System, Structures and Processes in Evaluation of Civil Protection Exercises

Harri Ruoslahti[1][a] and Harriet Lonka[2]
[1]*ResLab, Laurea University of Applied Sciences, Vanha maantie 9, Espoo, Finland*
[2]*North Savo Regional Council, Sepänkatu 1, 70100 Kuopio, Finland*

Keywords: System, Structures, Processes, Civil Protection Exercises, Exercise Evaluation.

Abstract: Civil protection exercises are activities that simulate real-life emergencies, where participants can practice, review, and test the exercise system, and its structures and processes. The Union Civil Protection Mechanism (UCPM) exercises all require systematic evaluation. This article applies the framework of systems theory to the practical evaluation of civil protection exercises with the research question (RQ): how does systems theory apply to the evaluation practices of civil protection exercises? The method of this study combines a descriptive literature review, Delphi workshops, and analysis of expert interview transcripts on the approaches behind the concepts which are then examined in the context of the evaluation of civil protection exercises. Organizational structures of exercise systems outline 'what' direct the activities that achieve the goals of the exercise. Structures are the combinations of relations between the organizational elements that form organizational activities, and may include rules, roles, methods, technologies, applications, and responsibilities of the exercise participants. Organizational processes of an exercise include the activities that establish the goals of the exercise. In an exercise evaluation context, processes focus on how operations and human interactions are carried out by the people who realize and manage the scenarios of the exercise. This three-dimensional approach can help address the complex interplay of factors within civil protection exercises. The contribution of this study is that it clarifies the theoretical background of literature on systems theory, organizational structures, and processes as they relate to the evaluation of civil protection exercises, which can have a practical contribution to the training of exercise evaluators.

1 INTRODUCTION

Civil protection exercises simulate real-life emergencies, so that participants can practice, review, and test the exercise system, and its structures and processes, in defined roles (Lausen & Kastner, 2022). Civil protection exercises are part of the development of the field civil protection, and for this reason these exercises require systematic evaluation (Bruns & Kern, 2022; Bruns, Çelikler & Jonitz, 2022).

Exercises aim at improving preparedness on an individual level, where exercises provide opportunities for hands-on practice, on disaster plans and procedures, while offering constructive criticism; and on an institutional system level, where a well-designed exercise may reveal resource and interagency coordination gaps, clarify roles and responsibilities, and uncover weaknesses in planning (Beerens, 2021).

The Union Civil Protection Mechanism (UCPM) classifies exercises as discussion based, such as seminars, workshops, tabletops, and games, and operations based, which can be e.g., drills, functional exercises, and full-scale exercises (European Commission, 2021). Exercises range from relatively simple exercises that may e.g., involve a small team to practice a relatively simple drill, to very complex exercises, where a wide range of organizations simulate a major emergency (WHO 2017; Lausen & Kastner, 2022).

Systematically interconnecting evaluation methods, tools and available evaluators can contribute to a continuous improvement of the outcomes of European civil protection exercises (Heinonen et al. 2024); Understanding these benefits from a holistic view where civil protection exercises form a European system that include national and

[a] https://orcid.org/0000-0001-9726-7956

Ruoslahti, H. and Lonka, H.
System, Structures and Processes in Evaluation of Civil Protection Exercises.
DOI: 10.5220/0013518500004000

In *Proceedings of the 17th International Joint Conference on Knowledge Discovery, Knowledge Engineering and Knowledge Management (IC3K 2025) - Volume 2: KEOD and KMIS*, pages 315-322
ISBN: 978-989-758-769-6; ISSN: 2184-3228

regional systems of systems (Heath, 1998). Exercise evaluation can include concepts and methodology coupled with very practical standard operating procedures (SOP) to help develop more standardized content and structure for the evaluation of different exercise formats (Bruns & Kern, 2022).

