first days (Institute for Safety, 2019[c]). The comparison of cases suggests that when the actual kind of a threat is disputable, it could cause organizational haziness due to unclear roles and responsibilities.

Furthermore, both cases generated barriers between the general and functional chain, which could be related to insufficient role knowledge. MWB had issues with difficult terminology from BOT-mi. Fryslan had to get used to the intra-organizational procedures of RWS. Interesting is that in both cases, there was tension between the multiple actors that were responsible for measurements. It seems like that when the national level and its actors get involved, it becomes unclear which actors serve which roles in terms of measuring toxic substances (Wijkhuijs, personal communication, April 28, 2020).

To conclude, the within-case analysis generated mixed results. The addition of actors from the functional chain exposed similar barriers in both cases during the first phase of the event; namely, the limited knowledge of each other's organizational background. Taking the challenges and achievements into consideration, the findings confirm that sufficient role knowledge primarily promotes effective collaboration between actors, which relates to inter-organizational information sharing.

5.3.3 Alignment of procedures

H3: A high degree of alignment enables a deliberate response, which benefits the information sharing through convergence.

5.3.3.1 Chemie-Pack 2011

The first identified step in the process of alignment is active involvement of collaborative actors. Logically, this starts with the notification of partners when the unfoldment of events demands their involvement. Within three minutes after the first call, the commander from the fire department asked

the dispatch centre (GMK) to notify Safety Region Zuid-Holland Zuid of the emerging fire (Brandweer Midden- en West-Brabant, 2011). MWB did not inform less-affected Regions. Other Regions noticed the unfolding crisis themselves through conventional media, for example (IOOV, 2011; Veiligheidsregio Rotterdam-Rijnmond, 2011).

Due to the cloud of smoke that crossed the canal, Zuid-Holland Zuid designated GRIP-4 around 3 pm (IOOV, 2011). This was approximately 30 minutes after the fire started. The ROT of ZHZ made a call to MWB and asked about their plans; were they also planning to designate GRIP-4? The chairman advised the mayor to align with ZHZ (The Dutch Safety Board, 2012). The mayor rejected this request since he felt responsible for his own municipality (Gemeente Moerdijk, 2014). Although there is no obligation in law, the unsynchronized upscaling caused adverse effects (Klein, 2011). Inter-organizational colleagues struggled with authority-related differences. After many negotiations between intra- and inter-organizational key figures, the mayor from Moerdijk agreed with the declaration of GRIP-4. Five hours later than ZHZ, MWB designated GRIP-4. Interviews by PriceWaterhousecoopers (2012) made clear that this benefitted the interregional response significantly. According to key figures, the chairman of both Regions and directors established a proper collaborative relationship which stemmed from intensive contact. At the same time, MWB adopted a deviant structure compared to the prescribed GRIP-level procedures. Normally, the RBT replaces a GBT when a Region declares GRIP-4 (Gemeente Moerdijk, 2014). In this case, the mayor of Moerdijk decided to maintain the GBT-team. Since the procedure of both teams operating did not correspond with prescribed structures, both teams had issues to determine their actual positing in the network during the evening (Gemeente Moerdijk, 2014; The Dutch Safety Board, 2012).

The first downscaling procedures took place synchronously the day after the initial fire. Interesting to mention, is that PricewaterhouseCoopers (2012) found that the interregional information sharing improved after MWB decided to return to GRIP-4, after they initially scaled down. Both Regions decided to carefully align communication and decision-making in the RBT with Region ZHZ. This suggests that after both Regions reached the same levels, this enabled a certain degree of alignment when the administrative levels turned equal. Although the levels during the aftermath turned unequal again, stakeholders already had established adequate entrances for inter-organizational information flows in earlier stages of the crisis. This further supports the hypothesis that alignment in GRIP-procedures does not only bring key figures with equal authority to the same table, but also enable proper routes for information (Klein, 2011).

Taking a closer look at the more operational actions, this crisis seemed to generate appropriate inter-organizational information sharing that stems from alignment. Around midnight, MWB reached enough capacity to knock down the fire by using a considerable amount of foam (PricewaterhouseCoopers, 2012). Before the units deployed on scene put this final round into practice, Policy-teams and the CoPI aligned with each other to minimize the impact of side-effects. Since the

foam would cause smoke and bad ignition of toxic gasses, the effects on the surrounded area could be severe (IOOV, 2011; Gemeente Moerdijk, 2014).

