driver+

Driving Innovation in Crisis Management for European Resilience

D934.17 - MEASURING RESILIENCE AND DASHBOARD

SP93 - SOLUTIONS

December 2017 (M44)

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The DRIVER+ project

Current and future challenges due to increasingly severe consequences of natural disasters and terrorist threats require the development and uptake of innovative solutions that are addressing the operational needs of practitioners dealing with Crisis Management. DRIVER+ (Driving Innovation in Crisis Management for European Resilience) is a FP7 Crisis Management demonstration project aiming at improving the way capability development and innovation management is tackled. DRIVER+ has three main objectives:

1. Develop a pan-European Test-bed for Crisis Management capability development:
    - Develop a common guidance methodology and tool (supporting Trial and the gathering of lessons learned
    - Develop an infrastructure to create relevant environments, for enabling the trialling of new solutions and to explore and share CM capabilities
    - Run Trial in order to assess the value of solutions addressing specific needs using guidance and infrastructure
    - Ensure the sustainability of the pan-European Test-bed
2. Develop a well-balanced comprehensive Portfolio of Crisis Management Solutions:
    - Facilitate the usage of the portfolio of solutions
    - Ensure the sustainability of the portfolio of tools
3. Facilitate a shared understanding of Crisis Management across Europe:
    - Establish a common background
    - Cooperate with external partners in joint Trial
    - Disseminate project results

In order to achieve these objectives, five Subprojects (SPs) have been established. **SP91** ***Project Management*** is devoted to consortium level project management, and it is also in charge of the alignment of DRIVER+ with external initiatives on crisis management for the benefit of DRIVER+ and its stakeholders. In DRIVER+, all activities related to SIA (from the former SP8 and SP9) are part of SP91 as well. **SP92** ***Testbed*** will deliver a Guidance methodology and guidance tool supporting the design, conduct and analysis of Trial and will develop a reference implementation of the test-bed. It will also create the scenario simulation capability to support execution of the Trials. **SP93** ***Solutions*** will deliver the Portfolio of Solutions (PoS) which is a database driven web site that documents all the available DRIVER+ solutions, as well as solutions from external organisations. Adapting solutions to fit the needs addressed in Trial will be done in SP93. **SP94** ***Trials*** will organize four series of Trial as well as the final demo. **SP95** ***Impact, Engagement and Sustainability***, is in charge of communication and dissemination, and also addresses issues related to improving sustainability, market aspects of solutions, and standardization.

The DRIVER+ Trial and the Final Demonstration will benefit from the DRIVER+ Test-bed, providing the technological infrastructure, the necessary supporting methodology and adequate support tools to prepare, conduct and evaluate the Trial. All results from the trails will be stored and made available in the Portfolio of Solutions, being a central platform to present innovative solutions from consortium partners and third parties and to share experiences and best practices with respect to their application. In order to enhance the current European cooperation framework within the Crisis Management domain and to facilitate a shared understanding of Crisis Management across Europe, DRIVER+ will carry out a wide range of activities, whose most important will be to build and structure a dedicated Community of Practice in Crisis Management (CoPCM), thereby connecting and fostering the exchange on lessons learnt and best practices between Crisis Management practitioners as well as technological solution providers.

Executive summary

Preparedness is a key factor when it comes to building resilience capacities. Preparation relates to risk awareness and actions within communities (citizens preparing for specific risks), but also to the cooperation between public and professional responders.

To validate an existing resilience model in a European context, a survey study was conducted investigating the relation between community resilience indicators and level of citizen preparedness for flooding in the Netherlands. Consistent with earlier work, the study confirmed that all levels that are distinguished in Community Engagement Theory (CET), individual, social and institutional, play a role in predicting hazard preparedness. This means that the indicators can be used in a European context as to measure community resilience. Extending the validation of CET to a European context successfully further strengthens the conclusion that it is a comprehensive, all-hazard approach to community resilience.

To investigate how knowledge of community resilience could enhance professionals' collaboration with citizens, a dashboard was developed showing both vulnerabilities and capacities of specific communities in The Hague. The qualitative findings suggest that such insights have great potential for utilising community capacities in crisis situations. To date the dashboard has limited value in the response phase due to uncertainties in the data, but can be used in the preparation phase as to increase mutual awareness.

For DRIVER+ a main recommendation is to convey a new foundational vision on crisis management that stresses 'collaborative resilience': collaborations between professionals and citizen communities that are based upon maximizing capacities and minimizing strict operating procedures. In order to attain this situation, resilience and cooperation needs to be built up in the pre-crisis phases. Resilience can be increased by motivating citizens to prepare for a broad range of both known and unknown risks. Cooperation between citizens and professionals can be enhanced by increasing trust and empowerment, and by mutual insight into each other's (perceived) roles, tasks and responsibilities.

Table of Content

1. Introduction 9
1.1 Present research 9
2. Predicting preparations for flooding 11
2.1 Introduction 11
2.1.1 Behavioural models 11
2.1.2 Social level influences on risk interpretation and action 12
2.1.3 Community Engagement Theory: individual, social and institutional level 12
2.1.4 Present study 12
2.2 Methods 13
2.2.1 Respondents and procedure 13
2.2.2 Material 13
2.3 Results 14
2.4 Discussion 17
3. Dashboard to enhance collaboration between citizens and professionals 20
3.1 Motivation 20
3.2 Method 20
3.2.1 Respondents and procedure 20
3.2.2 Material 21
3.3 Results 23
3.4 Discussion 24
4. Overall conclusion 25
Annexes 31
Annex 1 – DRIVER+ Terminology 31

List of Figures

Figure 2.1: Relation between underlying concepts and preparation intentions 17

Figure 3.1: Community Resilience Dashboard 22

List of Tables

Table 2.1: Mean 'worry' scores for the different events 15

Table 2.2: Means and standard deviations for the various concepts 15

Table 2.3: Correlations between the variables 16

Table 2.4: Regression weights and significance level with preparations as dependent variable 16

Table 2.5: Regression weights and significance level with intentions as dependent variable..... 17

List of Acronyms

Acronym	Definition
CET	Community Engagement Theory
CFI	Confirmatory Fit Index
CoPCM	Community of Practice in Crisis Management
DRR	Disaster Risk Reduction
EV	Eigenvalue
GIS	Geographic Information System
NOE	Negative Outcome Expectancy
POE	Positive Outcome Expectancy
PoS	Portfolio of Solutions
RMSEA	Root Mean Square Error of Approximation
SD	Standard Deviation
SEM	Structural Equation Model
SP	Subproject
TLI	Tucker Lewis Index
WP	Work Package

1. Introduction

Ever since the appearance of the Hyogo Framework for Action in 2005 (1), there has been a shift within the international disaster resilience discourse. Where once the main goal was that of hazard planning and disaster risk reduction, it has moved towards a focus on building community resilience. The widespread adoption of the 'resilience' discourse (e.g. (2) (3) (4) (5)) marks a notable shift from a state-centred approach to risk and safety, towards an integrated approach whereby the activated community (including all different stakeholders across the community as well as citizens) takes responsibility for building and strengthening its capacities to cope with sudden shocks and long-term stresses or transformations.

