Zeszyty Naukowe SGSP 2021
2021, Nr 77, s. 35–54
ISSN: 0239-5223

DOI: 10.5604/01.3001.0014.8412

MAJ PAWEŁ GROMEK, DSC ENG.
ASSOCIATE PROFESSOR
The Main School of Fire Service

SOCIETAL DIMENSION OF DISASTER RISK REDUCTION. CONCEPTUAL FRAMEWORK[1]

ABSTRACT

Current disaster risk reduction approach does not reflect the societal dimension of factors that shape risk and safety. The research objective is to elaborate a model of DRR in its societal dimension, respecting not only an engineering component of disaster risk, but also how people perceive it. The methodology bases on literature review and a deductive investigation for ideas and assumptions verification. As a first result, safety structure was presented. At the highest level of generality, it consists in real safety and safety sense. The second one is a derivative of four components: sense of being informed, sense of perpetration, sense of confidence and sense of anchoring. In analogy to safety, risk could be characterized by an engineering component and risk perception. Perception is structured with direct connection to safety sense. Morphological connection of risk structure, disaster risk reduction structure and two signs of risk (positives and negatives) allows to elaborate the model, which could prove to be a valuable tool in theory and practice of the reduction.

1 NATIONAL SCIENCE CENTRE POLAND The paper is a result of the research task titled 'Factors shaping safety perception in the system disaster risk reduction in Poland'. The task was funded by the National Science Centre under grant no. 2020/04/X/HS5/01318.

KEYWORDS
disaster, risk, risk perception, safety sense, disaster risk reduction

Received: 01.03.2021; Reviewed: 13.03.2021; Accepted: 16.03.2021

WYMIAR SPOŁECZNY REDUKCJI RYZYKA KATASTROF. RAMY KONCEPCYJNE

ABSTRAKT
Obecnie przyjęte podejście do redukcji ryzyka katastrof nie odzwierciedla wymiaru społecznego czynników wpływających na ryzyko i bezpieczeństwo. Zamierzeniem przeprowadzonych badań było opracowanie modelu redukcji ryzyka katastrof w wymiarze społecznym, biorąc pod uwagę nie tylko elementy inżynieryjne ryzyka katastrof, lecz również sposób, w jaki jest ono postrzegane przez ludzi. Metodologia obejmowała przegląd literatury oraz badania dedukcyjne ukierunkowane na weryfikowanie koncepcji i założeń. W pierwszym rzędzie zaprezentowano strukturę bezpieczeństwa. Można przyjąć w najogólniejszym zakresie, że obejmuje rzeczywiste bezpieczeństwo i poczucie bezpieczeństwa. Po drugie stanowi pochodną czterech elementów składowych: poczucie poinformowania, poczucie sprawstwa, poczucie pewności oraz poczucie zakotwiczenia. Podobnie do bezpieczeństwa, ryzyko obejmuje element inżynieryjny oraz percepcję ryzyka. Struktura percepcji jest w bezpośredni sposób powiązana z poczuciem bezpieczeństwa. Morfologiczne powiązanie struktury ryzyka, struktury redukcji ryzyka katastrof oraz dwóch oznak ryzyka (pozytywnych i negatywnych) umożliwia opracowanie modelu, który mógłby stać się cennym narzędziem w teorii i praktyce redukcji ryzyka.

SŁOWA KLUCZOWE
katastrofa, ryzyko. postrzeganie ryzyka, poczucie bezpieczeństwa, redukcja ryzyka katastrof

Przyjęty: 01.03.2021; Zrecenzowany: 13.03.2021; Zatwierdzony: 16.03.2021

1. INTRODUCTION

Disaster risk reduction (DRR) has become nowadays one of the most important directions for building safety and security [1, 2]. Its current general approach stems from the Sendai Framework for Disaster Risk Reduction 2015–2030 [3] and is implemented by the United Nations (UN), international organizations and particular states worldwide [4]. It touches the most important utilitarian values (human life and health) in terms of events which could exceed the coping potential of particular public institutions, local societies and, even, entire states.

Respecting its definition [3], disaster can initiate crisis situation and crises. Consequently, knowledge concerning relevant hazards, disaster risk specification, risk assessment and risk management is highly required. Moreover, risk seems to be a proper and universal dimension for designing activities and operations focused on prevention, preparation, response, as well as reconstruction and recovery due to disasters. Exemplifying, it is used to create public politics [5, 6], to moderate multi-entity response to crisis hazards [7], to integrate institutional and societal efforts aimed at coping with disasters and their consequences [8], as well as to shape safety and security culture [9, 10]. This finds its justification in handling risk with a safety and security measure, which allows to calculate values reflecting safety and security levels [11, 12], even if the two are intangible and hard to be calculated directly [13].