Remarks about the alignment in crisis communications were diverse. Many reports and media criticized the first press conference, which involved the mayor of Moerdijk (The Dutch Safety Board, 2012). The mayor stated that the fire did not generate dangerous air pollution and related threats for public health, according to the measurements (Gemeente Moerdijk, 2014). In the meantime, many experts in the media expressed their worries. Both images and videos showed a massive cloud of smoke that crossed the canal. Furthermore, video footage from the accident site showed collapsed containers filled with chemicals and a heavily burning courtyard. The accumulation of terrifying media reports caused that inhabitants became sceptical about the statements made (Gemeente Moerdijk, 2014).

On the other hand, Regions were also willing to assist and align in crisis communication (PricewaterhouseCoopers, 2012; Veiligheidsregio Rotterdam-Rijnmond, 2011). In the hot phase of the incident, the action centre for communications appointed communication advisors to align the crisis communication processes in the Regions. In the evening, Rotterdam-Rijnmond helped ZHZ to fill the emergency text page on the television. The Safety Regions decided to discuss the exact moments of crisis communication and generate unified crisis communication towards anxious inhabitants. In the morning after the fire, an interregional coordinated press conference informed the public about what occurred. During the aftermath, Regions aligned their communication concerned with the publication of BOT-mi reports and press conferences (The Dutch Safety Board, 2012). All in all, the reports illustrate that Regions were motivated and willing to align their crisis communication, which indicates a facilitating condition for information sharing.

Still, Safety Region Rotterdam-Rijnmond (2011) stated explicitly in their comprehensive report that they questioned whether MWB realized what Rotterdam-Rijnmond could bring them in this exceptional crisis. The author emphasized that actors should not feel the need to handle this type of crisis alone and others are willing to deliver knowledge and expertise.

5.3.3.2 MSC Zoe 2019

As discussed earlier, liaisons from both Groningen and Noord-Holland Noord joined the ROT. On January 7, Safety Region Fryslan designated GRIP-4 (Institute for Safety, 2019[c]). In consultation with the mayors from the Wadden Islands, they decided that the supra-local effects demanded a central point of coordination. According to Crone (2019), the chairman of Safety Region Fryslan, the involvement of external parties and the national level would benefit from less fragmentation of authority. The Institute for Safety (2019[c]) acknowledged this motivation. The purpose of an RBT was twofold: connect the mayors and converge the administrative level with the functional chain. Since mayors from affected municipalities outside Fryslan joined the RBT, the Regions adopted an informal GRIP-5 (Institute for Safety, 2019[c]). Wijkhuijs supported this flexible interpretation of the GRIP-structure since it improved alignment of procedures (personal communication, April 28, 2020).

As discussed before, unequal authority in relationships could inhibit alignment and therefore the information sharing. In lower GRIP levels, the Institute for Safety (2019[c]) noticed some tension between the general and functional chain. At first, senior advisors of RWS did not have the same mandate as collaborative figures from Safety Region in the lower GRIP levels (Vina Wijkhuijs, personal communication, April 28, 2020). The evaluation report stated that respondents from Safety Region had a hard time aligning their crisis communication with RWS the first days. Some respondents had the feeling all actions of the RWS-liaison needed verification from higher levels (Institute for Safety, 2019[c]). This obviously impacted the alignment of procedures, but not necessarily inhibited the information sharing (De Bruin, personal communication, April 30, 2020).

Declaration of GRIP-4 converged the administrative level of Safety Region with the organizational structure of RWS (Institute for Safety, 2019[c]). The head-engineer of RWS was used to communicate with key figures at the level of the mayor (Wijkhuijs, personal communication, April 28, 2020). Therefore, RWS aligned with the different mayors involved. Although GRIP-4 led to an administrative shift to the chairman, he acted as an intermediary in the discussions between the mayors and RWS. The incident affected each municipality differently, and therefore RWS had to realize customized alignment. GRIP-4, which brings the mayors together in the RBT, promoted this in a more structured way (Institute for Safety, 2019[c]).

The alignment of crisis communication received positive remarks. The Safety Regions had parallel crisis communication and reports do not indicate any contradictions. After the designation of GRIP-4, Safety Region and RWS determined a long-term communication strategy. The alignment concerned the division of responsibilities (Institute for Safety, 2019[c]).

5.3.3.3 Comparison of cases

During the first critical moments of the incident, it seems that actors in the MSC Zoe crisis actively informed each other when their involvement was desirable. The reports about Chemie-Pack argued that multiple affected Safety Regions had to see the crisis unfolding through conventional media. However, this difference could be related to the underlying explanation of Chemie-Pack being a sudden-impact crisis.

