Organizational Resilience and the Relationship With Six Major Crisis Types for Dutch Safety Regions

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An emergency response organization is resilient when it learns from and is well equipped to handle (potential) risks and hazards. In this paper, we will address the organizational resilience fit for Dutch emergency response organizations (safety regions) in relation to various types of crisis. The approach presented in this paper is based on a quantitative organizational resilience model. We validated the model by means of a survey conducted among the employees of Dutch safety regions. In this survey, we queried how the employees perceive the different attributes related to a set of crisis types. We used the results to calculate the quantitative representation of organizational resilience. We found that the presence of a Quality Management system or a Safety Management system does not significantly influence the organizational resilience of the organization. However, a statistically significant difference for organizational resilience was found in the type of staff assignment: volunteer, professional, or volunteer and professional. The volunteers rated the organizational resilience lower. We recommend to increase a safety region's organizational resilience by enhancing communication and organizational engagement of volunteers, stop pursuing a Quality/Safety Management program and perform further research on (international) emergency response organizations.

KEY WORDS: crisis type, emergency response organization, organizational resilience, safety management system, safety region, survey, quality management system

组织弹性及其与六种主要危机类型之间的关系——以荷兰"安全区域"为例

一个应急响应机构是具备弹性的，如果它有能力应对其所必须面临的（潜在）风险和危害，并同时从危机中吸取经验。笔者研究了荷兰应急响应机构（被称为安全区域）的设计方式和在应对不同（潜在）危机时的建构方式，二者之间可能存在的（非）适应。首先，本文提出的方法基于一项模型，这项模型定义了一组用于弥补组织弹性的性质。通过对荷兰安全区域中就职的员工进行调查，笔者证实了该模型。调查中，针对员工如何看待与一组危机类型有关的不同性质，笔者提出了疑问。笔者将调查结果引入上述模型，并计算了组织弹性的定量代表。笔者发现，质量管理体系或安全管理体系的存在并不会显著影响一个组织的组织弹性。然而，笔者在员工任务类型中找出了组织弹性的显著区别，员工任务类型分为：志愿者、专业人士、以及志愿者和专业人士。其中志愿者对组织弹性的评级较低。笔者建议，应通过以下方式增加一个安全区域的组织弹性：聚焦于提升沟通、促进志愿者进行组织参与、停止追求质量管理或安全管理计划、以及对（国际）应急响应组织展开进一步研究。

关键词： 危机类型, 应急响应组织, 组织弹性, 安全管理体系, 安全区域, 调查, 质量管理体系

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Una organización de respuesta a emergencias es resiliente si está bien equipada para lidiar con riesgos y peligros (potenciales) y para aprender de las crisis

En este documento trataremos el tema del posible (des)encaje de la forma en que las organizaciones de respuesta a emergencias en Países Bajos (las regiones de seguridad) están diseñadas y estructuradas para lidiar con una crisis (potencial) en relación con varios tipos de crisis. Primero, el enfoque presentado en este documento se basa en un modelo con un conjunto definido de atributos que conforma la resiliencia organizacional. Validamos con la ayuda de una encuesta llevada a cabo entre los empleados de las Regiones de Seguridad de Países Bajos. En esta encuesta preguntamos cómo perciben los empleados los diferentes atributos relacionados con un conjunto de tipos de crisis. Introdujimos en el modelo los resultados obtenidos y calculamos la representación cuantitativa de la resiliencia organizacional. Hallamos que la presencia de un sistema de gestión de calidad o un sistema de gestión de seguridad no tiene una influencia significativa sobre la resiliencia organizacional de la organización. Sin embargo, una diferencia estadística significativa de la resiliencia organizacional fue encontrada en el tipo de tarea del personal: voluntario, profesional o voluntario y profesional. Los voluntarios asignaron un valor menor a la resiliencia organizacional. Recomendamos aumentar la resiliencia organizacional de una región de seguridad con un enfoque en mejorar la comunicación, incrementar la participación de los voluntarios en la organización y dejar de buscar un programa de gestión de la calidad y / o seguridad y realizar investigaciones adicionales sobre organizaciones de respuesta a emergencias (internacionales).

PALABRAS CLAVES: tipo de crisis, organización de respuesta a emergencias, resiliencia organizacional, resiliencia organizacional, sistema de gestión de seguridad, región de seguridad, encuesta, sistema de gestión de calidad

Introduction

Resilience is one of the coping mechanisms organizations use as we live in a turbulent world in which many human-induced and natural hazards are present. Resilience is known to be considered in a multitude of varieties (Comfort, Sungu, Johnson, & Dunn, 2001; Folke, 2006; Folke et al., 2010; Holling, 1973; van Trijp, Boersma, & Groenewegen, 2018; Woods, 2007). Recently, we have seen the need for resilience in cases such as the hazards of the repeated wildfires in California (USA), Australia, Indonesia, and Southern Europe. Moreover, natural hazards such as flash floods and flooding in general, seem to be on the rise and threaten river settlements and coastal cities. Primary examples were hurricane Katrina that flooded New Orleans (2005) and super-storm Sandy causing major flooding in the greater New York area (2012) and most recently Harvey in the state of Texas (2017).