Common understanding of disaster risk bases on classical risk interpretation as "(…) synonym for probability of a harmful effect occurring and (…) as a synonym for the mathematical expectation of the magnitude of the undesirable consequence (even as a quasi-synonym of consequence, whereby risk has a similar meaning to undesirable outcome)" [4]. It seems to be unacceptably, cognitively narrow in terms of societal perception of floods, transportation accidents, chemical spills, wildfires, epidemics, military conflicts etc. One thing is to calculate the level of safety or security by experts, and another is how people perceive it; the two should be jointly taken into account when the total situational picture is created [10, 14, 15, 16]. This could explain preliminarily incomprehensible behavior of people who did not want to evacuate leaving their property when flood occurred in Poland in 2010, behavior of Fukushima workers who sacrificed themselves to limit nuclear contamination in 2011 and relatively low effectiveness of DRR strate-

gies implementation (especially in the context of climate change), presenting the societal dimension of DRR.

The research objective is to elaborate a model of DRR in its societal dimension. Given its practicality, the model should be coherent with DRR concept presented in the Sendai Framework and provide a conceptual framework for reduction – in its current standards, however, respecting also how people perceive the risk of disaster. I considered basic theories for safety and risk, paying special attention to their logical and cognitive relations. This allowed me to establish a solid theoretical background. I used the background to create a holistic model which can be implemented in both technical and social sciences, including DRR.

2. METHODOLOGY

2.1. General view on the research methodology

There could be many paths to achieve the research objective. Due to current evaluation of risk essence in security studies [16], ongoing penetration of organization and management theory and practice output by safety and security issues [17] as well as a development of DRR towards achieving a more comprehensive system thinking (and its impact on DRR politics, concepts, operations, projects etc.) [4], basic theories for safety and risk should be used to provide a framework for the theoretical background for further research exploration and modelling. Moreover, the basic approaches serve often as reference to more detail ones. As an effect their use in working out a background could create cognitive opportunities to connect the model with other safety and risk related issues (e.g. general risk assessment, vulnerability, built-back-better, crisis management, disaster management, critical infrastructure protection, smart city – smart security, sustainability etc.).

The above mentioned assumption allowed to state the research methodology which is comprised by 4 steps. The graphical presentation of the methodology is presented on Fig. 1.

Recognition of the general structure of risk requires finding out the structure of an object measured by risk. As an effect the first step relies on cognitive structuration of the safety concept. To highlight the close interrelation of safety and risk, in the second step the two should reflect both societal

and non-societal dimensions. Only this will make it possible to frame a holistic approach which could be implementable on multiple layers of theory and practice (e.g. risk assessment, risk management, disaster management, DRR). Step 3 presents the DRR structure as a derivative of safety and risk in a unique context of disasters. In turn, the societal context should be applied to relate the societal dimension of risk (in its general approach) with DRR concept. Basing on previous steps, the fourth one considers the results to elaborate DRR model. Contrary to the most popular model [3, 4], this one should be holistic and take into account both societal and non-societal dimensions of DRR.

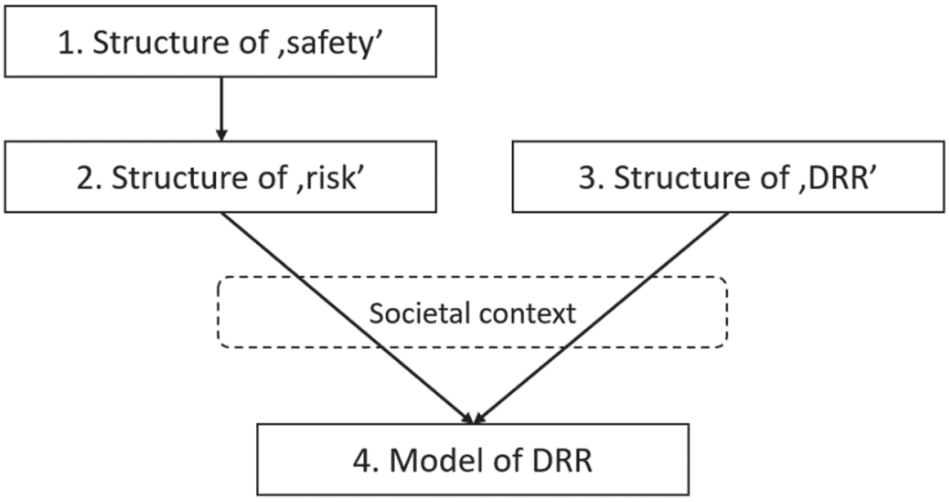

Fig. 1. Steps of the research methodology
Source: own study

2.2. Sources of information

Sources of information describing societal dimension of risk and its derivatives are scattered in time and space. For this reason I decided to carry out a literature review considering state-of-the-art from countries where this dimension was or is still present in regulations or national scientific output (e.g. USA, Germany, Poland and the Scandinavian states). To deepen the analysis and to collect more practical premises, I carried out an additional

exploration of the Web of Science Core Collection® database (remote access from the Main School of Fire Service in Warsaw, Poland). I used the following attributes to explore the database:

- 'disaster risk reduction AND sense',
- 'disaster risk reduction AND perception',
- 'disaster risk reduction AND feeling'.