Evaluation should include a concept, strategies of data collection, means of analysis and reporting, and generalizations of their appropriateness to evaluation areas or problems (Alkin, 1970). Bruns et al. (2022) propose that three exercise evaluation concepts, system, structures, and processes can enable to identify the most suitable evaluation methods with SOP as a useful guideline for exercise evaluators. The chosen evaluation focus must help understand the evaluation process and systematically assist addressing relevant factors within system, structures, and processes (Lausen & Kastner, 2022; Bruns et al., 2022).

This article aims to understand how to apply the framework of systems theory to the practical evaluation of civil protection exercises. The research question (RQ) of this paper is: how does systems theory apply to the evaluation practices of civil protection exercises?

The main contribution of this study is that it deepens the theoretical framework behind the evaluation foci of system, structures, and processes proposed by first Heath. (1998) and then Bruns et al. (2022) and provides practical notions to conduct evaluation processes in a systematic way and based on evaluation concepts thinking. The second section explains the methodology of this study; the third section how the three concepts from systems approach have been discussed in academic literature; the fourth section focuses on the context of civil protection exercise evaluation; and finally, the last section draws conclusions and proposes future steps and studies.

2 METHOD

The method of this study firstly compiles a descriptive literature review to understand the theories and approaches behind the concepts of system, structures, and processes. Secondly, these concepts are examined as foci in the context of the evaluation of civil protection exercises.

The database ProQuest Central was used for the search, which used combinations of the search words: systems theory; systems theory and evaluation; organiz(s)ational structures; and organiz(s)ational processes. Identified articles were first investigated by reading their title and abstract, after which those that best explain these concepts in an evaluation or organizational context were selected and read in full.

The second part of this study has been complemented by discussing the results of the literature review with practical iterations in expert discussions held at meetings and workshops that were completed in October and November of 2022. The nature of these meetings is action research (Denzin & Lincoln, 1994), where a mini-Delphi approach provided collective debate, individual estimations, and aggregation of answers (Gallego & Bueno, 2014) on how systems theory can be applied to the evaluation of civil protection exercises. These aim of these meetings and workshops were a systematic path to develop systematic evaluation of civil protection exercises (Table 1).

Table 1: Data collection for this study.

Event	Date	Venue	n =
Literature review on theory	Oct – Dec 2022	Search words: Systems theory Systems theory and evaluation Organiz(s)ational structures Organiz(s)ational processes	24 scientific articles
Practical discussions and iterations	Nov – Dec 2022	Teams and Face-to-face Mini-Delphi discussions based on literature review (Grant and Booth, 2009)	Ten (10) events of twelve (12) experts: Process 2, Eval. 4, Method 3, Training 2
Practical discussions and iterations	Dec 2022	Teams or Face-to-face Apr – Jun 2022 under INEGMA-E[2]	Ten (10) civil protection exercise / evaluation experts
Update literature review	Jul 2025	Search words: Evaluation of civil protection exercises	four additional scientific articles

The data collection of this study involved a literature review on theory focusing on the systems theory, evaluation, and organizational structures and processes. This phase was conducted by the authors between October and December of 2022, and it provided a final sample of 24 scientific articles. The findings of this literature review were then further discussed and deepened in a series of ten mini-Delphi discussions (Grant and Booth, 2009), which included

twelve (12) experts in ten meetings, held between November and December of 2022, and workshops involving twelve experts in four fields of expertise: two (2) of processes, four (4) on evaluation, three (3) on methods, and two (2) on training (Table 1).

In December of 2022 by transcripts of ten expert interviews, which had been conducted between April and June of 2022 with interviewees who have years of experience in evaluating a variety of civil protection exercises were examined. In July 2025 an additional literature search was added (Table 1). Qualitative data analysis is based on classification of objects, and is subjective, and cannot be generalized in the population (Denzin & Lincoln, 1994), as this research is strongly tied into the context of the evaluation of European civil protection exercises.

3 SYSTEMS APPROACH IN THE CONTEXT OF CIVIL PROTECTION EXERCISES

Literature discusses that evaluation is a social process, which implies a need for transparent participatory approaches (Gregory, 2000). One expert interviewee noted that "the idea of a structured evaluation with specific objectives is well received and should be used in future exercises" (INEGMA-E^2 / Expert 09, 2022).