Generally, citizens are the first ones to actually deal with the crisis situation, and evaluations have shown that they often respond adaptively: they take reasonable decisions and select the actions that are needed for the situation at hand (6) (7). However, even though citizens can demonstrate adaptive behaviours, the above studies also highlight how their capacity is bound by their knowledge and abilities. That is, adaptive capacity can be improved and its effectiveness developed through better preparations.

In a context of ever growing risk from natural hazards, encouraging sustained preparedness and the adoption of precautionary actions remains an essential Disaster Risk Reduction (DRR) goal. In the Netherlands for example, a flood is considered the most prominent risk, but research has shown that citizens are minimally prepared (8) (9). More insight is therefore needed into the psychological mechanisms underlying preparatory behaviour in order to effectively apply interventions that motivate citizens to prepare (10).

Increased community resilience and community empowerment are also changing the relations between citizens and professional responders in crisis management. First, as noted above, citizens do not passively wait for professionals to arrive (7). As a result all kinds of activities are going on when professionals arrive at the scene. In a Dutch study investigating how professionals would react to such active citizen it was observed that five teams (17% of a total of 29 teams) sent citizens away immediately, five teams allowed them to stay at the scene and the rest of the teams sent (part of) the citizens away at a later point in time (11). In all, this study illustrated the lack of guidelines professionals have in dealing with citizens at the scene.

In order to adaptively respond to an actual crisis, there is no 'one size fits all' solution. First, communities differ on various dimensions and it is important that the complexity of communities is understood (the 'DNA' of local areas) (2). One of the main lessons learned from countries that have experienced large scale disasters such as flooding (Australia) and earth quakes (New Zealand) is that professionals need deep insight into the specifics of local communities as to optimally link activities to community needs (2). This requirement relates to the changed relationship between citizens and professionals and is not easily achieved through procedures and guidelines, but rather requires a different mind-set (11). A first step towards this changed mind-set would be increased awareness of resilience differences between communities and implications for professional involvement.

1.1 Present research

The present deliverable describes a study that has been conducted in the context of the initial DRIVER project (SP3 Societal Resilience). It is closely related to D934.16 "Community engagement tool", which describes a specific method to increase community resilience. The goal of the present study was to identify the relation between community resilience indicators and level of preparedness for flooding as to validate the Community Engagement theory of Paton (12) (5) in a European context. A survey study was conducted in The Hague in the Netherlands. The results of this study are reported in Chapter 2. To address implications for professionals in dealing with more or less resilient communities a dashboard was developed that could be used by professionals to get insight into a community's resilience, that is, its vulnerabilities and capabilities. The applicability of this dashboard was assessed through a focus group with professionals from all relevant disciplines (and Safety Regions), complemented with dedicated interviews with professionals (Chapter 3).

As a theoretical background the Community Engagement Theory of Douglas Paton (13) (5) was used, which is a multi-level model, operating on three levels and theoretically underpinned by six indicators:

1. Individual level

   Indicator: (i) outcome expectancy.

2. Social and community level

   Indicators: (ii) community participation; (iii) collective efficacy; (iv) place attachment.

3. Institutional level

   Indicators: (v) empowerment; (vi) trust.

These CET variables are used as predictors for citizen preparedness for flooding in the Netherlands as well as capacities of communities incorporated in the dashboard as to support professional awareness of resilience differences between communities.

2. Predicting preparations for flooding[1]

2.1 Introduction

Citizens generally respond quite adaptively to crisis situations: they take reasonable decisions and select the actions that are needed for the situation at hand (7) (6). However, even though there is mostly no panic or irresponsible behaviour, the quality of the actions is clearly bound by knowledge and abilities. After the 2007 Hebei Spirit oil spill in South Korea, for example, many people suffered from skin diseases. These people were not aware of the toxicity and harmful effects of petroleum, and had consequently not taken any precautionary actions (14). This example illustrates how adaptive capacity can be improved through better preparations. However, even though many countries actively encourage their citizens to prepare for disaster, the results of those efforts are quite discouraging (15). This identifies a need to understand why some people prepare, while others do not, even when facing and acknowledging their risk.

The most predictive factor for precautionary actions is whether people have already experienced a disaster (16) (17). However, as few citizens have actually experienced one, it is important to focus attention on how to motivate people to prepare for potential threats in a context of infrequent hazard events that can occur with little or no warning. In the Netherlands for example, a flood is considered the most prominent risk, but research has shown that citizens are minimally prepared (8) (18). More insight is therefore needed into the psychological mechanisms underlying preparatory behaviour to effectively apply interventions to motivate citizens to prepare (10). Such insights are typically sought using behavioural models. These models have played prominent roles in preparedness because they focus on identifying how people make choices under conditions of uncertainty, such as those that prevail when dealing with unknown natural hazards.

2.1.1 Behavioural models

Several behavioural models, such as the Protective Action Decision Model (PADM) and the Protective Motivation Theory (PMT), have been used to predict flood disaster preparedness (19) (20). These theories have demonstrated how individual-level factors, such as risk appraisal, previous experiences, self-efficacy and response-efficacy can contribute to predicting both people's intentions to prepare and actual preparedness prior to the occurrence of disaster. While it has received less attention than other variables, there is evidence to indicate that precautionary behaviour is also influenced by affect (21) (22). Siegrist and Gutscher (23), for example, suggested that the negative feelings related to previous experiences with flooding directly affects preparations (24). Given that most preparedness actions occur prior to actual events, the question is whether affect plays a comparable role in circumstances in which people have not had hazard experiences.

Affect is a general concept and defined as 'positive and negative evaluations of an object, behaviour, or idea with intensity and activity dimensions' (25). Slovic and his colleagues suggest that affect reveals preferences: a positive affect signals a positive valuation of a situation or concept and the other way around, a negative affect a negative valuation (26). As such, affect can be used as a heuristic: a particular feeling may act as a driver for performing a certain kind of action or not (26). Loewenstein, et al. (27) argue that risk perception emanates from both a cognitive path and an affective path. This view was reiterated by Terpstra (28) who stated on the basis of his study that flood preparedness of Dutch residents is guided by an affective and by a cognitive path. Both paths can operate in parallel and have distinct influences on behaviour (an individual may, for example, know that a particular risk is low, but still feel anxiety or fear about that risk at the same time).