However, due to the enormous number of papers identified during the database exploration, the entire analysis was not a systematic literature review, but instead was aimed at finding substantiation. This means that I was referring to papers basing on their abstracts and content (if relevant abstract had become adequate to the research assumptions) until a relevant idea or sentence was substantiated (proved in the research context). This kind of proceeding was based on a deductive search for ideas and sentences verification [18, 19, 20].

3. RESULTS

3.1. Structure of safety

According to Oxford Learner's Dictionary, safety is said to be a "state of being safe and protected from danger or harm" [21]. It is closely connected to security, which means "the activities involved in protecting a country, building or person against attack, danger, etc." [21]. In this respect, safety can be expressed by physical conditions of hazard (e.g. flood, epidemic, wildfire). In turn, security refers to activities conducted to ensure safety. This is why, from the logical point of view, security seems to be a safety derivative. There is no logical reason to deal with security without direct or even indirect reflection about safety (which is a primary premise for the need of carrying out security activities). Furthermore, their meanings are so closely interrelated, that in some cultural environments safety and security are described by only one, common term (e.g. 'bezpieczeństwo' in Poland, 'bezpečnosť' in Slovak Republic, 'bezpečnostní' in Czech Republik, 'безопасность' in Russia).

Safety (itself or via security) is implemented into legal acts, standards, procedures, guidelines and practical operations of individuals, social groups, institutions, states, peoples and international organizations to prevent, prepare, respond and recover due to hazards' materialization. It seems to shape

a wide spectrum of strategic, temporary and daily activities, touching many areas of human life. This is why safety is understood also in the context of [22, 23]:

- need,
- objective,
- value,
- set of operations,
- process,
- configuration of situations, events and facts,
- existential requirement,
- human rights,
- state of consciousness.

Some perspectives for safety understanding refer to issues that can be parametrized and measured (e.g. objectives, operations, situations, events, facts). And some of them are unquantifiable, stemming from human psychology and societal culture (e.g. need, value, state of consciousness). This influences on a general safety structure, which consist in two basic elements – real safety and safety sense [24].

$$S = f(S_{real}, S_{sense}) \qquad \text{(Eq. 1.)}$$

where:
S – safety (in general),
S_{real} – real safety,
S_{sense} – safety sense.

In general, safety is a function of the real safety and the safety sense. Respectively, it can be counted by experts who are able to analyze and assess hazard conditions, events, facts and operations. On the other side, results of the experts' effort need to be confronted with the perception of people of their current safety-related situation.

The real safety assessment is a domain of activity performed by experts. The relevant value or level may be counted using multiple methods and tools (qualitative, quantitative, qualitative-quantitative) [16, 25]. The situation is quite different in case of the safety sense. Due to its subjectivism, there is not a single method (or even set of the methods) to calculate it. As it is

strongly related to psychological and sociological factors, such background is useful to formulate proper structure. Consequently, the safety sense can be analyzed with view to [26][2]:

- sense of being informed (deriving from theories of knowledge management and self-knowledge – which means a need to have information necessary to cope with the danger and to behave properly to the situational requirements, chances and limitations),
- sense of perpetration (stemming from conception of societal perpetration – this expresses a self-confidence so important when an individual is forced to struggle for safety regardless of circumstances),
- sense of confidence (basing on conceptions of self-knowledge and auto-presentation – created by environment and its dynamism and presented as the adequacy of individual abilities to cope with the situation and its changes),
- sense of anchoring (from the social psychology output – built when an individual is sure that institutional and/or non-institutional support will come).

The safety sense is typically a subjectively determined derivative of the particular senses' combination. Fig. 2 presents the final safety structure.

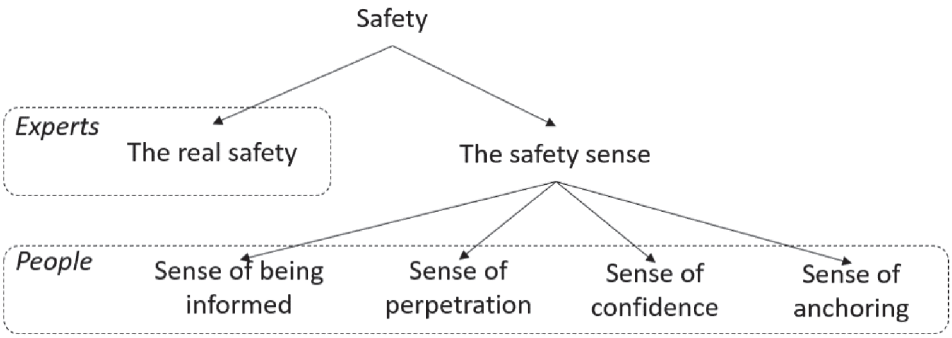

Fig. 2. Safety structure
Source: own study

The above-mentioned concept allows to frame four basic safety-related states [27]:

2 Basing on correspondence with E.M. Marciniak.

- state of safety (when experts confirmed an acceptable level of safety and people perceive it properly),
- state of false safety (when experts confirmed an unacceptable level of safety but people perceive the situation as safe),
- state of unsafety obsession (when experts confirmed an acceptable level of safety but people perceive the situation as unsafe),
- state of unsafety (when experts confirmed unacceptable level of safety and people perceive properly it).

