THE CHALLENGES OF RESEARCHING ORGANIZATIONAL RESILIENCE IN OCCUPATIONAL SAFETY

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Abstract: *The paper discusses the complexity of organizational resilience (OR) research and the associated challenges. In addition to presenting the differences between resilience and resistance, it also analyses the conceptual connections between risk management and disaster relief. Special attention is given to the positive and negative effects of academic competition, emphasizing the dangers of presenting incomplete research as finished work and the issues arising from competition between different scientific disciplines. The paper also highlights the difficulties of data collection in empirical research and the challenges of studying dynamic processes. Furthermore, it provides a detailed examination of the possibilities for developing OR, emphasizing the importance of workplace safety culture, leadership commitment, technological innovation, and continuous monitoring. The aim of the paper is to offer a comprehensive overview of the theoretical and practical approaches to OR and to provide guidance for related research.*
Key words: *resilient process model, buffer effect, organizational resilience, leadership commitment, workplace safety.*

1. INTRODUCTION

The issue of individual resilience began to receive focused attention in the 1950s, particularly concerning children living with high levels of stress or a disability. Garmezy and Werner were among the pioneers in this area [1], [2]. Werner's famous longitudinal study, which began in the late 1950s and early 1960s, ultimately reinforced the concept of resilience in developmental psychology. Psychologists observed that while most severely disadvantaged children struggled, a smaller group exhibited the opposite effect: the series of challenges they faced developed a capacity within them to emerge stronger from their trials [2],[3]. In military organizations, recruits in special units are subjected to such physical and mental challenges that those who do not meet the expectations drop out themselves, while those with sufficient resilience, adaptability, and flexibility emerge stronger in every respect, with a continued emphasis on developing these abilities further during their service in elite forces [4]. The defense efforts during the COVID-19 pandemic provided additional impetus to resilience research. The pandemic highlighted the vulnerabilities of existing systems and accelerated the application of resilience-related theories [5]. The resilience of healthcare systems became a particularly major area, where resilience at both the individual and organizational levels, especially in the context of occupational safety for healthcare workers, gained significant importance [7]. Challenges must also be addressed at the organizational level in a complex manner. Organizations that applied inappropriate strategies were significantly weakened, while those that recognized the need to rethink the entire operation of the organization beyond human resilience, continued to prosper. The challenges make the study of organizational resilience (OR) complex and multifaceted, but they also present an exciting and important area for scientific researchers, as the topic is crucial for ensuring the sustainability, long-term success, and high occupational safety indicators of modern organizations. Among the foundational works on resilience and occupational safety several studies were considered [8], [9], [10], [11], as well as the work on the relationship between organizational culture and occupational safety [12], are noteworthy. The survival and

development of a resilient organization also relies on the active support and contribution of individuals [13]. It is important to emphasize that OR is not only dependent on human factors; other factors such as technology, infrastructure, organizational behavior, and procedures are also crucial. Despite the considerable number of studies, the diversity of the topic indicates that further research is warranted. The legitimacy and importance of these studies are underscored by the fact that the theories and models are applicable across different industries and types of organizations.

This study, in addition to ongoing research focused on resilience in workplace safety, also presents a theoretical resilience process model. The research was carried out in collaboration of "Ergonomics and human factors in the cyber age" program.

2. RESEARCH OBJECTIVE

The goal of the research is to reduce the number of workplace accidents to zero, based on the Vision Zero concept, originally formulated in traffic safety and later adopted in numerous industries [15]. To overcome this significant challenge, all effective methods and tools must be utilized.

Our research aims to contribute to this goal by developing OR. In addition to the Vision Zero goal, the program also focuses on modelling resilient processes and identifying factors that hinder resilience research.

2.1 Scope of Application

In the context of workplace safety OR is reflected in static prevention [8], the safe handling of emergencies during extraordinary situations, and the swift but cautious resolution of recovery efforts. Furthermore, resilience promotes continuous learning and adaptation to changing conditions, supports proactive risk management, and enhances the organization's ability to anticipate and prepare for potential hazards. Additionally, resilient organizations possess strong communication networks and a culture of collaboration, which are crucial for quick responses and effective crisis management. Finally, resilience increases the organization's long-term sustainability by enabling rapid adaptation and return to normal operational status, minimizing losses, and ensuring employee safety.

2.2 Research Methods

The first phase of the research focuses on defining the concept of resilience, exploring the relationship between organizational behavior and OR, and examining their combined impact on workplace safety. The next step involves a comprehensive review of existing empirical and theoretical research, providing a foundation for our own study.