[1] This chapter was published as a journal article: Kerstholt, J., Duijnhoven, H. & Paton, D. (2017). Flooding in The Netherlands: How people's interpretation of personal, social and institutional resources influence flooding preparedness. International Journal of Disaster Risk Reduction, 24, 52-57.

Affect can also interact with cognitive processes to influence whether people prepare for natural hazards. Paton et al. (22) found that anxiety (about a hazard) could both increase and decrease the likelihood that people would adopt precautionary measures. Outcome expectancy (also known as response efficacy) played a mediating role in the relationship between anxiety and preparedness. Only if people believed that it was possible to adopt (personal/ household) protective actions to mitigate the risk, anxiety acted to increase the likelihood of preparedness. So, for hazards such as a coastal flooding in the Netherlands, it was predicted that both cognitive and affective factors influence preparedness.

The choice of variables used to inform how hazardous circumstances are interpreted should accommodate the degree of uncertainty in the decision-making context. In addition to the variables described above, the assessment of environmental risk is also influenced by others' views and the choices they make (29) (30). This introduces a need to consider how people's perceptions of the quality of their social relationships influence their interpretation of risk and what they might do to manage it.

2.1.2 Social level influences on risk interpretation and action

When seeking to understand preparedness actions, it is important to accommodate social influences on how the risk associated with infrequent and potentially challenging events is perceived and interpreted and how this informs what people do to deal with it (29). The emotional connections that develop between both the members of the neighbourhood (e.g., sense of community) and between them and the place itself (place attachment) increases the likelihood of hazard preparedness (31) (32) (33) (4). Wood, et al. (33) showed that the strongest motivator to take preparedness actions is when individuals share what they have done to prepare with others. Similarly, Paton and Buergelt (32) illustrated how discussions about hazards provided information on how to mitigate certain risks. In all, these studies suggest that exploring preparedness needs a theory that integrates variables at various levels, individual and social, and includes both cognition and emotions. The theory selected to provide the foundation for the work discussed in this paper is the Community Engagement Theory (CET) (12) (5).

2.1.3 Community Engagement Theory: individual, social and institutional level

In his CET, Paton (29) integrates variables at three different system levels: individual, social and institutional. Analyses of the CET demonstrated that the more people believe that personal actions can mitigate risk (*outcome expectancy*) the more citizens can collectively formulate their risk management needs and strategies under conditions of uncertainty (*community participation* and *collective efficacy*). Further, the more they perceive their needs as having been met through their relationship with civic agencies (*empowerment*), the more likely people are to *trust* civic agencies and the information they provide and use it to make readiness decisions. Trust, it is argued, plays a key role in how people make decisions under conditions of uncertainty. Trust has similarly been implicated in studies of flooding preparedness. Terpstra (28) discussed how trust affected both dread (an affective influence comparable to anxiety) and perceived likelihood, with these variables having an indirect effect on preparedness.

2.1.4 Present study

Previous research indicates that people underestimate the likelihood of low-probability risks (23) (34). To motivate citizens to take precautionary actions, more insight into the mechanisms underlying this behaviour is needed. In the present study, the Community Engagement Theory (5) was used as a starting point for measuring underlying constructs. The way in which the theory was adapted is discussed in more detail below.

Consistent with previous studies in the Dutch context (8) (18) (28), this study added risk perception (including affect) in addition to the variables included in previous studies with CET. Based on work that preceded the development of the CET, it was hypothesized that risk perception would have a direct influence on preparedness (22).

For affect it was hypothesized that, given the action of the 'affect heuristic' (26) (27), it would have a direct influence on preparedness. In addition, an indirect effect is hypothesized such that response efficacy mediates the relationship between affect and preparedness (22).

2.2 Methods

2.2.1 Respondents and procedure

Respondents were recruited through a panel that is managed by a professional agency commissioned by the municipality of The Hague. The city of The Hague borders the North Sea and as it is below sea level, consequences will be severe in case of a coastal flooding. The total panel consists of 6000 respondents. The characteristics of the panel are as follows: 1) gender: 54% male, 46% female; 2) age: 15-24, 1%, 25-44, 31%, 45-64, 46%, >65 22%; 3) education: low 12%, middle 25%, high 63%; 4) cultural background: native 70%, foreign 30%. A random sample of 1200 respondents was drawn from this data base. They were all invited to participate. As 629 persons agreed to participate the response rate was 52%.

The mean age of the respondents was 58 years (SD=13 years), 370 men (59%) and 259 women (41%). Most of the respondents had a higher education level (N=363, 58%), 179 (29%) had a mean level of education and 78 (12%) respondents a low level. Most of the respondents were employed (59%): 309 were salaried workers (49%), 60 (10%) were businessmen, 180 (29%) were retired and 48 (8%) were unemployed or disabled. 555 individuals (88%) were native and 62 (10%) were foreign.

2.2.2 Material

The survey used by Paton was translated, adjusted to the Dutch culture (which mainly concerned items at social level as most Dutch communities do not have evident community leaders) and risk perception (probability, consequences and affect) was added. Together with the original constructs in the Paton survey, response-efficacy (positive and negative), community participation, community efficacy, trust and empowerment, the survey comprised 8 underlying concepts. In this section, the operationalisation of these concepts is presented, while the results are described in the next section 2.3. For all scales factor analysis was used in order to extract the relevant factors from the set of items.

In order to measure affect three items were used: I feel anxious, I feel uneasy and I feel worried. Factor analyses over these items showed one factor (EV=2.51, 84% explained variance, α=.90). The mean value of these three items was taken as the score for 'affect'.

Probability was measured by three items, for example, 'probability that there will be flooding in the next 10 years' (one factor, EV=2.34, 78% explained variance, α=.86). The mean score of these items was taken as the score for 'probability'.

Consequences were measured by eight items (for example 'gas and electricity will fall out' and 'severe damage to your house'). Factor analysis revealed one factor (EV=4.47, 56% explained variance, α=.88). The mean value of these items measured 'consequences'.

Response-efficacy was measured by six items, for example, 'there are few things I can do to prepare for flooding'. There were two factors: the first factor reflected the opinion that preparation mitigates negative effects of flooding (four items: increased chance of surviving, reduction of probability of traumatic experience, less damage to the house and better able to help others, EV=2.4, 35% explained variance, α=.71). The second factor reflected helplessness towards preparing (three items: 'it is difficult to prepare', 'there are few things you can do' and 'it is of no use to protect yourself', EV=1.4, explained variance 20%, α=.56). Because the first factor seems to best reflect efficacy and as the internal consistency of the second factor is quite low, the mean score of the four factors was taken, as an indication of response efficacy.