3.1 Civil Protection Exercises as Systems

General systems theory emphasizes that systems are organized and composed of interdependent components (Kast & Rosenzweig, 1972). Open systems are embedded within wider systems, where e.g. individuals perform within e.g. an exercise ecosystem (Midgley, 2006; Kast & Rosenzweig, 1972). Any civil protection exercise can be seen as a system formed by parts/sub-systems such as the exercise participants, and its stakeholders. General systems theory can be seen to provide a model of certain general aspects of reality and as a way of seeing things which otherwise may become easily overlooked or bypassed (Von Bertalanffy, 1972). Some systems information is only partly clear (Rahimnia, Moghadasian & Mashreghi, 2011), which can be the case in many exercise systems. Evaluators can take from Systems Theory the idea that it is possible to evaluate how well an organization performs as an open system seeking to thrive in a turbulent environment (Midgley, 2006).

The Input-Transformation-Output model suggests that systems receive inputs their environments, that they transform in some way to export outputs (Kast & Rosenzweig, 1972; Vos & Schoemaker, 2004). Feedback, which is information about processes or outputs of the system, is fed back into the system as input (Kast & Rosenzweig, 1972). Data quality ensures that processed data is accurate, timely, and consistent to make reasonable decisions (Orr, 1998) "… because human thoughts and behaviours are part of wider systems of causality, evaluators need to be very careful about engaging in 'blame games'" (Midgley, 2006, p. 17).

Workflow processes and Standard operating procedures (SOP) have been widely applied in organizational processes (Hevner & Chatterjee, 2010). Each exercise project forms its own system within which the exercise participants and stakeholders act. A systems approach can help conceptualize exercises, as systems with interrelated parts that are open to influences from outside the system (Delphi discussions, 2022; Grunig, Grunig and Ehling (1992). Exercises may be seen to operate as open systems (INEGMA-E^2, 2022; Crossan, Lane and White, 1999). Communication spans the boundaries between system parts, sub-systems, and the environment of the system (Vos 2017).

Delphi discussion experts saw that a systems approach may be a useful lens to assess the various levels of civil protection exercises. Organizational processes, wider innovation eco-systems and their actors build a facilitating context for learning (Hautamäki 2010, Oksanen & Hautamäki 2014). Organizational learning involves recognizing the larger systems that an organization or exercise builds trusting relationships to create commitment among the stakeholders to support organizational learning (Senge et al., 2008). Systems can be complex, networked (Mitleton-Kelly 2003) and dynamic (Ahrweiler & Keane 2013), and combined with actor networks (Piperca & Floricel 2012, Steins & Edwards 1999), while an exercise may also fail to achieve its objectives due to the environmental conditions (Bruns et al., 2022).

Evaluation, when grounded in real scenarios, "features the added value of validating theoretical models and assessing the effectiveness of technological applications in optimizing emergency response systems" (Mandirola et al., 2024, p. 15). Exercise evaluation aims to capture the influencing factors of the system with multiple evaluation methods (Heinonen et al., 2024).

3.2 Structures Within Civil Protection Exercises

Organizations consist of elements, relations between elements, and structure becomes a combination of the relations between the organizational elements forming organizational activity (Ahmady, Mehrpour & Nikooravesh, 2016). Designing temporary project organizations can be challenging (Shirazi, Langford & Rowlinson, 1996), as structure can be understood as the relations between the components of an organized whole, e.g. relations between jobs, systems, operating processes, people (Ahmady, Mehrpour & Nikooravesh, 2016).

Temporary multiorganization seem to follow the principles of systems theory and distinguish between managing systems and operating systems (Shirazi et. al., 1996). Structures in an exercise setting can refer to the models of the internal relations by which power relations, reporting, formal communication channels, responsibilities and decision-making delegation become clarified (Ahmady, Mehrpour & Nikooravesh, 2016). Structures can directly influence organizational learning (Martínez-León & Martínez-García, 2011), and strategic decision-making processes (Fredrickson, 1986).