To establish a methodological basis, the principles previously mentioned will be adapted. Reason's Swiss Cheese Model provides the theoretical background for identifying the vulnerable points in the organization under study. Using Dekker's Just Culture theory, we will examine how to develop the horizontal and vertical communication essential for resilient operations within a closed organization. Another challenge of the research is adapting Woods' safety approach to dynamic systems in a closed organizational environment.

In the course of the research, understanding the sequence of events, identifying marker points, and uncovering the various characteristics of resilient processes will set further research directions. The assessment of OR will be based on qualitative interviews and quantitative methods using questionnaires, ensuring reliable data collection and analysis.

However, a challenge arises when the review reveals internal information that could be unfavorable to the organization. Therefore, strict adherence to data security protocols and the establishment of trust between the organization under study and the researchers are essential.

To ensure the necessary security guarantees, data collection will occur under the supervision of the organization, while data storage will take place on the organization's premises. Accordingly, the preparation for quantitative research requires significant resources, including time, expertise, and financial investment.

3. FUNDAMENTAL QUESTIONS OF RESILIENCE

3.1 Research on Resilience

According to Alexander's investigations, resilience first appears in the writings of Seneca [16]. In the field of sciences, mechanics [17] and child psychology [18] were the first to study resilience. Subsequently, it has rapidly entered other scientific disciplines. Today, resilience is defined as a complex concept, with key abilities including flexibility, resistance, adaptability, and recovery, among many other aspects that together form its underlying meaning. In recent decades, the concept of resilience has increasingly become the focus of organizational and systemic studies. For example, the Resilience Engineering approach applies the concept of resilience in the field of safety and accident prevention, where systems are capable of adapting and returning to equilibrium after disturbances. Additionally, resilience has played a central role in research on climate change and sustainable development, where it appears as an ability of systems that can withstand environmental challenges and maintain their functionality.

Interdisciplinary approaches have become increasingly prominent in resilience research, where various disciplines such as sociology, economics, information sciences, and ecology all contribute to a deeper understanding of the concept. These studies explore the different dimensions of resilience, including the resilience of social systems, the ability to respond to economic shocks, as well as the redundancy and adaptability of information systems.

Although the concept of resilience is becoming more widespread and applied, defining and measuring this concept remains a challenge for researchers. Furthermore, the long-term sustainability of resilience and the ability to adapt to unforeseen environmental and social changes also require further research. Future research should particularly focus on the resilience of complex systems, on the effect that different dimensions of resilience have on each other, and the role of the human factor in maintaining resilient systems.

Publications of Organisational Resilience

Fig. 1. The growth in the number of publications on organizational resilience between 1940 and 2024. (Author's drawing based on the Google Scholar publication database).

Using the Google Scholar publication database, we examined the changes in the significance of organizational resilience through the growth in publications from 1940 to 2024, as shown in Fig. 1. Organizational resilience research came back into the spotlight at the turn of the millennium with Y2K and 9/11, and again between 2020 and 2024 with COVID-19.

The growing significance of resilience has also appeared in international and national regulatory frameworks, where preparedness for developing adaptive and resilient strategies has gained prominence, such as in disaster management, urban planning, and information security. In practical applications, more and more organizations are developing their own resilience strategies aimed at minimizing operational disruptions and ensuring rapid recovery.

One possible way to categorize resilience is by focusing on human, technological, and procedural aspects. The human side can be examined from an individual perspective, which includes individuals' resistance to stress, flexibility, and adaptability, or from a community perspective, which considers the collective response capabilities of groups, their cohesion, and the role of community support networks. The technological framework can be monolithically stable and highly reliable, or it can be a web-like distributed or redundant system. Alexander identifies resilience in technical, physical, psychological, and social-focused research. In our view, the examination of the regulatory environment and local

procedures should be considered an equally important element in resilience research.

3.2 Resilient Processes

In processes, resilience refers to the quality of the ability to restart following an impact. Building on the approach of Cimarello et al. [19], the simplified time-course curve of events shown in Fig. 2 can be used to examine the capability of resilience.

The simplified diagram shows performance under normal conditions up until the onset of the strike (t_{0E}). The recovery time (t_{Rec}) begins at the moment of the impulse-like strike and lasts until the expected functionality is restored. When the strike ends, performance continues to decline due to the system's inertia, then begins to improve following the first substantive intervention. The decrease in functionality depends on several factors: the intensity of the strike, the organization's resistance to penetration, and the organizational buffering capabilities.