Neighbourhood participation was measured by four items (for example 'I collaborated with others to improve the liveability of this neighbourhood' and 'I attend public events when it concerns our neighbourhood'). There was one factor (EV=2.6, 65% explained variance, α=.82). The mean value was defined as 'neighbourhood participation'.

Community efficacy was measured by five items (for example 'we are able to take decisions together, even when opinions differ' and 'when times are hard we can collaborate as a neighbourhood to find a solution'). There was one factor (EV=3.4, 69% explained variance, α=.88) and the mean value across items was therefore computed.

Trust was measured by six items (for example 'I trust that the local government takes the needs of the citizens into account' and 'I trust that I will be warned by the government in time'). There was one factor (EV=4.4, 73% explained variance, α=.93). The mean value was taken as indication of trust.

Empowerment was measured by eight items (e.g. 'I think that chosen representatives take my opinion seriously' and 'Attending neighbourhood activities has positive results for me'). There were two factors. The first factor reflects an overall sense of empowerment (EV=3.9, 48% explained variance, α=.83), the second one makes a distinction in results of representatives and own activities (EV=1.4, 17% explained variance). The mean value of all items was used as an indication of empowerment.

A distinction was made in 15 items to measure specific activities to prepare for flooding such as 'get an emergency kit', 'search for information on what to do in case of an evacuation, 'know whether there is a suitable location to go to'. Participants could indicate whether they actual did it, whether they were intended to do it or no intention at all. Factor analysis shows that there are three factors with an eigenvalue larger than 1.0 (5.0, 1.7 and 1.2 respectively). The internal consistency across all items is high (α=.84). Two different measures were distinguished: actual preparation which is the number of behaviours that have actually be done (in the past) and intention which is the number of behaviours that is actually being done (in present) and that one is intended to do (in the future). So, the last measure would exclude the behaviours that one did not want to do.

As a benchmark, participants were asked to indicate how much they worried about the following events: increasing costs of living, crime/unsafety on the streets, societal disparity between demographic groups, climate changes, own health or health of family members, terrorism, large domestic fire, large flooding in their region.

2.3 Results

Table 2.1 summarizes how much respondents worried about hazardous events that could occur within their environment (using six points scale ranging from 'never' to 'often'). As can be seen in Table 2.1, respondents worry least about flooding. Instead, they were more concerned about societal disparity between demographic groups and health issues. While discussing this is beyond the goal of the present study, these data provide interesting insights into the societal context in which hazard preparedness is undertaken. These data highlight a problem with most hazard preparedness research; the implicit assumption that (infrequent) natural hazards are of sufficient interest to people to motivate action to mitigate their risk and prepare. The contents of Table 2.1 prompt speculation that the relatively low salience of floods, compared with other social-environmental challenges will act to reduce people's interest in flood preparedness.

Table 2.1: Mean 'worry' scores for the different events

type of event	mean and sd
societal disparity between demographic groups	3.50 (.91)
own health of health of family members	3.25 (.84)
crime/unsafety on the streets	3.12 (.94)
increasing costs of living	3.09 (1.06)
climate changes	2.92 (1.01)
terrorism	2.75 (1.0)
large domestic fire	2.40 (.82)
large flooding in your region	1.93 (.83)

Table 2.2 shows the mean values and standard deviations of all concepts that were distinguished and Table 2.3 the correlations. The correlation between the underlying mechanisms and actual preparations were quite low: the highest are community participation (.19) and response efficacy (.16). For intention to prepare the highest correlations were affect (.35), probability (.31), response efficacy (.35), participation (.29) and empowerment (.22).

Table 2.2: Means and standard deviations for the various concepts

variable	mean	sd
Affect (Af)	1.44	.60
Probability (Pr)	2.20	.99
Consequences (Co)	3.96	.78
Response efficacy (Re)	3.22	.78
Participation (Pa)	2.14	.88
Community efficacy (Ce)	3.38	.81
Trust (Tr)	3.95	.89
Empowerment (Em)	3.14	.73
Preparations (Pre)	2.04	1.94
Preparation intention (Int)	6.11	4.24

Table 2.3: Correlations between the variables

	Af	Pr	Co	Re	Pa	Ce	Tr	Em	Pre
Probability	.44								
Consequences	.25	.27							
Response efficacy	.16	-.13	.11						
Participation	.04	.11	-.03	.13					
Community efficacy	.04	.00	-.01	.21	.41				
Trust	.02	-.21	-.06	.16	.02	.16			
Empowerment	.04	.02	-.05	.30	.41	.49	.32		
Preparation	-.07	.11	.09	.16	.19	.13	.02	.10	
Intentions	.35	.31	.14	.35	.29	.16	.09	.22	.39

In order to analyse which variables would best predict actual preparations and intentions regression analyses was conducted with either intentions or actual preparations as dependent variable and with all other constructs as predictors. When preparation was used as the dependent variable the (adjusted) explained variance was .12, with intentions as the dependent variable 29% of the variance was explained (adjusted R^2). Table 2.4 and Table 2.5 present the β weights (standardized coefficients) and significance for actual preparations and intentions.

Table 2.4: Regression weights and significance level with preparations as dependent variable

Predictor	weight	p-level
Affect (Af)	-.14	.00
Probability (Pr)	.15	.00
Consequences (Co)	.12	.00
Response efficacy (Re)	.06	.50
Participation (Pa)	.14	.00
Community efficacy (Ce)	.02	.63
Trust (Tr)	.04	.35
Empowerment (Em)	-.03	.50

Table 2.5: Regression weights and significance level with intentions as dependent variable

Predictor	weight	p-level
Affect (Af)	.236	.000
Probability (Pr)	.164	.000
Consequences (Co)	.039	.28
Response efficacy (Re)	.22	.00
Participation (Pa)	.22	.00
Community efficacy (Ce)	-.04	.36
Trust (Tr)	.08	.04
Empowerment (Em)	.03	.45

Based on the correlations and regression weights a structural equation model (SEM)[2] was constructed including preparation intentions (actual behavior and intended behavior) rather than actual preparedness. The use of intentions increases the scope for comparing these findings with those in other studies (e.g. because the specifics of preparedness vary considerably from hazard to hazard and several less tangible factors can mediate the intention-preparedness link) (5) (12). The model is presented in Figure 2.1 ($X^2(7)=12.20$, p=.09; CFI=.99; TLI=.98; RMSEA=.034). The findings illustrate that the data are a good fit to the model. Furthermore, explaining 29% of the variance represents a good effect size (35).