All these states constituted all possible conditions to deal with safety, respecting its structure. This kind of theoretical framework can be useful for in-depth safety analyses, including DRR [10, 28, 29].

3.2. Structure of risk

Risk is considered a safety measure. Just like safety, this term has undergone numerous interpretations. Considering the meaning given in the dictionary, it is "the possibility of something bad happening at some time in the future; a situation that could be dangerous or have a bad result" [21]. Such understanding is operationalized by the assumption that risk is a probability of occurrence an adverse event along with its causes [16, 24, 30]. This is a commonly used risk definition and an engineering component of a general risk structure. It also serves as reference for more detailed risk definitions, specified taking into account multiple contexts as "mathematical expectation of the magnitude of the undesirable consequence" [4], effect of uncertainty related to objectives [31] as well as to operational costs, scope, time and quality [32], a situation or an event when some values are in danger and relevant consequence is uncertain [33].

However, in analogy to safety (which is expressed by the risk value or the risk level), in case of risk one needs to consider not only expert knowledge and results of calculation but also the societal perception of the danger situation. This was clearly observed by P. Sandman [15] and J. Wolanin [16] who noticed that elaborating a total risk value requires considering the engineering component of risk and community outrage. Such statement narrows the understanding of risk to negatively perceived circumstances and may be justified in terms of harmful environment [34], extreme events and disasters [10, 35] and their cascading effects [36]. Yet it does not reflect positive,

subjectively determined signs of the situation, especially operations conducted by authorities, services and individuals [37, 38, 39]. From the theoretical point of view, risk should allow for both negative and positive issues related to the danger situation and operations (public policy, education, public warning, risk communication, rescue actions, evacuation etc.), expressing relevant chances and hazards in a holistic picture of safety [31, 32]. This affects the general risk structure, which consists in two basic elements – engineering component of risk and risk perception (not only the outrage but also the positive signs).

$$R = f(R_{eng}, R_{perc}) \qquad \text{(Eq. 2.)}$$

where:
R – risk (in general),
R_{eng} – engineering component of risk,
R_{perc} – perception of risk.

Similarly as in case of real safety, engineering component of risk remains in the domain of experts (i.a. decision makers, analytics, researchers). The relevant value or level can be calculated using multiple methods and tools (qualitative, quantitative, qualitative-quantitative) and expressed by connections of such factors as probability, frequency, level of causes, number of victims, value of consequences, exposition, avoidance ability, vulnerability, resilience, coping capacity etc. [16, 25]. In accordance to risk perception, there is no single method of calculation. The major part of efforts has been focused on assessing the total risk perception [10, 14, 29, 34], and only few relied on in-depth analyses of community outrage [15, 41, 42]. This is a reason why analogies between safety and risk can be useful to formulate risk perception elements. In accordance with the safety sense, the risk perception can be divided into following elements:

- perception of information (related to information collected and required by an individual to cope with danger and to behave appropriately to the situational requirements, chances and limitations),
- perception of perpetration (which regards to self-confidence when individual activities to ensure safety are required),
- perception of confidence (when environment is perceived as relatively stable and the individual is capable of handling potential changes),

- perception of anchoring (in case of ensure that individual can count on external support in hazardous conditions).

Consequently, the risk structure is presented on Fig. 3.

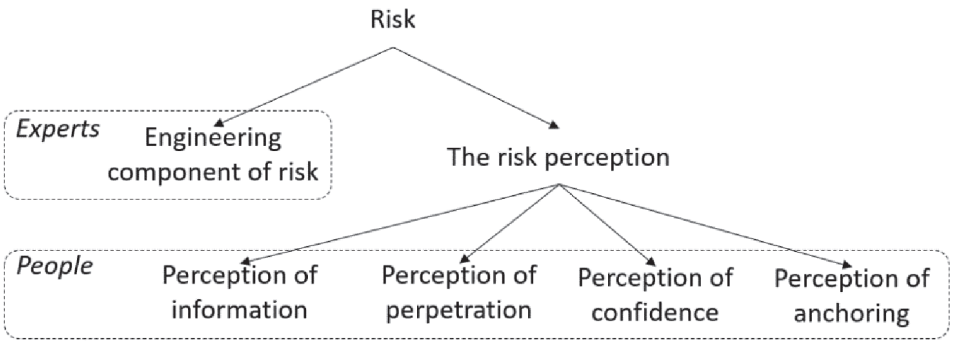

Fig. 3. Risk structure
Source: own study

Formulation of the risk structure allows the following prioritization of safety-related states:

- state of safety (when experts confirmed an acceptable level of risk and people perceive it properly),
- state of false safety (when experts confirmed an unacceptable level of risk but people perceive the situation as not risky),
- state of unsafety obsession (when experts confirmed an acceptable level of risk but people perceive the situation as risky),
- state of unsafety (when experts confirmed an unacceptable level of risk and people properly perceive it).