Buffering capacity effectively indicates the extent to which the unaffected areas of the organization can absorb the load during the impact and how much overload they can tolerate from the functions of the affected parts. Resistance reduces the depth of the strike, while increasing buffering slows down the course of the strike. Both factors independently reduce recovery time, thereby mitigating the adverse effects on the organization. The loss is represented by the area between the expected functionality and the curve, illustrated by the $Q(t)$ function.

The comparison of the temporal and functional effects of the original and improved resilience capabilities is shown in Fig. 3. Buffering capacity extends the effects over time while reducing their intensity, so the extent of damage caused by adverse events is expected to be smaller. "ΔQ" represents the instantaneous resilient absorption capacity, which indicates how well the system can absorb and manage disruptions at any given moment without suffering significant damage. This absorption capacity is influenced by various factors, such as the degree of buffering, system flexibility, and the effectiveness of the interventions applied.
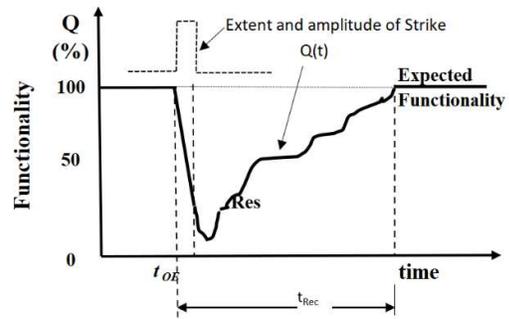

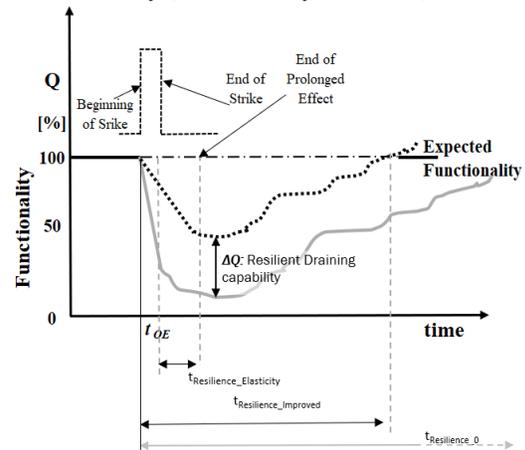**Fig. 2.** Resilience: The moment of strike and flow of recovery (illustration by the author).

Fig. 3. Improved resilience (illustration by the author)

3.3 The Relationship between Resilience and the concepts of Resistance, Risk Management, and Disaster Response

Resistance is typically a passive capability that serves to prevent or mitigate adverse effects, for example, through structural reinforcements or protective systems. In contrast, resilience is a dynamic ability to respond to current problems with loss-reducing actions rather than passively enduring impacts. Risk management involves the continuous assessment and prioritization of dangers and the development of the most appropriate responses to prevent harm.

Disaster response encompasses a range of activities aimed at preventing, mitigating, and recovering from severe accidents and other hazardous situations, including societal preparedness and drawing the lessons learned. The United Nations Office for Disaster Risk Reduction (UNDRR) defines the fundamental concepts in the Sendai Framework for Disaster Risk Reduction, focusing on disaster risk reduction and resilience improvement.

3.4 Current Relevance and Connections of the Organizational Resilience Approach

The importance of this issue is highlighted by the fact that, alongside intensive and extensive research, relevant international standards have also emerged (ISO 22316:2017 (en) Security and resilience (Organizational resilience) Principles and attributes, ISO 31000, Risk Management Standard).

Pera et al. [20] identify the capabilities that characterize resilient organizations, extending across all resources of the organization, as monitoring, foresight, and response capabilities, which mutually influence each other. Monitoring involves not only detecting predictive indicators and current signals but also delayed impact changes. The foresight capability is primarily based on the interpretation of predictive indicators. Effective response capability presupposes the efficient operation of an SMS (Safety Management System) that covers resources, competencies, responsibilities, procedures, and barriers.

Considering the principles of the Safety Management Model and organizational resilience, both approaches appear as strategic baselines in high-reliability organizations, with a noticeable integration in the operation of SMS. Since the SMS proactively addresses safety issues, it allows for the identification of potential hazards before events occur, thus providing a good chance for prevention or mitigating damage [21]. Thus, the effective operation of an SMS provides a solid foundation for establishing a resilient organizational structure and response [22]. Ewertowski and Kuzminski point out that a moderate correlation can be observed between the maturity models of SMS and resilience, underscoring that both are necessary to ensure the safety and sustainability of the organization.