Additionally, emergency response organizations have to deal with terrorist attacks like the Manchester Arena attack on May 22, 2017, in which a suicide bomber detonated an improvised device and killed twenty-two people and physically wounded over one hundred people (Kerslake, Deeming, Goodwin, Lund, & Wahlström, 2018). All these hazards are fully capable of disrupting society on a local, national, or global scale (Tierney, 2014). Ways are sought to mitigate the effects of these disruptions (Aldrich, 2010; Aldrich & Meyer, 2014) and to quantify

resilience (Cutter et al., 2008; Lee, Vargo, & Seville, 2013). This array of crises and disasters is not only capable of disrupting but presents challenges to emergency response organizations all over the globe as well.

Emergency response organizations are tasked with mitigating whenever possible the effects of such crises. Next to dealing with the types of crises described above, emergency response organizations are also tasked with handling daily incidents such as: fires, transportation incidents, industrial incidents, and extreme weather. Thus, emergency response organizations are stretched to their limit or even beyond when faced with these hazards or their effects. In literature, there is still a prevalent dominance to regard crises in connection with preparedness while system interconnectedness, leadership, and communication is noted to be of vital importance (Boin, 't Hart, & Kuipers, 2018; Kuipers & Welsh, 2017). While it is argued in literature, societal resilience is needed to cope with the aftermath and direct effects on critical infrastructure (Boin & McConnell, 2007) similarly emergency response organizations need to build resilience (Ansell, Boin, & Keller, 2010; Boin & Lodge, 2016)

Organizational capacity should focus on a variation in external crises to demonstrate their resilience (Lalonde, 2007, 2011; Ruiz-Martin, Lopez-Paredes, & Wainer, 2018). This is in line with the standard definitions for organizational resilience in which an organization learns to improve itself by withstanding, surviving, and adapting to crisis demands (McManus, Seville, Vargo, & Brunsdon, 2008; Ruiz-Martin et al., 2018; Seville, 2017; Somers, 2009; van Trijp et al., 2018).

In the Netherlands, emergency response organizations are organized by region in twenty-five different "Safety Regions." A safety region is a public authority, which is composed of regional fire services, municipal medical departments, and regional medical emergency services with the main tasks among others are to organize and execute crisis management and to create an overview of all relevant risks and hazards in its territory: a public hazards and risk profile (Anonymous, 2009, 2010). Currently, the safety regions as composite emergency response organizations play a principal role in the Netherlands in mitigating, preparing for, and preventing a wide range of threats, incidents, and crises. Our research focused on the main research question "What is the state of organizational resilience of Dutch safety regions."

The Dutch 2010 Safety Regions Act (Anonymous, 2010) stipulates that the response of the safety regions should be of ample quality and fit with the incident or crisis at hand, before, after, and during the occasion (Boersma, Wagenaar, & Wolbers, 2012). As such, the regions are composed of the emergency services in the midst of a great variety of stakeholders, from administrative bodies and authorities to those activated through societal and media influences as self-organizing groups activated by hazards or crises. These tasks are organized in a structure focusing on policy, protocols, and standards laid down in a rigid structure demanded by the 2010 Safety Regions Act and checked regularly by the ministry and inspectorate.

In this paper, we propose an alternative and explore the usefulness of organizational resilience to describe the state of a safety region. In order to do so, we use a quantitative model that describes organizational resilience, and we applied it to the Dutch safety regions (van Trijp, Ulieru, & van Gelder, 2012, 2013). We

postulate that organizational resilience may be a good approach to describe the organizational state of safety regions in relation to the hazards in its service area.

We surveyed safety regions' employees throughout the Netherlands. We asked questions, from which we derive the utility value of each attribute according to the model, while other questions gave us insight if the presence of a quality management—or safety management system in the safety region enhanced organizational resilience. In this paper, we present and discuss the analysis of the quantitative data and the results of this survey. The survey should provide answers to the following research questions that make up for our main research question:

1. Which relevant crisis types are of interest to a Safety Region?
2. What is the organizational resilience of safety regions in relation to the defined external clusters of hazards and risks, also named "crisis types"?
3. What are the respective weight factors or utility values of the attributes that make up for organizational resilience?
4. Is organizational resilience influenced by the presence or absence of a quality and/or safety management system?
5. How do volunteer and regular staff rate the organizational resilience of their safety region?

The first three research questions have a direct relationship with the chosen model (van Trijp, 2012; van Trijp et al., 2012, 2013). Research question 4 is grounded in a theoretical study in which the contribution of a quality management or safety management system was found to be very low: just over 2 percent (van Trijp & Breur, 2013). This research question acts as a face validity study in which the outcome of the model is compared to previously obtained data. In the last research question, we engage any possible differences between volunteer or regular staff. In literature, we found indications that volunteer staff organizational engagement may diminish when those volunteers are faced with higher demands without a corresponding increase in organizational influence (Crawford, Lepine, & Rich, 2010; Harp, Scherer, & Allen, 2017; Sonnentag, Mojza, Demerouti, & Bakker, 2012). In this paper, we focus on the Dutch safety regions in general and organizational resilience in particular in relation to a set of real-world crisis types. Those crisis types act as typical and comparable external conditions in relation to which organizational resilience is determined.