As part of systems, structures have hierarchy as organizational units have relative ranks, which can be visualized in an organizational chart, also they have a functional dimension showing the distance of each person in organization to central core of organization (Ahmady, Mehrpour & Nikooravesh, 2016).

Structures may be physical or social, such as buildings or geographical or relations between people, positions, units, and sectors (Ahmady, Mehrpour & Nikooravesh, 2016), while in crisis situations, structure may become subservient to turbulent environmental variables (Fredrickson, 1986).

Exercise evaluation may measure and analyse resolution strategies and possible alternative measures with resources available to achieve measurable change within the exercise scenario (Döring & Bortz, 2026).

Structures lay out who does what, so the exercise organization can meet its objectives. Structures refer to the devices and mechanisms by which the exercise system is operated and managed. Structures outline how selected activities are directed, what everyone's job is, and how it fits within the overall system, as structures may e.g. clearly define chains of command, or leave individual actors with high levels of personal agency.

Exercise structures may be illustrated as diagrams or organizational charts. "When defining the objectives, the evaluators should be part of the planning team, to guarantee good evaluation results" (INEGMA-E^2 / Expert 02, 2022).

European civil protection exercises include international and national operational structures that are activated by the Union Civil Protection Mechanism (UCPM) (Call for Proposals UCPM-2021-EX, p. 8). These instruments and techniques may be used operationally in specific cases such as response capacities and modules (Call for Proposals UCPM-2021-EX, p. 8). Exercises may provide a testing ground to implement new tools and procedures, and effectiveness becomes a focus when evaluating structures. External influences may be addressed through systems (Bruns et al., 2022).

3.3 Processes Within Civil Protection Exercises

Observed organizational processes and structures help influence and improve managerial behaviours in practice (Ozbas, 2005). Techniques for representing processes include flow charts and data-flow diagrams (Malone et al., 1993). Delegation within hierarchies helps restrain internal competition and improve the quality of strategic communication (Ozbas, 2005).

Organizational implications could be made by collecting appropriately rich datasets of internal procedures, organizational structure, personnel usage, etc. (Ozbas, 2005). Process evaluation should become anchored in practice for performance measurement and evaluation, and to frame organizational processes as social practices (Kelly & Cordeiro, 2020). Strategic communication, which is vital to allocating resources, may decrease in quality with increasing levels of integration (Ozbas, 2005). Recently internalized tacit knowledge can best contribute to improving the capability to manage alliances when socialization and externalization practices make this knowledge is more widely available (Feller et al., 2013).

"Attention to the collection and meaningful use of performance information may support improved student outcomes by shaping goal-setting activities, providing feedback on performance, and making targeted changes to organizational processes" (Sun & Henderson, 2017, p. 1). One expert interviewee commented that: "follow the structure and its successful" and that it is "important how evaluation is integrated in the whole exercise" (INEGMA-E^2 / Expert 01, 2022).

A challenge with measurement is that metrics across stakeholders may not be comparable to their relationship to performance (Eccles, Ioannou & Serafeim, 2014). It may be helpful to involve historical and institutional knowledge to make suppositions about the nature of some aspects of change, rather than attempting to measure it directly (Carroll, Dobrev & Swaminathan, 2002), as human agency or societal processes can be difficult to measure (Gasc-Barbier, 2024).

Processes refer to 'how' structures are managed by humans, and they include all activities that establish the goals of the exercise. In an exercise evaluation context, processes focus on how operations and human interactions are carried out by the people who realize and manage the scenarios of the exercise. When structures consist of the 'what' is used to do something in the exercise system, processes describe 'how' these structures become managed by the participants. Analysis of the processes can be made in the actual implementations of the measure, such as implementation, problems, and quality perceived by target groups and the exercise staff (Döring & Bortz, 2016). Exercise evaluation should check how exercise objectives are achieved, as “clear training objectives lead to a very clear way of working and thus a very easy evaluation process” (INEGMA-E^2 / Expert 03, 2022).