Interesting to mention is that unequal upscaling led to alignment issues in both cases. In the Chemie-Pack case, the late designation of GRIP-4 by MWB frustrated other collaborative actors (IOOV, 2011). The moment MWB went to the level of the chairman, collaboration improved between the Regions. Still, the presence of a GBT during GRIP-4 generated a deviant structure. Not every actor appreciated the continuity of the GBT since it was not in accordance with the prescribed GRIP structure.

During the MSC Zoe incident, Groningen and Noord-Holland did not designate to GRIP-4. However, the leaders attended the important meetings after they carefully outlined their collective prospects (Institute for Safet, 2019[c]). Furthermore, the declaration of GRIP-4 did justice to the

organizational background and administrative level of RWS, which improved the collaboration and promoted the information sharing.

For both cases, the reports stated that Regions aligned the crisis communication consistently. Multiple actions indicate that Regions were motivated to conduct a strategy together. The alignment with the functional chain faced some obstacles in the beginning due to reciprocal role knowledge, but worked out fine eventually for both MSC Zoe and Chemie-Pack.

To conclude, a synchronous alignment in procedures with regards to GRIP-structure is favourable for crisis management actors. Still, Wijkhuijs (personal communication, April 28, 2020) stated that most Regions take flexible intermediate roads that are most practical. She refers to the GRIP-5 look-a-like structure during MSC Zoe. Taking this into consideration, not the extremely strict interpretation of the GRIP-level itself matters, but the right and equal inter-organizational positioning of decision-makers. Relating this to the hypothesis that represents this causal factor, both cases support that alignment promotes the information sharing. Actors that are motivated to align their procedures create appropriate lines and converge authority to benefit the information sharing.

5.3.4 Inter-organizational contact

H4: Low reachability of inter-organizational actors inhibits the information sharing.

H5: Information overload acts as a barrier in information sharing, since it keeps delivered information underutilized or could cause misinterpretation of information.

H6: Using discipline-based terminology could negatively affect the inter-organizational information sharing, since it triggers additional information flows for clarification or causes wrongful interpretation..

5.3.4.1 Chemie-Pack 2011

Reading through the reports, many evaluating organizations concluded the same findings. The reachability of actors was relatively acceptable between MWB and ZHZ (IOOV, 2011). However, 'the outside world' had a hard time to reach both Regions. MWB was almost unreachable through all portals for other collaborative actors and the public. Also the ROT of Rotterdam-Rijnmond was not able to get in contact with both the ROT of MWB and ZHZ (Veiligheidsregio Rotterdam-Rijnmond, 2011). Contact by phone was desirable, mainly since MWB did not adequately provide the information system with updates (IOOV, 2011). According to Boin, Kuipers and De Jongh (2018), the limited reachability of MWB and its Policy-teams turned out to be a significant bottleneck in the collective crisis management response. The researchers stated that the national level put additional pressure on the communication lines. To make matters worse, the municipality of Moerdijk made use of the same phone numbers for both crisis communication with the public and maintaining information sharing with collaborative actors (Boin, Kuipers, & De Jongh, 2018).

The Dutch Safety Board (2012) described in which way BOT-mi faced issues to get in contact with the general chain, and vice versa. Around 15:30, BOT-mi tried to get in contact with the fire department and dispatch centre of MWB but failed to establish a connection. At the same time, ZHZ requested a central hub, which coordinated BOT-mi, that they would like to carry out measurements in this Region. However, BOT-mi stated that this request did not reach them. Via ZHZ, BOT-mi was able to create a connection with an advisor hazardous substances from MWB around 17:00. This advisor remained the responsible contact that represented MWB during the entire crisis.

Information overload stems from both capabilities of the sender and receiver. The lack of appropriate inter-organizational information provided by MWB, therefore, did not seem to cause severe levels of information overload at other actors. Information sharing deficiencies stemmed from the workload in MWB, for example. PricewaterhouseCoopers (2012) stated that MWB had to fulfil many tasks and had many incoming questions from media, residents, other collaborative actors and the national level. Not to forget, this Region also had to deal with the crisis itself in Moerdijk.

Limited understandability of communications could inhibit the information sharing on the inter-organizational and intra-organizational level. Safety Region Rotterdam-Rijnmond (2011) concluded that some ROT plenary discussions turned out to be too detailed by use of technical language. This caused that other disciplines built up different expectations of the unfolding event. In theory, this distorted perception of reality could cause consequences when communicating with other organizations. The Region considered this observation as an important point of attention.