Table 1. Occurrence of the Six Most Prevalent Crisis Types as Scored From the Regional Risk and Hazard Profiles Plus a Wrap Up Category

Nos	Crisis Type	*n*
1	Pandemic	22
2	Extreme weather conditions	19
3	Fire in a building with vulnerable people or a large crowd	12
4	Wildfire	11
5	Disruption of the energy grid	11
6	Traffic incidents; land-based	11
7	Wrap up	3

A Brief Sketch of the Model

Van Trijp et al. (2012, 2013) described and derived the organizational resilience model for Dutch safety regions. The model consists of a multitude of attributes covered by the general terms: resilience, awareness, keystone vulnerabilities, adaptive capacity, and quality.

The authors used a survey in which they asked respondents from Dutch safety regions to state their preference over presented statements. The statements based upon literature are relevant aspects (the mentioned general terms) from organizational resilience and are known as "attributes." The given answers were analyzed by multi-criteria analysis according to the principles of a Value Tree (Goodwin & Wright, 2011). The authors generated a quantitative model where they show that each attribute has a unique impact on the outcome of organizational resilience in Resilience Units (RU). The authors to quantify and define the outcome of the model introduce Resilience Units. In literature, it is postulated that Resilience Units have a dynamic relationship with Risks and Hazards as shown by the Propeller model (van Trijp, 2012). To relate the weight of each attribute to a certain situation (i.e., a hazard or crisis type) utility values or weight factors are added to the attributes. The authors describe when all utility values have a value of "1"; the maximum achievable outcome is 22.54 RU. They also described a quick scan version (which is used in this paper) with a minimized number of attributes.

Full model:

$$f(R_{ero})_{UV} = (R_{ero})_{UV}\left((R_{awa})_{UV} + (R_{kv})_{UV} + (R_{ac})_{UV} + (R_q)_{UV} + \varepsilon\right) \quad (1)$$

Quick scan method:

$$f(R_{ero})_{UV} = 1.88f\left((R_{ero})_{QS}\right)_{UV} \quad (2)$$

See Appendix A for a full break down of the model (3–18) and Appendix C for the declaration of symbols.

Methodology

From all twenty-five safety regions in the Netherlands the public regional risk and hazard profiles were analyzed for hazards ("Crisis Types" according to the Dutch terminology) in the classes D "Probable" ($0.05 \geq p < 0.50$) and E "Highly Probable" ($0.50 \geq p \leq 1.00$) with an impact score ranging from "Notable"—"Serious"—"Very Serious" to "Catastrophic." The classes were taken from the Dutch Model Regional Risk and Hazard Profile (Anonymous, 2009). Any hazard with a probability $p < 0.05$ was left out as we consider $p \geq 0.05$ a realistic occurrence hazard rate for safety regions to show resilience for. We assumed any respondent had a good chance of meeting one of these crisis types.

We created the questionnaire in Survey Monkey®. We approached the Presidium of the Safety Region CEOs for clearance and support to distribute the survey among their co-workers. This was granted, and the Presidium recommended the survey to all

Table 2. Descriptive Meta-Analysis of Collected Respondents' Data

Category	*n*	%
Respondents (answered at least one question)	418	100.00
Respondents that finished the questionnaire	276	66.03
Male respondents	304	78.35
Female respondents	84	21.65
Number of respondents employed at a safety region	397	94.98
Number of professional staff	261	67.21
Number of volunteer staff	59	15.21
Number of staff with a professional and volunteer assignment	68	17.53
Average number of years employment	14	
Median number of years employment	12	
Average number of years' experience in current occupation	8	
Median number of years' experience in current occupation	6	
Respondents previously employed at a different safety region	92	25.14
Respondents solely employed at current safety region	274	74.86
Operational staff (first responders, incident command, and control)	110	30.05
Executive staff (risk management, training, education, planning)	80	21.86
Staff with combined operational and executive positions	176	48.09
On secondment from another safety region	9	2.46

twenty-five CEO's by e-mail, which also included a cover letter we drew up to state the purpose of the survey, together with the hyperlink where to find it on the Internet. Three weeks later, we sent a written reminder to the CEOs by regular mail. We received word from five CEOs, they distributed the survey hyperlink in their organization. Six weeks later, we contacted all safety regions by phone to check if they had distributed the survey hyperlink among their employees. Many of the regions did not recall when and how they distributed the survey. As the survey was completely anonymous, we could only assume the set of regions and respondents as representative for the Dutch situation. The survey was open for a total of 17 weeks and four hundred and eighteen respondents answered at least one question while two hundred and seventy-six respondents finished the entire questionnaire.

We asked the respondents to identify if they work for or at a safety region or not (respondent was disqualified when the answer was "No"), their gender, occupation type, being a volunteer or a regular and the presence of a management quality and or safety system. Next, they had to choose a crisis type from Table 1 and fill out the questionnaire by the crisis type chosen.