The exercise organization is a whole that consists of unified parts that act in harmony to effectively and efficiently execute the tasks needed to achieve the goals of the exercise. Processes focus on the ways in which operations and human interactions are carried out by people to realize and manage the exercise scenario (Russo & Rindone, 2024).

4 HOLISTIC CIVIL PROTECTION EXERCISE EVALUATION

The analysis of the data of expert interviews confirms the approach developed based on the literature review. Projects gather teams of diverse expertise to achieve common goals (Canonico et al. 2013), demonstrating a need to actively manage communication in all these three phases of knowledge development with the context of civil protection exercises (Table 2).

Table 2: Evaluation focus definitions and some examples.

Evaluation Focus	Issues	Examples
System	Exercise can be seen as a system formed by parts/sub-systems such as the exercise participants, and its stakeholders. Mostly designed by organizers and exercise members	Project management Exercise preparation Scenarios On-site security Cultural influencing factors Expert 09: *structured evaluation with specific should be used in future exercises*
Structures	Organizational structures of exercise systems outline how activities are directed to achieve the goals of the exercise. Who does what so exercise meets objectives Participants’ jobs and how they fit within overall exercise system. .	Chain of command Rules Roles Responsibilities Expert 02: *When defining the objectives, the evaluators should be part of the planning team* Expert 01: *it’s important how evaluation is integrated in the whole exercise*
Processes	Activities that establish goals Organization — a whole consisting of unified parts acting in harmony to execute tasks to achieve goals, both effectively and efficiently	Search and rescue operations Firefighting Deployment of medical personnel Communication Expert 03: *clear training objectives lead to a very easy evaluation process*

This data (Table 2) was used to enrich the results with empirical evidence. System, structures, and

processes can be used as a basis to build a framework that maps the process of evaluating civil protection exercises holistically in the project flow and focuses on the points to be considered for an evaluation concept. The three evaluation concepts, system, structures, and processes influence each other, "… there is a tight coupling of systems and processes, and there are many interdependencies between these systems and processes" (Vos 2017, p. 23).

There are complex interactions between people, technologies, and processes, while more and more modern systems used by civil protection organizations can be considered cyber-physical (Linkov et al. 2013) or socio-technical (Amir & Kant 2018) as they combine human activities with information technologies.

Processes turn inputs through throughput or transformation into outputs (Katz & Kahn 1978). Inputs may be resources, and outputs learning, knowledge creation processes, and ideas, while throughputs are the interactions between the exercise actors (Pinho et al. 2014). Feedback is needed (Tran & Tian, 2013) to create change to the transformation process and/or future outputs, to maintain a steady state (Kast & Rosenzweig, 1972).

The framework of system, structures, and processes can serve as a grounding concept for methods recommendations for the different types of exercises. Expert 07 proposes that develop less generic standard operating procedures (SOP) "could help during the evaluation process", while "evaluators need to know exactly on what details they have to keep an eye on" (INEGMA-E^2 / Expert 02, 2022).

The results indicate that general systems theory can provide a useful model of aspects of reality by providing a methodological approach that helps see things which otherwise may become easily overlooked or bypassed (Von Bertalanffy, 1972). Evaluators can reference to systems thinking to enhance their theory and practice in their usage of quantitative and qualitative evaluation methods to provide very useful ways evaluate how well an organization performs as an open system seeking to thrive in a turbulent environment (Midgley, 2006). Standard operating procedures (SOP) and other workflow processes help guide and structure evaluation processes (Hevner & Chatterjee, 2010). Gregory (2000) recommends ensuring that participation in evaluation is explicitly considered rather than ignored or implicitly assumed.