The use of risk to describe states of safety facilitates calculating all its elements and could be helpful in explanation of issues which are hard to be explained when only real safety and the engineering component of risk are considered. Moreover, the risk structure is so general that it could be implemented in all areas of risk (human, societal, environmental, industrial, national etc.), corresponding to multiple domains of safety [16] and respecting all factors that have influence on risk judgement of the people [43].

3.3. Structure of DRR

DRR concerns the safety of individuals, societal groups, nations and international societies. It refers to all hazards (not only natural ones) [4], especially these that can exceed coping abilities of the local society or nation and lead to crisis situations and crises.

The structure of DRR is formalized in the Sendai Framework. The following equation presents elements of the structure [3].

$$R_D = f\left(\frac{H,V,E}{C_O}\right) = f\left(\frac{H,V,E}{r}\right) \qquad \text{(Eq. 3.)}$$

where:
c – disaster risk,
H – hazard,
V – vulnerability,
E – exposure,
C_O – coping capacity,
r – resilience.

International regulations provide descriptions of particular elements of the DRR structure. Hazard is understood as "A dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage" [44]. In other terms, vulnerability is said to be "The characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard" [44]. Exposure regards "People, property, systems, or other elements present in hazard zones that are thereby subject to potential losses" [44]. The coping capacity deals with "The ability of people, organizations and systems, using available skills and resources, to face and manage adverse conditions, emergencies or disasters" [44]. And resilience is understood as "The ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions " [44].

These definitions have been determining DRR issues presented in international strategies since 2005 (Hyogo Framework for Action, Sendai Framework for Disaster Risk Reduction, 2030 Agenda for Sustainable Development, Paris Agreement and New Urban Agenda) [3, 45, 46, 47, 48] and show general directions for DRR, when hazard, vulnerability and exposure should be limited and coping capacity and resilience need to be developed. They constitute the DRR structure which presents the international concept of risk in the context of disasters.

3.4. Model of DRR (societal dimension)

The presented DRR structure is widely implemented for the purposes of risk reduction worldwide. Object progress and DRR concept evaluation are temporarily reported in Global Assessment Reports on Disaster Risk Reduction (see [4] and the preceding ones). According to the reports, the main focus of attention has been placed on governance and managerial issues. Risk perception accents are mostly limited to risk communication and tasks that ascribe elements to perception in an indirect way (e.g. involvement of civil society, private sector and individuals in disaster planning, building trust in public institutions, highlighting an influence of risk perception on safety). Furthermore research efforts confirm that risk perception is used selectively and considers relatively narrow areas of DRR theory and practice (e.g. disaster response strategy [10], hazard analysis and mapping [35], political activity [36], risk communication and management [49], and creation of societal safety [50]).

The is no information about a holistic approach, which would cover all elements of the DRR structure by issues reflecting societal context of disaster. This is considered to be a serious theoretical gap, which could be filled by the relation of the risk structure with the DRR structure, paying special attention to aspects helpful in explaining issues that could be hard to explain only by experts. Figure 4 presents a model of DRR, which meets this assumption.

The model has the form of a morphological cube. Three walls correspond to three layers of the DRR analysis. The first one refers to signs of risk perception – not only the negatives but also positive issues related to disaster and relevant operations (e.g. disaster response, human support, risk communication). Inclusion of the risk structure elements could help to ensure the holism

and comprehensiveness of the model. Direct relation with elements of the DRR structure allows to connect the model with all the existing and future DRR concepts, approaches, methodologies, methods, techniques and tools and support them by taking into consideration societal dimension of risk.