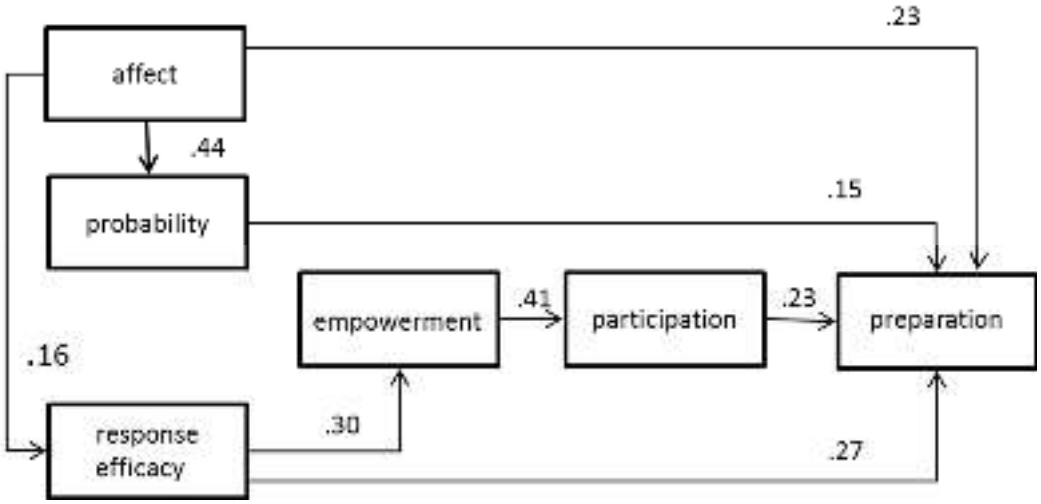

Figure 2.1: Relation between underlying concepts and preparation intentions

Figure 2.1 illustrates how affect had both direct and indirect effects on (intention for) preparation. The indirect influence of 'affect' on preparedness was mediated by the assessment of probability and response efficacy. Response efficacy had both direct and indirect influences on preparation. Its indirect effect was mediated by empowerment and participation.

2.4 Discussion

[2] SEM is a statistical model describing potential causal dependencies between variables. The strength of the relationships is provided by numerical estimates for each of the parameters (arrows) in the model. The "fit" of an estimated model, to determine how well it models the data, is described by a set of indicators (CFI, TLI and RMSEA).

Using an adapted version of Paton's Community Engagement Theory (5), the present analysis confirmed that people's engagement in social networks (empowerment and participation) mediates the relationship in their belief that personal actions can mitigate risk and preparedness. The major change to the version tested was the inclusion of measures of risk perception, the assessment of probability and consequences as well as affect. Affect had both a direct and an indirect effect on the level of preparations (Figure 2.1). The direct effect can be explained by the action of the 'affect heuristic' (26) (27). This heuristic means that a feeling associated with the risk of flooding is directly used as a trigger for action.

Two indirect pathways were evident (Figure 2.1). The first indicated that people's beliefs about the probability of a future event mediate the relationship between affect and preparedness. This supports the notion that preparatory behaviour is influenced by both a cognitive and an affective route (27) (28). A second indirect relationship was evident in the path linking affect and response efficacy (or positive outcome expectancy). This supports earlier findings that response efficacy mediates the relationship between affect and interpretive processes that support preparedness (22). While Paton et al. (22) identified cognitive factors (e.g., action coping beliefs) as being instrumental in this context; the present study suggests that affect represents an appropriate additional variable to include in a modified CET.

Respondents who felt that preparations could actually mitigate the consequences of a flooding, felt more empowered by formal agencies and were in turn, more likely to engage with others in their community to determine ways to enact precautionary behaviour. This result partially supports previous findings of Paton (12). A role for collective efficacy was not supported in the present analysis however.

In addition to variables at an individual level of analysis, preparations were also influenced by level of community participation. Level of participation may reflect strong social networks, increasing the chance that information is exchanged informally in ways that support preparing for uncertain events (33) (32) (36). Respondents who felt more empowered by formal agencies more often participated in their community, which in its turn increased the likelihood of their engaging with others in ways that motivated them to prepare for flooding.

Consistent with the findings of Terpstra (28), a positive relationship between trust and preparedness was predicted. However, this role for trust was not supported. One explanation for the discrepancy derives from how trust is operationalised. Terpstra (28) specifically asked for trust related to flood defences (such as strength, height and maintenance) whereas the present study used a generalised operationalisation of trust in civic agencies (also including aspects like advice and information about what people and households should do to prepare for hazard events). The present study failed to find a role for the latter aspect of trust. This failure to find an influence for trust is, however, consistent with the theoretical foundation of CET (20).

Paton (12) discussed how trust was predicted to be important only when people faced uncertainty when being asked to prepare for infrequently-occurring hazards. That is in circumstances where they cannot find out about a hazard for themselves and are dependent on others, particularly civic risk management agencies. Paton tested this idea by comparing the model for infrequent (e.g., earthquake, volcanic hazards) and frequent hazard events (e.g., bushfires in Portugal and Australia and volcanic hazards in Kagoshima, Japan). The latter studies confirmed the premise that underpinned the original conceptualisation of the theory. Trust was not supported in analyses of events about which people had knowledge and direct or indirect (e.g., highly frequent media coverage) experience of (29) (32) (5). The failure to support a role for trust could be explained by people believing that they sufficiently know themselves. Another possibility (or a complementary one) is that the role of trust was reduced by the low perceived salience of flood hazards increasing the likelihood of people transferring responsibility for managing risk from themselves to civic agencies (20).

As shown in Table 2.1 by the results, citizens worried most about societal disparity between demographic groups (3.5 on a six points-scale) followed by health issues (3.25 on a six points-scale). Flooding, on the other hand, had the lowest score (1.9 on a six points-scale), meaning that it is a less salient hazard for

citizens. This is particularly important as people exactly need to think about hazards and preparedness during periods of hazard quiescence. Low salience is also likely to reduce the effectiveness of risk communication as civic agencies are communicating with people at a time when flooding and flood preparedness are issues occupying low prominence in the community discourse.

The problem of encouraging household and personal flood preparedness could be compounded by the fact that citizens may be over-reliant on structural flood defences. Not only are these structural measures, such as dikes, highly visible, but Dutch people also have been consistently told by the government that they are quite safe in their country due to these measures. A combination of the presence of prominent structural measures and being consistently told of the effectiveness of these measures could, via the action of the risk compensation bias (18) (20), reduce people's perceived need for personal preparedness. This bias arises because people make judgments about their risk based on their perception of how safe the environment appears to be. The visibility of structural mitigations and civic risk management agencies consistently reminding people of their existence and their ability to offer protection (which people may overestimate) can result in people seeing their environment as safe and as negating any need for them to prepare.