5 CONCLUSIONS

The three-dimensional approach of system, structures and processes can help address the complex interplay of factors within civil protection exercises. The contribution of this study is its attempt to clarify the theoretical and practical basis and background as they are examined in literature on systems theory, and organizational structures and processes as they relate to the evaluation of civil protection exercises. Structured methods and SOPs, coupled with evaluator trainings, can help ensure that evaluation is appropriately focused on correct issues that are based on the aims and goals of the exercise.

One main research question that deserves further study is: "Why evaluate?" This will help understand how evaluation may promote preparedness, performance, or collaboration. This study provides theoretical background to the practice of exercise evaluation. This understanding may be used for evidence-based policies and planning of systematically collected and analysed exercise evaluation results that in turn help provide needed inputs to improve relevant procedures and policy processes.

It is important that exercise evaluators can recognize what factors that are essential in coping with the exercise scenario. This study recommends compiling appropriate sets of questions that can be used to collect relevant data from exercise to exercise, over time, and types of exercise. These sets of questions can be coupled with related standard operating procedures (SOP).

These aim to provide structure to exercise evaluation. Further study may help understand how SOPs can also aid evaluator learning, and through structured evaluation promote learning outcomes among all exercise participants and help them communicate what they have learned. Added clarity provided by SOPs can help identify higher level development issues. One main contribution of this study is the addition to the body of knowledge used to create structured frameworks for evaluation of system, structures, and processes (Heath, 1998; Bruns et al., 2022) practical methodology, SOPs, and trained evaluators for more systematic evaluation processes.

Further study is recommended on the role of evaluation in promoting learning among exercise participants. Sharing information on evaluation methodology and reports to all individual exercise participants can promote individual learning. Can e.g. an evaluation questionnaire open participants' awareness to how their roles tie into the whole. Structured methodology provides an opportunity to

collect evaluation data from multiple exercises by multiple case study method. Cases can be exercises over time, in different locations, or civil protection across sectors. As the number of exercise evaluations increases, the use of multiple case study methods can provide increasing insights to better understand exercise evaluation of multiple exercises, of either the same or different type and of re-occurring exercises over time.

To achieve this, however European-wide data would have to be securely stored by someone. To serve this purpose, parts of the data collected protocols could be standardized across multiple evaluations, while the other parts of these data collection protocols could remain customizable to best reflect the exercise goals.

The development of evaluation methods and tools should proceed in a coordinated fashion to provide solutions that are methodologically sound but also quick and easy to use in all possible, even very harsh conditions. Today's technologies permit the collection of large sets of hard data (position, communication, video, etc.) the analysis of which will also need to be considered. One very important question to be considered the future development and benefit of European civil protection exercises will determine the most suitable actor responsible of the secure storage and dissemination for shared knowledge and understanding on a European level; could this be DG-ECHO or who?

REFERENCES

Ahmady, G. A., Mehrpour, M., & Nikooravesh, A. (2016). 'Organizational structure'. *Procedia-Social and Behavioral Sciences*, 230, 455-462.

Ahrweiler, P. & Keane, M. T. (2013). Innovation networks, *Mind & Society*, 12(1), 73-90.

Alkin, M. C. (1970). Evaluation theory development. Evaluation of short-term training in rehabilitation, 9-16.

Amir, S., & Kant, V. (2018). Sociotechnical resilience: A preliminary concept, *Risk Analysis*, vol 38, no 1, 8-16.

Beerens, R. J., Tehler, H., & Pelzer, B. (2020). How Can We Make Disaster Management Evaluations More Useful? An Empirical Study of Dutch Exercise Evaluations. International Journal of Disaster Risk Science, 11, pp. 578-591.

Bruns, H., Çelikler, J., & Jonitz, J. (2022). *D2. 2 A framework for evaluation concepts WP2—Methodology & SOP*.

Bruns, H. & Kern, E-M (2022). Framework for Evaluation Concepts in European Civil Protection Exercises. *Proceedings of Disaster Research Days* 2022.

Carroll, G. R., Dobrev, S. D., & Swaminathan, A. (2002). Organizational processes of resource partitioning. *Research in organizational behavior*, 24, 1-40.