Table 3. Number (*n*) of Crisis Types Mentioned By the Respondents

Crisis Type	*n*
Pandemic	8
Extreme weather conditions	64
Fire in a building with vulnerable people or a large crowd	118
Wildfire	16
Disruption of the energy grid	36
Traffic incidents; land-based	31
Wrap up	3

The questions were based on the attributes as they appear in the simplified quick scan quantitative equation for Dynamic Organizational Resilience (van Trijp et al., 2012, 2013). We chose the simplified version to minimize the number of questions to be filled out by the respondent. Research showed that the quick scan method contributes 53.19 percent of the maximum attainable score when ε is nullified (see Appendix B for an explanation of ε). Hence, results were multiplied by a factor 1.88 to obtain a full score that represents all twenty-three attributes that make up the original model (van Trijp et al., 2012, 2013). Responses were presented to the respondents on a 5-point Likert scale ranging from "Strongly Disagree" to "Strongly Agree" + the option "I do not know." The response scale ran from "1" (Strongly Disagree) to "5" (Strongly agree). The value "3" is a neutral response (Disagree nor Agree). For a uniform response, we presented the following definitions for "Incident" and "Crisis": An Incident is a situation that disrupts for a short period the continuity of the local society (definition by the authors). A crisis is a situation in which a vital interest of society is affected or threatens to be affected (Anonymous, 2010).

For the questionnaire, the attributes were divided into sub-attributes where appropriate (Appendix B). The sub-attributes make up for the attribute involved. Like attribute *b* has sub-attributes *b1* and *b2*. Thus, it is possible to discriminate answer wise between the sub-attributes that concern the related attribute as a whole. The results of the questions identified the value of the utility values (*UV*), which provides the individual weight of the attributes as a whole.

We applied equations (1)–(18) to determine the organizational resilience (van Trijp et al., 2012, 2013).

For a full representation of the asked questions and the declaration of symbols, refer to Appendix C.

In addition, two questions were asked to determine whether the safety region is in the process of introducing or has introduced a Quality Management system like the EFQM Excellence model according to Wongrassamee, Gardiner, and Simmons (2003) or has a Safety Management system like BS OHSAS 18001 in place. The possible answers were "Yes," "No," "Being implemented at the time of the survey" and "I do not know."

At the end of the survey, we asked if the respondent still remembers the crisis type he/she used as a reference to fill out the questionnaire. When in doubt, the respondent was able to go over the answers again. A freestyle question with the possibility to provide an open answer concluded the questionnaire. To encourage the respondents to take part, at random five prizes were given away to those who left their e-mail address. It

Table 4. Data Average Utility Values of the Separate Attributes

	Utility Value									
Weight Factor	*b*	*c*	*f*	*k*	*n*	*o*	*r*	*t*	*u*	*w*
Mean	0.8509	0.8482	0.6823	0.6626	0.7195	0,6550	0.7014	0.6493	0.7005	0.6467
SD	0.1824	0.1398	0.2271	0.2038	0.2375	0,2224	0.2505	0.2780	0.2124	0.2486

Note. A full declaration of the utility values and how they are composed may be found in Appendices A and C.

Table 5. Organizational Resilience in Resilience Units (RU) Per Crisis Type

Crisis Type	Average $f(R_{ero})_{QS}$	Average $f(R_{ero}) = 1.88 \times$ (Average $f(R_{ero})_{QS}$)	(Average $f(R_{ero})/f(R_{ero})_{\max}) \times 100 = \%$
Pandemic	6.17	11.59	51.43
Extreme weather conditions	7.10	13.35	59.24
Fire in a building with vulnerable people or a large crowd	6.90	12.98	57.59
Wildfire	7.20	13.54	60.06
Disruption of the Energy Grid	7.73	14.53	64.45
Traffic incidents; land-based	7.62	14.33	63.58
Wrap Up	8.32	15.64	69.40
Average for all Hazard or Crisis Types	7.15	13.11	59.63

Notes. $f(R_{ero})_{QS}$ = the Dynamic Organizational Resilience of a safety region using the Quick Scan method; $f(R_{ero})$ = the Dynamic Organizational Resilience of a safety region; $f(R_{ero})_{\max})$ = the maximum achievable Dynamic Organization Resilience of a safety region, this equals to 22.54 RU or 100% (van Trijp et al., 2013).

was particularly stated the e-mail address was not to be used for any other purpose than the draw itself.

Results and Analysis

We scored twenty-one crisis types in total from the Regional Risk and Hazard Profiles of all twenty-five Safety Regions. We used six crisis types with the most prevalent scores (n) in the survey (see Table 1). The crisis types act as cases to score the different utility values of organizational resilience's attributes.

We added an extra crisis type #7 called "Wrap up" for any crisis type mentioned by a respondent that was not part of the original six-value set on offer.

Table 2 shows the descriptive analysis of the collected data.

Further analysis of the results showed that one out of six respondents ($n = 81$, 15.85%) answered a question one or more times "I do not know." In an answer in which this occurred, the result would be rendered useless for use in (1). Hence, we decided to transform all "I do not know" answers into the neutral "disagree/nor agree" and use them as such. In this way, we prevented respondents from leaving the questionnaire when in serious doubt what to answer and encouraged them to complete the survey. Any respondent that did leave the questionnaire was not taken into account and left out of the analysis. Note Table 2 shows the original set of respondents that started the survey. For analysis, we used the proper subsets of respondents who completed the survey.

Results were sorted according to the six clusters with different hazards and crisis types. One cluster with hazards and crisis types that could not be covered by

the six mentioned was added as an extra cluster ("Wrap up"). Next, the seven clusters were tested through one-way analysis of variance (ANOVA) with the data analysis module of Excel 2013© to determine for statistically significant differences for the outcome of (2) between the clusters at $p < 0.05$ level.