Based on the findings the following consequences for risk communication can be formulated. First, risk communication should not only focus on facts and figures, but trigger affective reactions as well as these reactions are most influential for actual preparations. As noted by Visschers et al. (37) many risk communication programs unintentionally induce affective reactions, which may actually have stronger effects than intentional manipulations like fear appeals. The finding that response efficacy plays an indirect role in the preparedness process suggests that risk reduction strategies should include information on why preparedness measures are effective (20). Second, risk communication should also take the diffusion of the message into consideration, particularly through existing social networks. In line with this suggestion, Prior and Paton (34) propose a collaborative approach, a forum where issues about preparing can be discussed and addressed more collectively. Finally, empowering the community may also create stronger sense of community by fostering householders' reliance on their peers in the community instead of the emergency services.

One limitation of this study, as is the case with all surveys, is the selective sample used. The sample was drawn from a panel of people in The Hague who had given their consent to fill in questionnaires of the municipality on a regular basis. In general, the panel over-represents elderly people, individuals with a higher education, two-person households and families, and under-represents foreigners. The potential for this sample to over-represent those with an interest in flood preparedness cannot be discounted. This possibility is supported by the benchmark measurements. The Hague residents perceive flooding as a low salience issue, raising the possibility that the sample reflects those interested in flooding or who have a high sense of civic responsibility. While this needs to be examined in more detail in future work, there are a number of positives that emerge from these findings. Citizens attribute higher levels of salience to social environmental hazards that are more prevalent in their life on a day-to-day basis, such as societal disparity between demographic groups, health issues and crime. This raises the possibility of enhancing the effectiveness of hazard preparedness by integrating it within a more generalised community development context (20). So in strengthening community resilience in a way that increases adaptive responses to a broad range of physical and social hazards it might be more effective to focus on issues that really bother citizens and trigger strong affective reactions. This can then be used to motivate people to take action to confront hazards on a more comprehensive basis.

3. Dashboard to enhance collaboration between citizens and professionals

3.1 Motivation

Increasing community resilience has implications for professionals. Often, citizens are already at the scene when an incident occurs, and they play a vital role in the early, chaotic stages of crisis response. Many disaster reports recount stories of citizens that spontaneously started with caring for victims, providing transport, or performing other tasks, as soon as they were confronted with a crisis (e.g. (7) (6) (38) (39). Such citizen actions come spontaneous and stem from fundamental inter-human interest (40) (41).

Ideally, professional responders make use of the local and situational knowledge of the public at the scene and fully utilize the capacities of the citizens that are present. In practice, however, there is often a lack of standing operational procedures or practical knowledge among professional responders on how to actually collaborate with the public at the scene (11). Aside from spontaneous volunteering at the disaster scene, modern (communication) technology makes it easier for people to mobilise crowds, gather funds or acquire supplies. Such citizen initiatives are usually hailed as prime examples of the power of community in times of trouble. But despite their good intentions, such initiatives also pose questions with regard to effectiveness, safety and situation control. If citizens become more pro-active during crises, the responsibilities and general attitude of professional responders need to be re-evaluated, and a new balance needs to be sought between the responsibilities of government parties and the inevitable actions of citizens.

In order to come to a more effective collaboration between professional responders and the public in crises, professionals could work on better tailoring their interactions with affected communities to the specific needs and capacities that are available within these communities. In order to evaluate how professional response activities could be better aligned to the specifics of the community, a dashboard was developed. This dashboard provided both the vulnerabilities and capabilities of the community and was used as a concrete measure to facilitate discussions as to how professionals could make better use of resilient communities.

3.2 Method

3.2.1 Respondents and procedure

All in all 12 experts gave their opinion on the dashboard in a qualitative study. First, the demo-version was discussed in a focus group with a multidisciplinary team of safety managers from the safety region The Hague. This team consisted of representatives from the municipality, fire brigade, police, and medical services. Secondly, dedicated interviews were conducted with four experts from the field of crisis management. These experts were two safety coordinators from two different safety regions (Midden-West Brabant and Haaglanden), a researcher from the Safety Institute, a freelancer in the safety domain and a neighbourhood team coordinator from the municipality of The Hague.

Based on the demo-version, the applicability of a dashboard was assessed in two steps. It was started with a presentation explaining the background of the study and an introduction of the dashboard. This was followed by a semi-structured interview with a focus on the following points: 1) opinion of the dashboard and usability; 2) who could use the dashboard and in which phase; 3) what information is relevant and what is the implication for cooperation with citizens; 4) additional ideas and requirements with regard to the content and design of the dashboard.

3.2.2 Material

The dashboard is based on a set of indicators to measure both the vulnerabilities and capacities of a community. For the vulnerabilities indicators were used such as the number of elderly citizens, citizens with special needs and the presence of hospitals or care facilities. Capacities were based on indicators of resilience adapted from the Community Engagement Theory (5).

The results from the survey administered in The Hague were used (see Chapter 2) combined with actual census registrations for The Hague to build a demo-version of the dashboard, providing resilience profiles for several districts in The Hague. The main page of the dashboard in the demo-version shows a resilience matrix with the two dimensions (capacities and vulnerabilities), in which each district is given a position based on the data of the underlying set of indicators (see Figure 3.1). This will provide the users of the dashboard with a quick view of the resilience profile of a specific community as belonging in one of four quadrants (the combination of high/low capacities and high/low vulnerabilities). The colours of the quadrants indicate the level of resilience, green: high capacities/low vulnerabilities; yellow: low capacities/low vulnerabilities; orange: high capacities/high vulnerabilities; red: low capacities/high vulnerabilities.