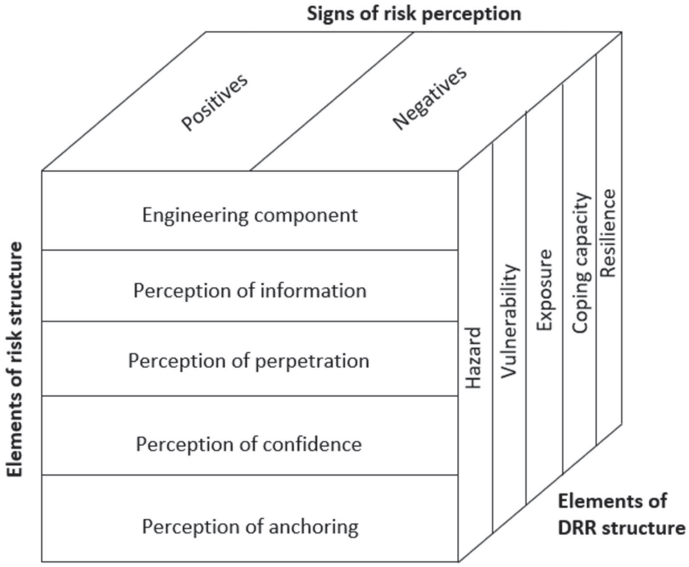

Fig. 4. Matrix model of DRR
Source: own study

As there are many potential complex circumstances to be described by the model, it is relatively hard to state universal connections between its elements. The connections will be unique in individual cases. This is why practical use of the model consists in morphological analyses of all or the most probable connections. The morphological approach is valuable from the cognitive point of view in disaster research [23, 51, 52]. It points to the need of analysing all relations (logical and illogical ones) between the model elements to find out connections that are both obvious and unobvious. A simple multiplication of the elements (5 elements of risk structure × 5 elements of the DRR structure × 2 kinds of signs of risk perception) gives 50 connections which can be treated as analytical areas. 80% of them deal with societal dimension of the DRR. The areas can be used among others for:

- identification of societal premises and conditions indicating directions for the DRR,
- literature review to identify gaps in the DRR theory and practice (when the societal dimension is not taken into consideration),
- evaluation of existing equations for the DRR and relevant risk elements (hazard, vulnerability, exposure, coping capacity and resilience),
- formulation of equations to calculate the perception measures,
- further methodological investigation.

As regards situations that arise from the classical risk approach, people may not wish to evacuate if they perceive the evacuation risk greater than the risk related to shelter in place. There could be many reasons of such situational judgement, from fear of family separation (especially when small kids are considered), violence on evacuation routes or robbery to relatively good preparation for long isolation at home and high self-confidence. Fukushima workers could try to balance the risk of their sacrifice and risk related to situation when nobody limits internally the plant failures, in accordance to their knowledge, skills and beliefs. In term, the low effectiveness of DRR strategies implementation could stem from the inadequacy between DRR behaviours designed by experts and people (entrepreneurs, societal groups, individual) needs and values affected by the disaster and (additionally) by the manners.

More detailed answers for indicated problems would become available after practical implementation of the model into mathematical mechanisms for risk calculation. Nevertheless, such general view preliminarily confirms its usefulness in the analysed context.

4. CONCLUSION

DRR has nowadays become one of the most important directions for building safety and security. However, even if strategic approaches have been implemented by international organizations for many years, there is still no concept that would cover the entire area of risk factors, also in its societal dimension.

The development of the DRR approach should start from basic terms and theories. This is why the first steps should be focused on the safety structure. At the highest level of generality, safety comprises actual safety and the sense of safety. In such a way, two closely related issues are connected – objective safety level assessed by experts and subjective perception of peoples' feelings,

fears, values and behaviours. As risk is understood as a safety measure, the two dimensions can be implemented directly to the risk structure. Consequently, risk is constituted by the engineering component and by risk perception. The engineering component is widely examined by theorists and practitioners who use it in DRR worldwide. The problem appears when it comes to risk perception, because there is no holistic approach that would allow its calculation. The use of psychological and sociological concepts allows a division of the risk perception into perception of information, perception of perpetration, perception of confidence and perception of anchoring. These elements seem to fill the theoretical gap in the DRR theory in its societal dimension.

The morphological connection of risk structure elements, DRR structure elements and two signs of the risk perception (positives and negatives) constitutes a DRR model which comprehensively deals with DRR with view to its societal and non-societal dimensions. One thing is distinctively noticeable, and namely two kinds of signs of the risk perception. The model includes all factors that determine the entire spectrum of risk and DRR elements. The factors could have not only negative impact on safety. A holistic specification requires taking into account also issues, events, operations and facts that could provide support in the prevention of disasters, preparedness, response and recovery.

The main research result is the DRR model. The research was carried out with the use of deductive investigation to allow verification of ideas and assumptions. This is why further scientific efforts should be based on induction proceedings. In addition, even if the model corresponds to many case studies, its practical verification is desirable to provide more complex and detailed guidelines for DRR in its both societal and non-societal dimensions.

REFERENCES:

1. Busayo, E., Kalumba T., Afuye A.M., Ekundayo G.A., Orimoloye O.Y., I. R. 2020. Assessment of the Sendai framework for disaster risk reduction studies since 2015. International Journal of Disaster Risk Reduction 50, 101906. https://doi.org/10.1016/j.ijdrr.2020.101906.
2. Enia, J. 2020. Is there an international disaster risk reduction regime? Does it matter? Progress in Disaster Science 7, 100098. http://dx.doi.org/10.1016/j.pdisas.2020.100098.
3. The Sendai Framework for Disaster Risk Reduction 2015–2030. United Nations.