The external national-organized actor responsible for measurements, BOT-mi, deserved lots of attention in reports with regards to terminology as a barrier in information sharing (PriceWaterhousecoopers, 2012). Anxious residents demanded additional information about the effects of the chemical fire. A few days after the initial fire, governmental actors and anxious residents wanted a public health screening to get insight into health complaints. The mayors were responsible for the decision-making of this interregional possibility, but needed more info from BOT-mi about the subject matter. However, the information provided by BOT-mi was hard to read for many professionals and raised more questions than they answered. It took a considerable amount of time to transform it into more compatible advice.

Also with relation to other crisis communication purposes faced Safety Region issues with incompatible reports from BOT-mi (PriceWaterhousecoopers, 2012). Safety Region had to complement the reports with concrete advises for affected residents. Safety Regions tried to get clarifications at ministries to verify their interpretation. As an effect, unclear and incomplete communication led to many responses from the media and experts gave their own, undesired twist on the information provided. It goes without saying, that it is hard to come up with an adequate answer as a communication employee with complicated reports in hands.

ZHZ reacted to this fundamental information barrier with a fitting solution. As a response to the difficult reports, a set of specialized individuals formed a team to interpret the BOT-mi reports. This

team consisted of the regional environmental agency and specialists from the fire department. They provided civilians with a Q&A to answer urgent questions. Overall, Safety Regions had to translate the advice into workable and understandable pieces of crisis communication.

5.3.4.2 MSC Zoe 2019

In terms of inter-organizational reachability, Wijkhuijs argued that she did not notice this specific barrier in the interviews conducted by the IFV. Although the incident unfolded during the holidays, crisis management continues behind the scenes. Even with employees abroad, technological tools such as Whatsapp enable crisis managers to stay connected and align if necessary (Wijkhuijs, personal communication, April 28, 2020).

Both respondents in this study agreed that the establishment of a set of rules for Whatsapp after a few days was appropriate. The many inter-organizational Whatsapp-groups contained much information, which also included news feeds (De Bruin, personal communication, April 30, 2020; Wijkhuijs, personal communication, April 28, 2020). Fryslan composed a protocol after the incident, which outlines the advice for using Whatsapp. Still, both respondents do not believe that this led to information overload for users.

Lastly, Wijkhuijs and De Bruin explicitly stated that they did not notice any barriers in complicated terminology. The overall information sharing was good and the actors involved experienced the inter-organizational collaboration positively.

5.3.4.3 Comparison of cases

The reachability of the Region where the crisis unfolded in relation to collaborative partners strongly differs in this comparative case analysis. The reports suggest that MWB was practically unreachable for other Safety Regions, except for ZHZ. In the MSC Zoe case, sources suggest that actors could maintain a sufficient inter-organizational relationship in terms of reachability. It is no surprise, that unreachable actors could not provide valuable information to other Regions or actors from the functional chain. BOT-mi had to use ZHZ as a hub to get in touch with MWB in the Chemie-Pack case, for example.

Only the Chemie-Pack reports identified difficult terminology in the BOT-mi reports. De Bruin stated that Safety Region did not notice any barriers in information sharing due to professional language of RWS. A possible explanation could be that RWS is a more familiar actor to Safety Region than BOT-mi. The position of RWS in the set of operating safety organizations suggests that RWS meets Safety Region more often. In this sense, utilizing understandable terminology might stem from the relationship. If individuals have an adequate impression of other actors their knowledge and capabilities, they might adapt the language to their level.

Speaking of the hypotheses related to inter-organizational contact, both cases support hypotheses four and six. Both supported causal factors obviously differ in the comparison. Therefore,

these causal factors contribute to the answer to the research question. Lastly, no sources mentioned information overload as a barrier in Chemie-Pack or MSC Zoe. Therefore, the analysis neither confirmed nor rejected the hypothesis.

5.3.5 Technology & tools

H7: Having interoperable technological systems promotes the inter-organizational information sharing.

H8: Limited skills with interoperable technological systems act as a barrier in information sharing, as well as low motivation to use the devices properly.