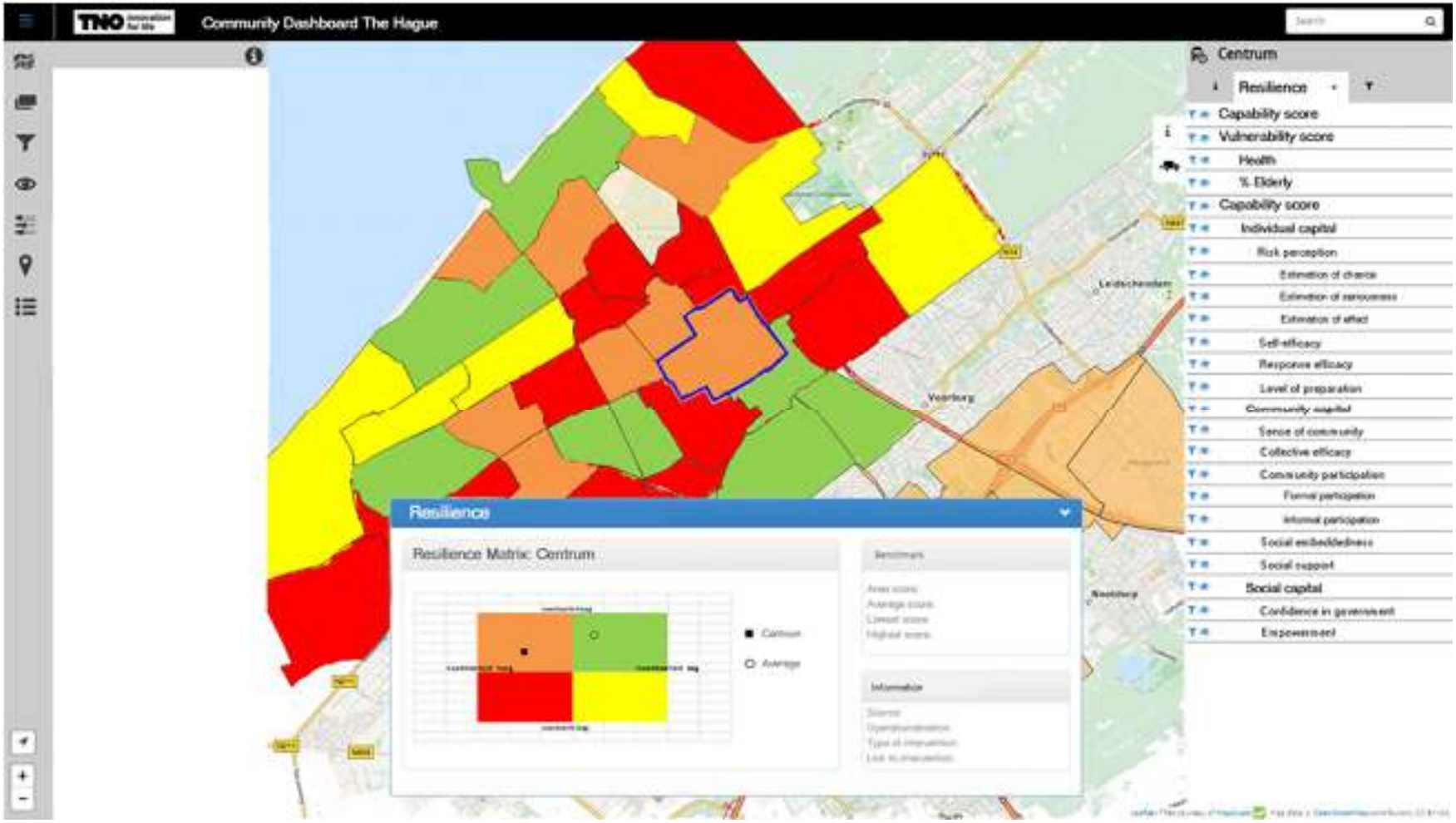

Figure 3.1: Community Resilience Dashboard

For a more in-depth analysis of the resilience profiles, users may browse each of the underlying factors in order to see what the specific factors are that influence the actual position in the matrix. This information can provide useful input for determining or adjusting the course of action of professional responders when preparing for or responding to an event in that community.

Displaying geographic information about the resilience of an area is typically performed in a Geographic Information Systems (GIS). There are several popular commercial GIS systems available, each with different strengths and limitations. In order to be able to share the information more widely, the open source web-application CommonSense (http://github.com/TNOCS/csWeb) was chosen: besides being familiar with this framework, as it was developed by TNO, it uses modern techniques and also offers many customisation features that were needed.

The CommonSense framework provided the base map application out-of-the-box: to show the data, select different background layers, and style and filter the areas of interest. In addition, it was needed to design the specific info graphic to display the results. In CommonSense, additional functionality can be added in the form of dashboards and widgets: therefore a project-specific widget was created that was integrated with the framework and added to the main (default) dashboard of the application.

The initial design of the info graphic itself was further done by creating screenshots of the base application, and using cut-and-paste to add different graphics on top of this (see Figure 3.1 for an example of these screenshots).

3.3 Results

In general the respondents were positive about the underlying idea of bringing together useful information about the level of resilience of different communities to enhance professional responders' assessment of a crisis situation. The idea is in line with current ambitions in the field to make better use of existing information to facilitate and stimulate effective collaboration with citizens and groups or organizations in affected communities and to better utilize the range of capacities that are present in these communities.

The respondents saw a lot of benefits of using such a dashboard during the pre-event phases. They argued that it could contribute to improved collaboration, starting in the preparation phase, for instance by building stronger relationships between existing community networks and the professional responders. Such relations would save time during a crisis because there are existing connections with the affected community through these points of contact.

According to the respondents, the use of a dashboard like the demo-version during the actual crisis response phase seems more complicated. In particular, they saw a risk in basing part of the decisions about courses of action on the information in a dashboard. In order to be able to base a decision on such information, it is essential that the data is correct and updated dynamically (in real-time). Crisis situations are always unique and it is dangerous to assume to know what can be expected based on more or less static information that is drawn from external sources or a periodic survey. Technically it would be possible to create automatic links with existing, external databases to make sure the dashboard always represents the latest information. But this means that the quality of the dashboard still needs to rely on the accuracy of and connection with those external databases. The respondents indicated that they would be very careful and hesitant to draw conclusions about their courses of action based on such information. At best, it would point them into certain directions much more quickly, but they would still need to verify the direction with the actual situation at the scene. Not only because the information may be outdated, but also because the crisis may have caused changes in the community in such a way that the capacities that are available in normal situations may already have been hampered.

Nevertheless, as the respondents indicated, certain information can contribute to the assessment and sense-making processes. For instance if there have been several incidents in a community related to tensions between different ethnic groups, this may indicate that even a relatively small event may escalate.

Also, knowing that there are active networks in the community (such as a neighbourhood watch) gives them the opportunity to contact key persons much quicker to get information about the situation.

The lay-out and interface of the demo-version of the dashboard was also discussed although most respondents did not have strong opinions about this. A few of them suggested changing the colours of the matrix, because the current colours are a bit suggestive and can be misleading or too judgmental.