Table 3 shows the number of crisis types mentioned by the respondents that filled out the questionnaire. Respondents mentioned the crisis type "Wrap up" three times, which is 1.09% of the total amount of mentioned crisis types. The crisis types presented to the respondents were taken from Table 1.

We tested if there was a statistically significant difference between the seven crisis types at $p < 0.05$ level and found no difference between the seven crisis types at the $p < 0.05$ level. We repeated the analysis for crisis types 1–6 by omitting the "Wrap up" crisis type. It shows there is no difference between the crisis types 1–6 at the $p < 0.05$ level. Hence, we concluded all data generated from the seven crisis type subsets could be handled as one set of data; we could observe no statistically significant differences in outcome for (2) in RU between the crisis types. RU means "Resilience Units," originally introduced by Van Trijp et al. (2012, 2013) as AU (Arbitrary Units) and later renamed as Resilience Units. It describes the quantitative measure of organizational resilience (van Trijp, 2012; van Trijp & Ulieru, 2014; van Trijp et al., 2018).

Table 4 shows the average of the utility values and the standard deviation in the total set of data. For an explanation of the used symbols, refer to Appendix C.

When all the acquired individual utility values were introduced into (3) to (17) as shown in Appendix A and subsequently into (2) to determine the organizational resilience in Resilience Units (RU) (1), the following results were obtained (Table 5).

From Table 5 we concluded that according to the Quick Scan method the average value for organizational resilience is 7.15 RU. When we corrected this value according to (2), we found the average value for organizational resilience is 13.1 RU. This implied that for the seven crisis types the mean score for organizational resilience for all safety regions is 60%.

We were interested if there was any difference between three groups concerning organizational resilience: volunteer staff, professional staff, and staff with the double assignment volunteer and professional.

The three groups were tested through one-way ANOVA with the data analysis module of Excel 2013© to determine for statistically significant differences between the groups at $p < 0.05$ level. We found a statistically significant difference between the three groups at $p < 0.05$ level. When we analyzed the three groups further, we found no statistically significant difference at $p < 0.05$ level between the two groups: professional staff and volunteer and professional double assignment staff, $p = 0.51$. However, we did find a statistically significant difference at $p < 0.05$ level between volunteer staff and professional staff, $p < 0.01$ and for the two groups volunteer staff and volunteer and professional double assignment staff, $p < 0.01$. Analysis shows volunteer staff rate resilience on average at $f(R_{ero}) = 10.41$ RU (46%), professional staff rate 14.47 RU (64%), and volunteer and professional double assignment staff rate 13.79 RU (61%).

We concluded volunteer staff rates their safety regions with a statistically significant lower value for organizational resilience than the other two groups do. Results further indicated that staff with a professional and volunteer double assignment rate their organization no different from staff with just a professional assignment. We made no analysis on basis of age, education, and so forth, as the data are not available in this survey.

From the open individual answers given by some respondents in our survey, we provide three representative examples that show what the heart of the issue is.

> *My region seems to forget what the reason of our existence is. This leads to policy options that have an adverse effect on the operations of the suppression division. This tells me something about the interconnectedness of our organization, vision sharing, sharing of policy choices made and the subsequent order for the suppression division to concur. By lack of any policy choice, explanation comprehension and choices made lead to discord (Resp. #169, individual with professional assignment).*

> *The safety region sub-uses the present knowledge and experience of the volunteer first responders that they possess from their main daily profession and acts mainly on hierarchical structures. In other words, rank is preferred over knowledge and experience as a result, ignorance rules during incidents (Resp. #35, individual with volunteer assignment).*

> *Volunteer first responders miss a lot of what is going on CEO level of the safety region and have no insight into the criteria involved in decision-making (Resp. #9, individual with volunteer assignment).*

We determined 67 percent of the respondents are professional staff, 15 percent volunteer staff, and 18 percent have a combined professional and volunteer assignment. In the Netherlands, a grand total of twenty-three thousand nine hundred and fifty-eight staff work at the twenty-five regional fire services. Those regional fire services may be judged equal to the twenty-five safety regions (van Trijp et al., 2012, 2013). This grand total consists of volunteer staff, eighteen thousand eight hundred and twenty-two (68 percent), operational staff, five thousand one hundred and thirty-six (18 percent), and non-operational staff, three thousand eight hundred and eleven (14 percent) (Statistics Netherlands, 2017). Operational and non-operational staff is similar to staff with a professional assignment. The respondents of this survey were dominantly operational staff unlike the situation in the real world. Despite the written and formal request to do otherwise, the majority of CEO's of the twenty-five safety regions did not distribute the survey in the entire organization but only in the professional section. Hence, causing a population majority with a professional assignment. Professional staff had a response rate of 1.7 percent while 1.2 percent finished the questionnaire. We conclude volunteer staff statistically rate their safety regions significantly lower for organizational resilience than their professional counterparts do.

We liked to know if the presence of a Quality Management system or a Safety Management system would affect organizational resilience. The answers were "Yes," "No," "Being implemented at the time of the survey," and "I do not know."

We found no statistical difference between the four clusters of answers at $p < 0.05$ for either the presence of a Quality Management system or a Safety Management system on organizational resilience. As the number for "Yes" and "Being implemented at the time of the survey" is low we decided to combine the responses of these answers and analyzed again finding no difference at the $p < 0.05$ level. Again, we found no statistical significant influence on organizational resilience.