5.3.5.1 Chemie-Pack 2011

As discussed before, the Regions involved made use of LCMS, an interoperable instrument for crisis management actors. Still, the system was about to be completely enrolled throughout the organizations and did not involve many actors with access from the functional chain (Boin, Kuipers, & De Jongh, 2018; Institute for Safety, 2019[a]). Deficiencies in information sharing did not result from incompatibilities in technological instruments. Besides LCMS, other facilitators enhanced information sharing between Regions. Short after the initial call, the dispatch centre opened inter-organizational communication channels to provide information about measurements. In this way, ZHZ was able to follow some of the developments by using the radio channel (PricewaterhouseCoopers, 2012). Moreover, this did not demand additional information flows and workload for MWB since ZHZ could simply listen to their operational communications.

The evaluation conducted by the IOOV (2011) argued that MWB did not work accordingly to netcentric work standards. As a result, there were informational deficiencies within and between Safety Regions. Also Safety Region Rotterdam-Rijnmond (2011) concluded in their report that they noticed limited familiarity with LCMS by ZHZ and especially MWB. As a result, MWB had a hard time expressing the severity of the situation in Moerdijk on-time. This caused a delay in the actuality of information for collaborative actors on both regional and national level (Boin, Kuipers, & De Jongh, 2018). The evaluation made clear that the limited input was further limited to only a few pre-designed tabs. MWB only used the dispatch centre tab, and ZHZ only used the digital component designed for the ROT (Veiligheidsregio Rotterdam-Rijnmond, 2011). Rotterdam-Rijnmond tried to offer assistance by sending employees in order to get their LCMS pages up-to-date. Unfortunately, the offer not seemed to receive any response from both collaborative Regions.

5.3.5.2 MSC Zoe 2019

The application of LCSM received only positive evaluations by both interviewees and the report of the IFV (2019[c]). All actors properly filled the tabs, also the actors from the functional chain that implemented LCMS not very long ago. Wijkhuijs noticed that RWS was very motivated to keep other

collaborative actors up-to-date through LCMS (personal communication, April 28, 2020). De Bruin stated that actors emphasized that LCMS was the primary system for information sharing and that organizations could build upon this information.

For all actors involved, it took some time to identify which information shared in Whatsapp also needed to be available in LCMS. Wijkhuijs stated that actors established this awareness of the 'right' balance over time. All in all, De Bruin (personal communication, April 30, 2020) argued that Whatsapp served an excellent purpose since Whatsapp is easily accessible. Most individuals use the tool on a daily basis. At work and at home. Also the Institute for Safety (2019[c]) acknowledged this argument in their report.

5.3.5.3 Comparison of cases

The last potential causal factor sheds light on both cases differently. The Region were the Chemie-Pack fire occurred, MWB, had severe issues with maintaining information flows with collaborative partners. Rotterdam-Rijnmond tried to send support, but could not reach MWB through all possible technological devices. For MWB, the combination of bad reachability (LCMS and phone) and lacking input of their LCMS tabs heavily inhibited the information sharing with other Regions. The information sharing by using technological devices was only slightly better with ZHZ. Although reports mention that LCMS got recently implemented, they do not explicitly conclude whether this potential cause strongly relates to the lack of information provided by MWB.

On the other hand, the MSC Zoe inter-organizational information sharing received many positive remarks. Both interviewees and the reports had little to add on the information sharing. Regions and RWS properly filled the tabs and were motivated to utilize the interoperable system LCMS.

With an eye on the last two hypotheses, the findings of both Chemie-Pack and MSC Zoe support the hypotheses. However, there are considerable cross-case differences in the analysis.

5.4 Overview of results

Figure 6 aims to present a comprehensive reflection of the analysis. To clarify, the presented barriers or facilitators could also be written down in the opposite manner (Berchtold et al., 2020). As an example, low reachability inhibits the information sharing, but high reachability promotes the information sharing. Although some findings do not directly confirm the hypothesis as presented, it confirms the opposite statement of the particular hypothesis as illustrated above. The degree of significance for differences between cases stems from:

- The leverage of the causal factor with regards to the information sharing (unreachability does not inhibit information sharing, it practically makes information sharing impossible);
- Whether the researcher identified the causal factor on the level of multiple Regions, or also between Regions and the functional chain;
- Reports explicitly stating that a causal factor drastically impacted information sharing.