Based on these considerations, the respondents arrived at the conclusion that even though a lot of data may be available to include in such a tool, it is important not to try to add too much details because that increases the possibility of erroneous or outdated information. Even though one may be inclined to consider a lot of different data to be relevant, it cannot be a sufficient basis for decision making in a crisis response situation. At best it will only lead to decisions to increase certain specialist response efforts or to contact specific key contacts within the community to facilitate better collaboration and aligning interpretations of the situation.

3.4 Discussion

Although most of the respondents saw benefits in using a dashboard with relevant data about community resilience, in particular for preparation and training purposes, the overall conclusion was that it is even more important to work on stronger relations between professionals and the community, through existing networks. Many organizations are already active at the neighbourhood level, for instance local neighbourhood police officers, welfare and healthcare agencies or neighbourhood officers from the municipality. These professionals know a lot about the communities and could be a great link between the emergency response professionals and the community. Furthermore, there are many existing social networks in communities that could be a good entry-point for contact with the members of a community.

There are many different types of networks varying from face-to-face or online networks, ad-hoc, short-term or long- term networks, networks that are bound by a geographical community or dispersed, large or small networks, networks relying on one or few individuals to stay active or networks that are more or less ‘asleep’, etc. Social networks have multiple functions, for instance emotional support, assistance, trust, a sense of belonging, advice, guidance, social integration or material aid and services (41). The importance here is that these networks are well established communities where people are familiar with each other, the procedures, the way of communication, but also know how to use the interfaces or technologies. It is important for response professionals during a crisis to work together with existing networks, as they are valuable sources of information about the area, the strengths and weaknesses or the key persons. Moreover, citizens who are at the scene of a disaster are the actual first responders and they will start offering help to each other even before the professional responders arrive.

4. Overall conclusion

The acknowledgement of the importance of strengthening community resilience is part of a broader transition in disaster management. It is recognized that preparation is a key factor when it comes to building resilience capacities (5) (20). Preparation relates to risk awareness and actions within communities (citizens preparing for specific risks) but also to relations between the public and professional responders. While professional responders have a long tradition in training and preparing for response procedures in crisis situations, they generally do not prepare for collaboration with (resilient) citizens. So if citizens are stimulated more and more to become resilient and prepare for disasters, professionals also need to prepare for interacting with resilient communities.

A survey was administered based on the multilevel resilience framework (CET) among citizens in The Hague relating resilience indicators to taking precautionary actions. The main finding from this study is that all levels that were identified in the CET framework were relevant to prepare for flooding in The Hague: at the individual level affect, assessment of probability and response efficacy; at community level participation; and at institutional level empowerment. CET was already validated in a broad range of countries, like Australia and the Philippines. The research has shown that CET has an even broader scope such that similar indicators were found for preparation in a European country with a low-risk hazard: flooding in the Netherlands. An implication is that the questionnaire can be used as validated instrument to assess various indicators of community resilience. As such it would provide insight into the overall (comparative) level of resilience, as well as relative strong and weak aspects that could be used as a starting point for increasing resilience.

From the perspective of the responders, the results indicated that having access to information about the level of resilience of communities has a great potential in supporting professional responders in crisis management. Yet knowledge about communities' levels of resilience or sharing information is not enough and comes with limitations (for instance regarding information reliability and accuracy in a dynamic crisis context).

Even more important is to facilitate the structural collaboration between citizen communities and professionals. To improve collaboration during or after a crisis, professionals and communities should build stronger relationships already in the pre-crisis phases. Collaboration should already start in the preparation phase and continue throughout all phases in crisis management. An important starting point for professionals to build relations with communities is to use existing social networks as entry points to the communities. If professionals know what kind of networks exists and how to contact key members of those networks, they can get quicker access to in-situ knowledge in case of a crisis. Since people tend to use what they are familiar with when they are under stress (in crisis situations), it makes sense for professionals to also use existing networks to obtain relevant information and to build relationships with communities.

In turn, building relationships with professional responders before a crisis occurs may contribute to citizens' resilience. Getting to know each other will increase mutual trust and facilitates approaching response organizations during a crisis for coordination of needs and actions, which will increase the effectiveness of their own response activities.

For DRIVER+, a main recommendation is to convey a new foundational vision on crisis management that stresses 'collaborative resilience': collaborations between professionals and citizen communities that are based upon maximizing capacities and minimizing strict operating procedures. In order to attain this situation, resilience and cooperation needs to be built up in the pre-crisis phases. Resilience can be increased by motivating citizens to prepare for a broad range of both known and unknown risks. Interventions should not be restricted to the individual level, for example risk communication, but take community level into account as well. Cooperation between citizens and professionals can be enhanced by increasing trust and empowerment (institutional level) and by mutual insight into each other's (perceived) roles, tasks and responsibilities.

Collaborative-resilience is not about creating formal, static collaboration agreements or rigid procedures. It is about creating conditions which encourage society-wide collaboration in disaster management and which are based on mutual understanding of capacities, limitations and ambitions across communities.

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Annexes

Annex 1 – DRIVER+ Terminology

In order to have a common understanding within the DRIVER+ project and beyond and to ensure the use of a common language in all project deliverables and communications, a terminology is developed by making reference to main sources, such as ISO standards and UNISDR. This terminology is presented online as part of the Portfolio of Solutions and it will be continuously reviewed and updated[3]. The terminology is applied throughout the documents produced by DRIVER+. Each deliverable includes an annex as provided hereunder, which holds an extract from the comprehensive terminology containing the relevant DRIVER+ terms for this respective document.

Terminology	Definition	Comment
Capability	The means to accomplish one or more tasks under specific conditions.	
Community building		Definition is still "under construction" and can be found online in the near future.
Community resilience	The sustained ability of a community to utilize available resources to respond to, withstand, recover from and adapt to adverse situations.	
Crisis	Situation with high level of uncertainty that disrupts the core activities and/or credibility of an organization and requires urgent action.	
Crisis management professionals		Definition is still "under construction" and can be found online in the near future.
Disaster risk reduction	Disaster risk reduction is the policy objective aimed at preventing new and reducing existing disaster risk and managing residual risk, all of which contributes to strengthening resilience.	
Measurement	Process to determine a value.	
Preparedness	The knowledge and capacities developed by governments, professional response and recovery organizations, communities and individuals to effectively anticipate, respond to, and recover from, the impacts of likely, imminent or current disasters.	
Prevention	Measures that enable an organization to avoid, preclude or limit the impact of an undesirable event or potential disruption.	
Societal resilience	Social entities and their abilities to tolerate, absorb, cope with and adjust to environmental and social threats of various kinds.	

[3] Until the Portfolio of Solutions is operational, the terminology is presented in the DRIVER+ Project Handbook and access can be requested by third parties by contacting coordination@projectdriver.eu.