4. Global Assessment report on Disaster Risk Reduction 2019, Geneva, Switzerland, United Nations Office for Disaster Risk Reduction (UNDRR).
5. Tselios, V., Tompkins, E L. 2020. Can we prevent disasters using socioeconomic and political policy tools? International Journal of Disaster Risk Reduction 51, 101764. https://doi.org/10.1016/j.ijdrr.2020.101764.
6. Lassa, J.A., Surjan, A., Caballero-Anthony, M., Fisher, R. 2019. Measuring political will: An index of commitment to disaster risk reduction. International Journal of Disaster Risk Reduction 34, p. 64–74. https://doi.org/10.1016/j.ijdrr.2018.11.006.
7. Oostlander, S.A., Bournival, V., O'Sullivan, T.L. 2020. The roles of emergency managers and emergency social services directors to support disaster risk reduction in Canada. International Journal of Disaster Risk Reduction 51, 101925. https://doi.org/10.1016/j.ijdrr.2020.101925.
8. Ward, P.J. et al. 2020. The need to integrate flood and drought disaster risk reduction strategies. Water Security 11, 100070. https://doi.org/10.1016/j.wasec.2020.100070.
9. Martinez, G., Costas, S., Ferreira, O. 2020. The role of culture and informal aspects for coastal disaster risk reduction measures: Empirical evidence from northern and southern Europe. Advances in Climate Change Research in press. https://doi.org/10.1016/j.accre.2020.11.001.
10. Marshall, T.M. 2020. Risk perception and safety culture: Tools for improving the implementation of disaster risk reduction strategies. International Journal of Disaster Risk Reduction 47, 101557. https://doi.org/10.1016/j.ijdrr.2020.101557.
11. Simak, L., Ristvej, J. 2009. The Present Status of Creating the Security System of the Slovak Republic after Entering the European Union. Journal of Homeland Security and Emergency Management 6(1). https://doi.org/10.2202/1547-7355.1443.
12. Wolanin, J. 2017. Common Societal Security Culture in the Baltic Sea Region. Basics and the way forward. Stockholm. Council of the Baltic Sea States Secretariat. http://www.bsr-secure.eu/wp-content/uploads/2017/03/Common-Societal-Security-Culture-working-paper.pdf.
13. Gromek, P. 2017. Teoria organizacji bezpieczeństwa na przykładzie masowej ewakuacji ludności *[Theory of security organisation on the example of mass population evacuation]*. Warsaw, Difin.
14. Kasperson, R.E., Renn, O., Slovic, P., Brown, H.S., Emel, J., Goble, R., Kasperson, J.X., Ratick, S. 1988. The Social Amplification of Risk: A Conceptual Framework. Risk Analysis 8(2), p. 177–187.

15. Sandman, P. 2012. Responding to Community Outrage: Strategies for Effective Risk Communication. AIHA Press.
16. Wolanin, J. 2020. Inżynieria w bezpieczeństwie wewnętrznym *[Engineering in internal security]*. Warsaw, Wydawnictwo Szkoły Głównej Służby Pożarniczej.
17. Gromek, P. 2015. Dorobek teorii organizacji i zarządzania w projektowaniu systemów bezpieczeństwa – pętla implementacyjna *[Achievements of the theory of organisation and management in planning security systems – implementation loop* [in:] Metodologiczne i dydaktyczne aspekty bezpieczeństwa narodowego *[Methodological and didactic aspects of national ecurity]*, eds. W. Kitler, T. Kośmider. Warsaw, Difin, p. 246–259.
18. Senthilnathan, S. 2017. Relationships and Hypotheses in Social Science Research. SSRN Electronic Journal. DOI: 10.2139/ssrn.30322.
19. Kabir, S.M.S. 2016. Formulating and testing of hypothesis In: Basic Guidelines for Research: An Introductory Approach for All Disciplines. Bangladesh, Book Zone Publication.
20. Wiśniewski B. 2020. Praktyczne aspekty badań bezpieczeństwa *[Practical aspects of security research]*. Warsaw, Difin.
21. www.oxfordlearnersdictionaries.com.
22. Boughton, G. 2000. Principles of Disaster Mitigation in Health Facilities. Washington, PAHO/WHO.
23. Gromek, P. 2018. W sieci ratownictwa *[In the rescue network]*. Warsaw, Main School of Fire Service.
24. Wolanin, J. 2005. Zarys teorii bezpieczeństwa obywateli. Ochrona ludności na czas pokoju *[Outline of the Citizens' Security Theory. Population Protection in the Time of Peace]*. Warsaw, Danmar.
25. Wróblewski, D. (Ed.). 2018. Zarządzanie ryzykiem. Przegląd wybranych metodyk. Wydanie rozszerzone *[Risk management. Review of Selected Methodologies. Extended edition]*. Józefów, Józef Tuliszkowski Scientific and Research Centre for Fire Protection – National Research Institute.
26. Marciniak, E. M. 2009. Psychologiczne aspekty poczucia bezpieczeństwa *[Psychological Aspects of the Sense of Security]* In: S. Sulowski, M. Brzeziński (Eds.) Bezpieczeństwo wewnętrzne państwa. Wybrane zagadnienia *[Internal State Security. Selected Issues]*. Warsaw, Dom Wydawniczy Elipsa.
27. Frei, D. 1977. Sicherheit. Grundfragen der Weltpolitik, Stuttgart: Verlag W. Kohlhammer.
28. Rundmo, T. 1996. Associations between risk perception and safety. Safety Science 24(3), p. 197–209.