Canonico, P., Söderlund, J., De Nito, E. & Mangia, G. (2013). Special issue on organizational mechanisms for effective knowledge creation in projects: Guest editorial. International Journal of Managing Projects in Business, 6(2), 223-235.

Chia, R. (1997). Essai: Thirty years on: From organizational structures to the organization of thought. *Organization Studies*, 18(4), 685-707.

Crossan, M.M., Lane, H.W. & White, R.E. (1999). An organizational learning framework: from intuition to institution. *Academy of Management Review*, 24 (3), 522-537.

Denzin, N. K., & Lincoln, Y. S. (1994). *Handbook of Qualitative Research*. Sage Publications, Thousand Oaks, USA.

Döring, N., & Bortz, J. (2016). Forschungsmethoden und Evaluation in den Sozial- und Humanwissenschaften. Berlin Heidelberg: Springer-Verlag.

Eccles, R. G., Ioannou, I., & Serafeim, G. (2014). The impact of corporate sustainability on organizational processes and performance. *Management science*, 60(11), 2835-2857.

European-Commission (2021). *Union Civil Protection Mechanism (UCPM) – Technical Guide for UCPM Full-scale exercises*. Available: https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/ucpm/guidance/technical-guide-full-scaleexercises_ucpm_en.pdf (accessed on 09 February 2022).

Feller, J., Parhankangas, A., Smeds, R., & Jaatinen, M. (2013). How companies learn to collaborate: Emergence of improved inter-organizational processes in R&D alliances. *Organization Studies*, 34(3), 313-343.

Fredrickson, J. W. (1986). The strategic decision process and organizational structure. *Academy of management* review, 11(2), 280-297.

Gasc-Barbier, M., Mateos, R. M., Iasio, C., Chanal, A., Villatte, A., Bernardie, S., ... & Monserrat, O. (2024). Crisis exercise in the framework of coastal geohazards: Experience in the Balearic islands (Spain). *International Journal of Disaster Risk Reduction*, 102, 104270.

Gregory, A. (2000). Problematizing participation: A critical review of approaches to participation in evaluation theory. *Evaluation*, 6(2), 179-199.

Grunig, L. A., Grunig, J. E. & Ehling, W. P. (1992). What is an effective organization. *Excellence in public relations and communication management*, 65-90.

Heath, R. (1998). Looking for answers: suggestions for improving how we evaluate crisis management. *Safety Science*, 30, pp. 151 – 163.

Heinonen, J., & Ruoslahti, H. (2024, June). Measuring Societal Impacts of Cybersecurity. *European Conference on Cyber Warfare and Security* (Vol. 23, No. 1, pp. 189-196).

Heinonen, J., Ruoslahti, H., Lonka, H., Savolainen, J., Jokela, J., Hario, P., ... & Bruns, H. (2024, June).

Evaluation Methodology for Civil Protection Exercises. In 2024 IEEE International Conference on Engineering, Technology, and Innovation (ICE/ITMC), pp. 1-7.

Hevner, A., & Chatterjee, S. (2010). *Design research in information systems: theory and practice* (Vol. 22). Springer Science & Business Media.

INEGMA-E^2 (2022). *Transcripts of ten expert interviews* (E01 - E10). Unpublished. Efforts under project task 2.2.

Kast, F. E., & Rosenzweig, J. E. (1972). General systems theory: Applications for organization and management. *Academy of management journal*,15(4), 447-465.

Katz, D., & Kahn, R. L. 1978. The social psychology of organizations, Vol. 2, p. 528, Wiley, New York.

Kelly, L. M., & Cordeiro, M. (2020). Three principles of pragmatism for research on organizational processes. *Methodological innovations*, 13(2), 2059799120937242.

Král, P., & Králová, V. (2016). Approaches to changing organizational structure: The effect of drivers and communication. *Journal of Business Research*, 69(11), 5169-5174.