Discussion

Comparable Research in the Netherlands

By Lammers (2016) a survey was conducted at the Dutch Safety Region Drenthe —VRD among firefighters. Lammers made no distinction for the type of staff assignment. She used the quantitative model in a simplified quick scan mode and related the answers of the questions to the crisis type "traffic incidents." She found a score of 34 percent for organizational resilience. When we compare this with the result in this survey: 60 percent overall organizational resilience and the results found earlier in a case study with crisis type "industrial chemical blaze" for the Dutch safety region "Veiligheidsregio Midden-en West-Brabant (MWB)": 18 percent organizational resilience (van Trijp & Ulieru, 2014) we observe some large differences between the three results. In our survey, we made no distinctions between the safety regions as separate entities as the respondents gave results anonymously without stating their employer. Hence, results we could not relate our results to an individual safety region. Therefore, the presented results are an average for all twenty-five safety regions in the Netherlands. However, it is likely to presume some safety regions have a better score than others for the investigated crisis types.

The Importance of Communication

Communication plays a major role within the concept of organizational resilience as it aims on continuity management to enhance a culture of high reliability: communication supports organizational resilience (Vos & van der Molen, 2017, pp. 29–37). Communication/sense making (or the lack of…) between stakeholders during, before, or after a crisis or incident is often found to be a key ingredient for successful mitigation and cooperation or not (Gimenez, Hernantes, Labaka, Hiltz, & Turoff, 2017; Kanno & Futura, 2006; Treurniet, Besseling, & Wolbers, 2012; Visser & van Rossenberg, 2012; Weick, Sutcliffe, & Obstfeld, 2005). Hence, we conclude one of the main tasks to increase the organizational resilience of

the Dutch Safety Regions is to enhance the quality of communication between stakeholders, internally and externally.

Professional and Volunteer Staff

In literature, it is suggested organizational engagement of volunteers of non-profit organizations is very important when those volunteers are faced with demands or organizational constraints. A low engagement could make volunteers less energetic and prevent them from optimal functioning (Crawford et al., 2010; Harp et al., 2017; Sonnentag et al., 2012). An increase of bureaucratic procedures and top–down management that occurred after the transformation of local fire services into regional fire services in the Netherlands was mentioned as one major obstacle by volunteers to maintain engagement (van Steden, Boelens, Drenth, & van den Ende, 2018). van Duijneveldt and Herder (2017) observed a similar finding amongst Dutch fire service volunteers. Harp et al. (2017) state when organizations want to increase volunteer engagement and reduce constraints they should look into the needs of the volunteers. It is important to provide not only the necessary equipment but also information and support. To help to understand their needs and perceptions it is also crucial to check in periodically and survey the volunteers assisted by the use of focus groups. Harp et al. (2017) mention this topic is under-researched and needs extra research to substantiate their findings. In the Dutch situation volunteers normally occupy a regular job outside the fire service and by comparison, may be quite able to judge the operational character of the fire service/safety region. Nevertheless, the safety regions find it difficult to embed their professional opinion on this matter. Although, in a strategic positioning paper volunteers are specifically addressed and by 2040, they should work in a flexible organizational structure and enjoy the possibility to choose other tasks than suppression, that is, civic fire communication (Anonymous, 2018).

Limitations and Validity

The external validity of this study is warranted by the following five conditions: (i) the justified use of ANOVA; (ii) organizational development should focus on a variety in external crises; (iii) organizational resilience of the safety regions is identical to organizational resilience of the regional fire services; (iv) respondents' answers are not only governed by interpretation but also by personal experience; (v) population size and validity.

1. Boone and Boone (2012) suggest ANOVA or one-way analysis is a valid data analysis procedure for our type of survey while Norman (2010) shows ANOVA is such a robust statistical technique that it can also be used when small sample sizes ($n > 5$) are involved; we used one-way analysis in this survey to determine

probable significant differences between groups. Our sample sizes meet the minimum demand of $n > 5$. Hence, justified the use of ANOVA as a data analysis procedure.