29. Barrios, J.M., Hochberg, Y.V. 2020. Risk perception through the lens of politics in the time of the COVID-19 pandemic. Working paper no. 2020–32. Becker Friedman Institute.
30. Ridley, J., Channing, J. 1999. Risk Management. Safety at Work Series 2.
31. ISO 31000:2018 – Risk management – Guidelines.
32. A Guide to the Project Management Body of Knowledge (PMBOK® Guide), Fifth Edition.
33. Aven, T., Rosa, O., Renn, O. 2011. On the ontological status of the concept of risk. Safety Science 49, 1074–1079. https://doi.org/10.1016/j.ssci.2011.04.015.
34. Slovic, P. 1987. Perception of Risk. Science 236, p. 280–285.
35. Slovic, P., Weber, E.U. 2002. Perception of Risk Posed by Extreme Events. Risk Management strategies in an Uncertain World," Palisades, New York, April 12–13, 2002.
36. Shao, W., Hao, F. 2020. Confidence in political leaders can slant risk perceptions of COVID–19 in a highly polarized environment. Social Science & Medicine 261, 113235. https://doi.org/10.1016/j.socscimed.2020.113235.
37. Yamashita, R. 2020. Relationship between citizens' risk perceptions formed by disaster information and migration decision-making: Evidence from Japan. Progress in Disaster Science 5, 100056. http://dx.doi.org/10.1016/j.pdisas.2019.100056.
38. Sun, X., Chang-Richards, A.Y., Kleinsman, T., Innes, A. 2021. Improving human resource mobilisation for post-disaster recovery: A New Zealand case study. International Journal of Disaster Risk Reduction 52, 101998. https://doi.org/10.1016/j.ijdrr.2020.101998.
39. Astuti, N.M.W., Werdhiana, I.K., Wahyono, U. 2021. Impacts of direct disaster experience on teachers' knowledge, attitudes and perceptions of disaster risk reduction curriculum implementation in Central Sulawesi, Indonesia. International Journal of Disaster Risk Reduction 53, 101992, https://doi.org/10.1016/j.ijdrr.2020.101992.
40. Tselios, V., Tompkins, E.L. 2020. Can we prevent disasters using socioeconomic and political policy tools? International Journal of Disaster Risk Reduction 51, 101764. https://doi.org/10.1016/j.ijdrr.2020.101764.
41. Fischoff, B., Slovic, P., Lichtenstein, S., Read S. & Combs, B. (2000). How Safe Is Safe Enough? A Psychometric Study of Attitudes Toward Technological Risks and Benefits. In: P. Slovic (Ed.). The Perception of Risk, pp. 80–104. London: Earthscan.
42. Grądzka, N. 2018. Wpływ społecznego wzburzenia na wartość ryzyka *[Impact of social outrage on the value of risk]*. Master thesis. Main School of Fire Service.

43. Oltedal, S., Moen, B.-E., Klempe, H., Rundmo, T. 2004. Explaining risk perception. An evaluation of cultural theory. Trondheim, Rotunde publikasjoner.
44. 2009 UNISDR Terminology on Disaster Risk Reduction. Geneva, UNISDR.
45. Hyogo Framework for Action 2005–2015. Building the Resilience of Nations and Communities to Disasters. A/CONF.206/6.
46. Transforming our world: the 2030 Agenda for Sustainable Development. A/RES/70.1.
47. Report of the Conference of the Parties on its twenty-first session, held in Paris from 30 November to 13 December 2015. Part two: Action taken by the Conference of the Parties at its twenty-first session.
48. New Urban Agenda. 2017. A/RES/71/256.
49. Rohrmann, B. 2008. Risk perception, risk attitude, risk communication, risk management. A conceptual appraisal. In: Global co-operation in emergency and disaster management. The International Emergency Management Society TIEMS-2008 in Prague/Czechia.
50. Olsen, O.E., Kruke, B.I., Hovden, J. 2007. Societal Safety: Concept, Borders and Dilemmas. Journal of Contingencies and Crisis Management 2, p. 69–79.
51. Ritchey, T. 2006. Modelling Multi-Hazard Disaster Reduction Strategies with Computer-Aided Morphological Analysis. Modelling Multi-Hazard Disaster Reduction Strategies. Proceedings of the 3rd International ISCRAM Conference (B. Van de Walle and M. Turoff, eds.), Newark, NJ (USA), May 2006.
52. Ritchey, T. 2012. Modelling Complex Socio-Technical Systems Using Morphological Analysis. Swedish Morphological Society. www.swemorph.com.

PAWEŁ GROMEK – holder of post-doctoral degree of security studies, master in fire protection, engineer, professor at the Main School of Fire Service, officer of the State Fire Service.
ORCID: 0000-0003-0997-5069

PAWEŁ GROMEK – doktor habilitowany nauk o bezpieczeństwie, magister inżynier pożarnictwa, profesor Szkoły Głównej Służby Pożarniczej, oficer Państwowej Straży Pożarnej.