Lausen, L. & Kastner, R. (2022). *D2.1 A Framework for Exercise Types. International Network of Evaluators & Guideline for a Methodological Approach in Exercise Evaluation* (INEGMA-E2), R-Document, report, 31 March 2022.

Linkov, I., Eisenberg, D. A., Plourde, K., Seager, T. P., Allen, J. & Kott, A. 2013. Resilience metrics for cyber systems. Environment Systems and Decisions, 33(4), 471-476.

Malone, T. W., Crowston, K., Lee, J., & Pentland, B. (1993, April). Tools for inventing organizations: Toward a handbook of organizational processes. *Proceedings Second Workshop on Enabling Technologies-Infrastructure for Collaborative Enterprises* (pp. 72-82), IEEE.

Mandirola, M., Casarotti, C., Morra di Cella, U., Berton, A., Rossi, G., Tacconi Stefanelli, C., ... & Lorusso, O. (2024). A technical-thematic civil protection exercise in Italy: UAS fleets-based activities supporting emergency response in seismic scenarios. Applied Sciences, 14(12), 5306.

Martínez‐León, I. M., & Martínez‐García, J. A. (2011). The influence of organizational structure on organizational learning. *International Journal of Manpower*.

Midgley, G. (2006). Systems thinking for evaluation. *Systems concepts in evaluation: An expert anthology*, 11-34.

Mitleton-Kelly, E. (2003). Ten Principles of Complexity and Enabling Infrastructures. Mitleton-Kelly, E. (Ed), *Complex Systems and Evolutionary Perspectives on Organisations: The Application of Complexity Theory to Organisations*, Pergamon. Amsterdam, 23 - 50.

Orr, K. (1998). Data quality and systems theory. *Communications of the ACM*, 41(2), 66-71.

Ozbas, O. (2005). Integration, organizational processes, and allocation of resources. *Journal of Financial Economics*, 75(1), 201-242.

Piperca, S. & Floricel, S. (2012). A typology of unexpected events in complex projects. *International Journal of Managing Projects in Business*, 5(2), 248-265.

Rahimnia, F., Moghadasian, M., & Mashreghi, E. (2011). *Application of grey theory approach to evaluation of organizational vision Grey Systems: Theory and Application*.

Russo, F., & Rindone, C. (2024, July). Planned and implemented actions by exercises. In International Conference on Computational Science and Its Applications (pp. 28-40). Cham: Springer Nature Switzerland.

Shirazi, B., Langford, D. A., & Rowlinson, S. M. (1996). Organizational structures in the construction industry. *Construction Management & Economics*, 14(3), 199-212.

Steins, N. A. & Edwards, V. M. (1999). Collective Action in Common-Pool Resource Management: The Contribution of a Social Constructivist Perspective to Existing Theory. *Society & Natural Resources*, 12:6, 539-557.

Sun, R., & Henderson, A. C. (2017). Transformational leadership and organizational processes: Influencing public performance. *Public Administration Review*, 77(4), 554-565.

Tran, Q., & Tian, Y. (2013). Organizational structure: Influencing factors and impact on a firm. *American Journal of Industrial and Business Management* Vol.3 No.2(2013), Article ID:30242,8 pages.

Von Bertalanffy, L. (1972). The history and status of general systems theory. *Academy of management journal*, 15(4), 407-426.

Vos, M. (2017). *Communication in Turbulent Times: Exploring Issue Arenas and Crisis Communication to Enhance Organisational Resilience.* Jyväskylä University School of Business and Economics, N:o 40 / 2017.

Vos & Schoemaker (2004). *Accountability of Communication Management, A Balanced Scorecard for Communication Quality.* Lemma Publishers, Utrecht, 2004.

World Health Organization (2017). World Health Organization WHO Simulation Exercise Manual: A Practical Guide and Tool for Planning. *Conducting and Evaluating Simulation Exercises for Outbreaks and Public Health Emergency Preparedness and Response*, Available: https://apps.who.int/iris/handle/10665/254741 (accessed on 15 August 2022).