2. In the introduction of this paper, we cited Lalonde (2007, 2011) and Ruiz-Martin et al. (2018) who state organizational development should focus on a variety in external crises to determine their influences on organizational resilience. In line with these statements, we established six (seven when you include the "wrap up" group) crisis types of a different nature. The respondents gave their opinion on the one crisis type they know best. We derived crisis types from the official Risk and Hazard profile made and published by the safety regions. As such, we conclude we meet the criteria of a variety in external crisis and can present our results in organizational resilience perspective.
3. The safety region is an organization made up from several emergency services like the regional fire service and the regional medical service. van Trijp et al. (2012, 2013) argue that there is no difference between the whole population of the safety regions and the incorporated regional fire service. This regional fire service makes up for 90 percent or more for the entire organization. They concluded that organizational resilience of the safety regions is identical to organizational resilience of the regional fire services.
4. In this survey, we presented the respondents with cases based upon real-world experiences as the respondents lived and experienced those themselves. Respondents' answers are not only governed by interpretation but also by personal experience. Hence, enhancing the external validity of the results of this survey (Golafshani, 2003; Taylor, 2005; Wilks, 2004). Based upon the presented data, we found our results look representative for the real-world situation (Bartlett, Kotrlik, & Higgins, 2001). But, the model still needs further operational validation (Hanea, 2009, p. 108)
5. The survey has some limitations caused by the chosen pathway: from population to sample and the translation back to the original population again. This introduced several types of errors with subsequent bias. As we approached all safety regions to participate in the survey, we learned later not every employee was asked to enter, or one did not recall how and if the survey was disseminated in the organization. This reduced the target population by an unknown factor, leading to a smaller target population and introduced an unknown error in the representation. From this target population, a much smaller number of respondents reacted. Hence, a nonresponse error was introduced (Firebaugh, 2008, pp. 93–101). Although these exclusion errors introduce a degree of uncertainty about the actual opinion of the target population, we still can validate our results. Our findings show the presence of a Quality Management system or a Safety Management system contrary to expectations do not contribute to organizational resilience. This is in line with our earlier findings where we found in a theoretical approach that they only contribute marginally (2.31%) to the organizational resilience of the safety regions as a whole (van Trijp & Breur, 2013).

Conclusion

Based upon the findings of our survey we recommend to increase a safety region's organizational resilience by focusing on improvements in communication, enhance organizational engagement of volunteers, and stop pursuing a Quality Management and/or Safety Management program.

We further suggest that future research should focus on the role of volunteer staff and their significance for organizational resilience. Special attention should be given to relevant aspects like status, age, and education. We also suggest this type of research should be extended to other emergency response organizations to put the Dutch safety region's outcomes in a wider (international) perspective. This model still needs further operational validation using an extended face validity study: In this study outcomes of the model have to be checked against the real world by means of interviewing field experts.

As we consider our results an onset for an emergent organizational design paradigm, we strongly recommend future research to substantiate our findings on organizational resilience and emergency response organizations.

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Notes

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Appendix A: Break Down of the Organizational Resilience model

$$R_{ero} = 1.00c + 0.70b \tag{3}$$

$$R_{awa} = 1.00k + 0.95f \tag{4}$$

$$R_{kv} = 1.00n + 0.80o \tag{5}$$

$$R_{ac} = 1.00r + 0.70t \tag{6}$$

$$R_q = 1.00w + 0.50u \tag{7}$$

Break down of attributes into sub-attributes:

$$b = (b1 + b2)/2 \tag{8}$$

$$c = (c1 + c2 + c3 + c4 + c5 + c6 + c7 + c8)/8 \tag{9}$$

$$f = (f1 + f2 + f3 + f4)/4 \tag{10}$$

$$k = (k1 + k2 + k3 + k4 + k5 + k6)/6 \tag{11}$$

$$n = (n1 + n2 + n3)/3 \tag{12}$$

$$o = (o1 + o2)/2 \tag{13}$$

$$r = (r1 + r2)/2 \tag{14}$$

$$t = (t1 + t2)/2 \tag{15}$$

$$u = (u1 + u2 + u3)/3 \tag{16}$$

$$w = (w1 + w2)/2 \tag{17}$$

Due to the Likert scale used, all results have a value in the range of 1–5. To use those values as utility values or weight factors, values between 0–1 are necessary. Therefore, we transformed all values by means of (18):

$$y = 0.25x - 0.25 \tag{18}$$

where x = value 1–5 and y = the transformed value 0–1.

We fed each transformed value into (3) to (17) and subsequently into (2) to determine the organizational resilience in Resilience Units (RU) (1).

Appendix B: Tables With Statistical Analyses

Table B1. One-Way Analysis of Variance For All Seven Crisis Types

Source of Variation	*SS*	*df*	*MS*	*F*	*p*	*CAF*
Between crisis types 1–7	38.04	6	6.34	0.95	0.46	2.13
Between subjects within the crisis types	1,802.51	269	6.70			
Total	1,840.56	275				

Table B2. One-Way Analysis of Variance While Omitting "Wrap Up" Crisis Type

Source	*SS*	*df*	*MS*	*F*	*p*	*CAF*
Between crisis types 1–6	33.88	5	6.78	1.01	0.41	2.25
Between subjects within the crisis types	1,798.33	267	6.74			
Total	1,832.20	272				

Table B3. One-Way Analysis of Variance of Overall Results of Organizational Resilience for Three Groups According to Professional Assignment

Groups	*n*	*S*	*M*	*V*
Volunteer staff	38	395.70	10.41	27.5
Professional staff	173	2503.45	14.47	21.91
Volunteer and professional double assignment staff	21	289.57	13.79	7.24

Table B4. One-Way Analysis of Variance of All Three Groups For Organizational Resilience

Source	*SS*	*df*	*MS*	*F*	*p*	*Critical Area F*
Between the three groups	513.01	2	256.50	11.91	< 0.01	3.04
Between subjects within the three groups	4,931.16	229	21.53			
Total	5,444.17	231				

Table B5. One-Way Analysis of Variance of Overall Results Presence of A Quality Management System

Answer	*n*	*S*	*M*	*V*
Yes	67	506.35	7.56	5.84
No	42	291.67	6.94	9.54
Being implemented at the time of the survey	32	221.32	6.92	6.55
I do not know	122	854.20	7.00	6.75