Hypothesis:	**Causal (sub)factor:**	**Chemie-Pack:** Confirm / reject the hypothesis? (+/-)	**MSC Zoe:** Confirm / reject the hypothesis? (+/-)	**Considerable difference in cases which could explain the outcome?**
H1	**Co-location**	+	+	Negligible difference
H2	**Role knowledge**	+	+	Negligible difference
H3	**Alignment of procedures**	+	+	To a medium degree
H4	**Inter-organizational contact** Reachability	+	+	To a high degree
H5	**Inter-organizational contact** Information overload	Not applicable	Not applicable	Negligible difference
H6	**Inter-organizational contact** Difficult terminology	+	+	To a low degree
H7	**Technology and tools** Interoperability	+	+	Negligible difference
H8	**Technology and tools** Familiarity and use	+	+	To a high degree

Table 3: Comprehensive table of results.

6. Conclusion and discussion

6.1 Conclusion

The last decades, globalization and technological development made our society increasingly complex (Berchtold et al., 2020). An intertwined world, however, might also become increasingly vulnerable due to the interdependencies it generates (Blondin, 2016). When sectors connect and boundaries fade, significant contingencies could provoke a domino effect. Ansell, Boin and Keller (2010) identify these events as transboundary crises. This increasingly present threat crosses geographical boundaries and involves a wide variety of actors. Cybersecurity breaches, natural disasters and industrial incidents are all types of potentially transboundary and impactful events (Institute for Safety, 2019[a]). Due to the increased risk and the urge to control and suppress consequences of these events, additional research into crisis response to transboundary crises is of utmost importance (Kalkman, Kerstholt, & Roelofs, 2018; Institute for Safety, 2019[a]).

In this particular study, a comparative case study design generated interesting insights into two Dutch responses of transboundary crises. The analysis aimed to expose why the information sharing did differ through the identification of barriers and facilitators. The Chemie-Pack fire of 2011 received a predominantly negative evaluation about the interregional information sharing. The MSC Zoe container crisis, on the other hand, was remarked positively by credible organizations.

With an eye on the analytical framework of causal factors, reports and interviews revealed which barriers and facilitators probably caused the different outcome. Although some mechanisms showed a negligible difference, a few causal factors generated contrasting perspectives. Primarily, the Safety Region where the Chemie-Pack crisis unfolded was almost unreachable for most collaborative actors. Furthermore, the inadequate use of the interoperable systems further inhibited the information sharing in the inter-organizational network. By contrast, crisis managers in the MSC Zoe response faced little issues with both barriers. Revising the alignment of procedures led to mixed results. In Chemie-Pack, an unsynchronized upscaling pattern and continuity of teams, against procedures, led to organizational haziness and issues in alignment. However, when the right key figures established an adequate connection, unequal alignment of administrative structures almost seemed to disappear as a barrier. Also in the MSC Zoe incident, various examples illustrated practical variations on the GRIP-structure. When key figures adequately aligned the deviant administrative structures, this adoption actually benefited the crisis response. As stated in the analysis, it seems that “not the extremely strict interpretation of the GRIP-level itself matters, but the right and equal inter-organizational positioning of decision-makers” (p. 46).

To answer the research question, limited use of interoperable systems and bad inter-organizational reachability of the Region where the fire was located (MWB) primarily generated a negative evaluation of the Chemie-Pack response, based on the gathered information. Also, deficiencies in the alignment of procedures during the Chemie-Pack case probably contributed to a difference in terms of the outcome.

6.2 Embeddedness in the theoretical framework

Multiple observations in the comparative case study could be related to the knowledge gained in the theoretical framework. Embeddedness in the theoretical framework is twofold in this study. First, the degree to in which way the results are in accordance with the literature, stems from the hypotheses concerned with the barriers and facilitators. Second, the theoretical framework discussed assumptions about the network.

In terms of the hypotheses drawn, both cases confirmed that the causal factors work as described in the gathered empirical studies. For example, BOT-mi used too much complicated terminology in the Chemie-Pack case, which inhibited the information sharing with Safety Region. Safety Region actually had to establish a team of experts to interpret the advice of BOT-mi, a 'collaborative' partner. Limited knowledge about other's capabilities causes this barrier (Gilja, 2013; Waring, Humann, & Dawson, 2019). Furthermore, the Chemie-Pack reports explicitly stated that the physical attendance of key leaders drastically improved the inter-organizational information sharing, which refers to facilitating conditions that belong to 'co-location.' Lastly, the MSC Zoe case illustrated that a combination of interoperable technological instruments and motivation to utilize these systems enabled adequate information sharing. The reports and interviews emphasized that RWS, as an actor from the functional chain, was motivated to fill the LCMS tabs. Therefore, 'transboundary' stakeholders in the self-regulating network could make sense of mutual developments and needs.