Table B6. One-Way Analysis of Variance of all Four Clusters With Answers for the Presence of Quality Management System

Source	*SS*	*df*	*MS*	*F*	*p*	*CAF*
Between the four clusters with answers	17.15	3	5.72	0.82	0.48	2.64
Between subjects within the four clusters with answers	1,797.09	259	6.94			
Total	1,814.24	262				

Table B7. One-Way Analysis Of Variance of Overall Results Presence of a Safety Management System

Answer	*n*	*S*	*M*	*V*
Yes	7	50.53	7.22	4.71
No	65	350.46	5.39	5.05
Being implemented at the time of the survey	4	20.63	5.16	8.63
I do not know	187	1030.08	5.51	5.28

Table B8. One-Way Analysis of Variance of All Four Clusters With Answers for the Presence of Safety Management System

Source	*SS*	*df*	*MS*	*F*	*p*	*CAF*
Between the four clusters with answers	21.82	3	7.27	1.39	0.25	2.64
Between subjects within the four clusters with answers	1,359.63	259	5.25			
Total	1,381.45	262				

Table B9. One-Way Analysis of Variance of Overall Results Presence of a Safety Management System, Question 1 and 3 Combined

Answer	*n*	*S*	*M*	*V*
Yes + Being implemented at the time of the survey	11	71.17	6.47	6.49
No	65	350.46	5.39	5.0
I do not know	187	1,030.08	5.51	5.28

Table B10. One-Way Analysis of Variance for Three Clusters With Answers for the Presence of a Safety Management System

Source	*SS*	*df*	*MS*	*F*	*p*	*CAF*
Between the three clusters with answers	11.01	2	5.51	1.04	0.35	3.03
Between subjects within the three clusters with answers	1,370.43	260	5.27			
Total	1,381.45	262				

Appendix C: Symbols and Questions

Symbol	Meaning
b1	My safety region acts well upon the occurrence of unforeseen incidents
b2	My safety region acts well upon the occurrence of a crisis
c1	My safety region possesses the ability to adapt to changing circumstances during an incident
c2	My safety region possesses the ability to adapt to changing circumstances during a crisis
c3	The staff possesses the ability to adapt to changing circumstances during an incident
c4	The staff possesses the ability to adapt to changing circumstances during a crisis
c5	My safety region recuperates well after enduring or mitigating an incident
c6	My safety region recuperates well after enduring or mitigating a crisis
c7	The staff recuperates well after enduring or mitigating an incident
c8	The staff recuperates well after enduring or mitigating a crisis
f1	My safety region has the ability to assess well future opportunities
f2	My safety region has the ability to assess well future developments
f3	My safety region has the ability to assess well future incidents
f4	My safety region has the ability to assess well future crises
$f(R_{ero})$	Dynamic Organizational Resilience of a safety region
$f(R_{ero})_{\max}$	Maximum achievable Dynamic Organization Resilience of a safety region; 22.54 RU
$f(R_{ero})_{QS}$	Dynamic Organizational Resilience of a safety region using the Quick Scan method
$f((R_{ero})_{QS})_{UV}$	Unique Dynamic Organizational Resilience of a safety region dependent on utility values *(UV)* using the Quick Scan method
$f(R_{ero})_{UV}$	Unique dynamic organizational resilience of a safety region dependent on utility values (*UV*)
k1	My safety region is very well aware of the expectations she has towards her internal (staff) network
k2	My safety region is very well aware of the obligations she has towards her internal (staff) network
k3	My safety region is very well aware of the limitations she has towards her internal (staff) network
k4	My safety region is very well aware of the expectations she has towards her external network
k5	My safety region is very well aware of the obligations she has towards her external network
k6	My safety region is very well aware of the limitations she has towards her external network
n1	My safety region is well aware of the importance of her professional specialists
n2	My safety region is well aware of the importance of her managers
n3	My safety region is well aware of the importance of her decision makers
o1	Inside my safety region groups and departments share good relationships with each other
o2	My safety region shares good relationships with important external groups
r1	My safety region recognizes the importance of her decision structures
r2	My safety region recognizes the importance of leadership
$(R_{ac})_{UV}$	The level of Adaptive Capacity of a safety region Safety Region dependent on utility values (*UV*)
$(R_{awa})_{UV}$	The level of Awareness of a safety region dependent on utility values (*UV*)
$(R_{ero})_{UV}$	The level of Resilience of a safety region dependent on utility values (*UV*)
$(R_{kv})_{UV}$	The level of importance of Keystone Vulnerabilities of a safety region dependent on utility values (*UV*)
$(R_q)_{UV}$	The level of Quality of a Safety Region dependent on utility values (*UV*)
RU	Resilience Units
t1	My safety region promotes and supports flexibility

(*Continued*)

Symbol	Meaning
t2	My safety region promotes and supports creativity
u1	My safety region is well aware how she operates
u2	My safety region is well aware how her key-holders operate
u3	My safety region is well aware of the environment in which she operates
UV	The utility values of an attribute in a Value Tree
w1	My safety region is well equipped to cope with novel situations by using new and innovative solutions
w2	My safety region is well equipped to cope with new and unforeseen situations by adapting and changing instruments (i.e., plans, procedures, organization) she already possesses
ε	The level of unspecified data and items which are also a function of resilience