In terms of multi-sectoral networks, the collaboration between the general chain and functional chain experienced similar challenges. These barriers stemmed from different organizational backgrounds. In the MSC Zoe container incident, staff of Safety Region indicated that in the first days, RWS representatives faced challenges in decision-making. Schraagen, Huis in 't Veld and De Koning (2010) explained why certain organizations can not decide on procedures as easy as other collaborative partners. The researchers argued that hierarchical teams need more time to align actions within the organization bottom-up. Furthermore, multiple studies argue that even when organizations are relatively familiar to each other, crisis situations might expose unfamiliar elements or situations that not come to light in contemporary tasks (Ansell, Boin, & Keller, 2010; Deverell, Alvinius, & Hede, 2019). Municipality Moerdijk (2014) explicitly stated that all stakeholders had little experience with the extraordinary organizational structures the Chemie-Pack crisis provoked.

6.3 Limitations

Limitations in this particular type of study could stem from the cognitive capabilities of the researcher, application of a pre-designed analytical framework and other potential biases. The evaluation reports might put too much emphasis on certain causal factors, that actually only occurred during a short amount of time or had little leverage. The researcher might also have overlooked important barriers in the reports. Consistent use of content analysis tools aimed to minimalize this shortcoming. Furthermore, the presence or absence of a barrier does not necessarily prove beyond a reasonable doubt that it inhibited

or promoted the information sharing. Furthermore, this study might have excluded crucial barriers or facilitators from the analysis due to adopting a pre-generated framework.

In the MSC Zoe case, the addition of interviewees minimalized the risk of certain methodological limitations described above. The researcher asked critical questions about the representativeness of significant causal factors in the reports and asked for alternative explanations that were not covered in the set of questions.

6.4 Avenues for further research

During the interviews, both respondents often related their perspective on the MSC Zoe crisis to the COVID-19 crisis response. Since the COVID-19 crisis affected all 25 Safety Regions, it would be interesting to examine which barriers and facilitators inhibited the inter-organizational information sharing if all Regions get involved. Did the Regions work in organizational silos? Did Regions adequately align their procedures? Furthermore, the RIVM played a key role in the functional chain. Therefore, the COVID-19 could be an interesting case to investigate using the inter-organizational framework composed in this study.

6.5 Recommendations and the 2012 commission advice

When proposing recommendations, it would be inaccurate to base the suggestions on the case with the negative outcome in 2011. Obviously, as stated in the alternative explanations, organizations learned and further developed technological instrument the decade after Chemie-Pack. Still, multiple barriers seemed to return years after the Chemie-Pack fire.

Despite of learning and technological developments after the Chemie-Pack case, the MSC Zoe response exposed similar tension between the general and functional chain in terms of role knowledge. In this case, it concerned the organizational background of administrative structures. Botch chains could put more effort into getting familiar with potential collaborative actors when preparing for (extraordinary) crises. To achieve this, preparatory meetings that include all types of actors that present themselves and their organizational background could improve mutual role knowledge when crisis strikes. Actors could identify if appointed roles clash in imaginable events and investigate what the implications are of the mutual administrative levels in crisis management.

Furthermore, the division of roles and responsibilities seemed to be unclear when national parties from the functional chain added to the response. Also in the MSC Zoe crisis, multiple teams felt responsible for measuring or identifying toxic substances. Wijkhuijs acknowledged that it is not always clear which organization serves which role in comparable incidents (personal communication, April 28, 2020). Policymakers might clarify the exact roles and responsibilities when organizations with comparable specializations add to the network.

As mentioned in the introduction, a commission evaluated interregional performances of Safety Region after Chemie-Pack (Veiligheidsberaad, 2012). Based on the analysis, the MSC Zoe response

acted according to the advice composed in 2012. One responsible Region took the lead and other and collaborative actors aligned the crisis communication properly. The Veiligheidsberaad (2012) explicitly advised a uniform GRIP-upscaling to enable adequate authority at the same operating levels. In the MSC Zoe response, crisis managers adopted a deviant structure in line with the advised standards. Still, credible sources acknowledged that practical deviances might work better than sticking to non-flexible structures (Institute for Safety, 2017[a]; Vina Wijkhuijs, personal communication, April 28, 2020).

7. References

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Appendix A: Observable indicators of independent variables

Causal factor	**Operationalization**	**Observable indicators** *Mainly written down as barriers, opposite findings could indicate facilitating conditions in most cases.*
Co-location	**Physical attendance of key figures at meetings**	- The number of figures during meetings. - Sources stating that key figures from core disciplines were missing. This could relate to members of the CoPI, ROT, RBT, etcetera.
	Over attendance of irrelevant figures at meetings	- Sources stating that figures distracted the meetings from its main objectives. - Sources stating that there were too much representatives from the same discipline attendant.
	Appropriate circumstances to have a meeting	- Sources stating that the representatives of particular actors changed often, which led to moments were the new representative was not up-to-date. - Sources stating that necessary means were missing during the meetings. - The presence of loud noises or other interruptions that affected the continuity or effectiveness of meetings.
Role Knowledge	**Awareness roles and their background**	- Sources stating that individuals had issues to examine which information other actors had to receive to fulfill their objectives. Explicitly relates to (un)clear roles and responsibilities. - Sources stating that actors needed time to understand the organizational background of other collaborative actors, and which implications this had for decision-making.

		- Sources stating that individuals had no idea what other's exact function was in the network.
Alignment of procedures	**Having a mutually aligned response**	- Discussion and alignment in how to apply the GRIP-level upscaling procedure. - Sources stating that organizations informed other actors when they were planning to carry out influential activities. - Alignment in crisis communication. - Sources stating that they were convinced that the crisis had to be managed together. This had to be put into practice in order to positively contribute to this variable.
Inter-organizational contact	**Reachability**	- Sources stating that organizations had a hard time to get in contact with collaborative actors. - Sources stating that the network had limited or no capacity to process communications.
	Information overload	- Sources stating that they received too much information to process effectively. This could be further discussed in terms of amount of information, and relevance of information.
	Understandable terminology	- Sources stating that they had no idea what the certain terms or abbreviations represented, communicated by collaborative actors. - Sources stating that confusion occurred when certain terms turned out to have different meanings in different organizations.

Technology & Tools	**Degree of interoperability**	- Sources observing stating that actors faced issues communicating, since they did not use the same technological devices.
	Familiarity with technological systems	- The observation that organizations recently introduced the technological system. - Sources stating that individuals did not understand the essence of sharing inter-organizational information (lack of motivation). - Sources stating that information managers did not fill their tabs properly.

Table 4: Observable indicators of independent variables.

Appendix B: Dutch administrative crisis management levels and technological systems

Dutch GRIP-levels in crisis management

Since both crises occurred within comparable prescribed structures, one comprehensive table should take care of the structures found in both events. This table presents inter-organizational guidelines to make clear who is in charge. This has the advantage that most actors involved have a shared understanding of the organizational structure. In some cases, crisis managers interpret the guidelines in a more flexible way for practical reasons (Institute for Safety, 2017[a]).

GRIP-level	When?	Teams	Side notes
GRIP-1	An event demands a degree of administrative coordination	CoPI (Team of operational commanders on scene)	Informing the mayor
GRIP-2	Risks for surrounded area. (+ effect area)	+ ROT (Regional Operational Team, focusses on effects on surrounded area.)	After this level, upscaling mostly causes shifts in administrative leverage.
GRIP-3	Urge for more administrative clout	+ GBT (Municipal Policy Team, advises mayor)	Direct involvement of the mayor generally.
GRIP-4	Effects of the event exceed supra-local borders.	GBT turns into RBT. (From Municipal- to Regional Policy Team.)	Authority goes to the chairman of the Safety Region.
GRIP-5*	The effects exceed the geographical borders of the source Safety Region.	+ NCC (National Crisis Centre)	Authority stays at level of multiple Safety Regions, one Region takes the lead.

Table 5: Dutch GRIP-structures

(Institute for Safety, 2017[a]; Institute for Safety, 2017[b]; Gemeente Moerdijk, 2011).

* = Grip-5 indicates an incident that crosses the boundaries of Safety Regions and has national consequences. The Chemie-Pack fire led to the establishment of this additional level.

Interoperable technological system: LCMS

Crisis management actors in the Netherlands make use of LCMS (IOOV, 2011). This interoperable instrument enables crisis management actors to share data about the incident. LCMS aims to provide actors with complete and accurate data, where they can base decisions on (LCMS NL, 2018). This notion of digital collaboration stems from the urge for 'netcentric work.' This central instrument provides possibilities to add and view images, interactive geographic maps and provide information about decisions and needs to other actors in the network. Recent years, many more functional crisis management actors, besides the 25 Safety Regions, decided to join the centralized technological system (LCMS NL, 2018).