3.5 The Parallel Lines of Operating a SMS and a Resilient Organization (OR)

The parallel characteristics and similarities of SMS and OR, based on the thoughts of Ewertowski and Kuzminski [22], are shown in Table 1.

Table 1

Comparative Table of SMS and OR.

Criteria	Responses formulated according to the criteria	
	SMS	**OR**
Risk Management	A framework aimed at identifying, assessing, and managing risks, ensuring that the organization can effectively respond to safety threats.	Resilient organizations are capable of proactively identifying and managing risks arising from unexpected events, allowing them to adapt more quickly and recover from crises
Proactive Approach	Proactively addresses safety issues by identifying potential hazards before events occur and planning for their management	The prerequisite for organizational resilience is a proactive approach. Organizations not only respond to challenges but continuously develop their capabilities to adapt to future changes.
Learning and Continuous Improvement	SMS mandates that organizations learn from safety events, review procedures, and improve the system when necessary.	One of the keys to organizational resilience is learning, where the organization continuously analyzes experiences and adapts its strategies for more effective operations.
Adaptive Capacity	The safety management system can adapt to changing environments and regulations, allowing it to respond flexibly to internal and external challenges.	Resilient organizations excel in quickly adapting to changing environmental factors and unexpected events, while maintaining operational continuity
Organizational Culture and Communication	A key element of safety management is the organizational culture, where recognizing and addressing safety risks is present at all levels. Effective communication and increased safety awareness are essential.	Organizational resilience also largely depends on organizational culture, where collaboration, open communication, and adaptive leadership play a crucial role.

4. THEORETICAL AND PRACTICAL CHALLENGES OF RESEARCH

4.1 Model Selection – Determining Measurement Points

The diverse aspects of OR research results in significant complexity, further complicated by the difficulties in the workplace safety area. Resilience, as a multidimensional concept, can be defined differently by various research groups, leading to diverse methodological approaches. Therefore, a unified starting point cannot be established.

The research methodology, the measurability of selected parameters, and the indicators used for measurement can all vary, hindering comparability and the validity of results. Different theoretical and methodological approaches from various scientific disciplines result in different investigative cross sections, and the definition, validation, and acceptance of theoretical models that can be universally applied across organizations operating under different circumstances remain a challenge for the future. However, the interdisciplinary approaches may enrich research by providing new perspectives for understanding and applying the concept of resilience.

4.2 Research Competition

Interdisciplinary research competition can have a favourable impact when it is reflected positively in speed and results. However, presenting incomplete research as finished work, declaring the superiority, exclusivity, or leading role of different scientific disciplines is less justified due to the complexity of the research. Examples of how certain studies can derive differing approaches and conclusions from the same phenomenon highlight the challenges posed by competition [17].

4.3 Challenges of Empirical Research

Data collection and temporal dimensions both pose challenges. In resilience research, it is often difficult to gather appropriate and relevant data, especially in cases involving organizations' crisis management experiences or internal processes. The dataset is often confidential, making access limited, and the public sharing of results may be in conflict with organizational policies. Resilience and OR are dynamic processes that evolve and adapt over time. This complicates research conducted with static methods and presents challenges in interpreting data and tracking dynamic changes.

4.4 Generalization of Results

OR may manifest differently in state organizations, the private sector, various industries, and specific organizational models. In terms of generalizability, the challenge lies in the fact that a resilient solution for one type of organization may not necessarily work in another. Overcoming these challenges requires flexible methods and frameworks that can account for different organizational contexts and application conditions.

4.5 Implementability of Results

Other than leadership commitment to the principle, the willingness of organizations to participate is fundamentally determined by the practical feasibility of translating theoretical results into practice and the return on investment from research. While it is true that the theoretical research on the concept of OR is advanced, its practical application is often challenging. During the practical implementation of theoretical models, organizations frequently encounter specific, contextual difficulties that hinder or constrain the implementation of theoretical outcomes.

5. POSSIBLE SOLUTIONS

The development of OR can be achieved through various factors and measures. The workplace safety development groups we have identified are:

- Workplace safety culture and communication: Open, honest, and effective communication in extraordinary situations ensures the increase of solution-oriented efficiency.
- Safety training and awareness: Alongside conscious preparation, the development of defensive reflexes, and the continuous maintenance of acquired skills, ongoing improvement also contributes to preventing significant employee and organizational trauma following incidents.
- Leadership commitment and involvement: The active participation of leaders in the development and implementation of resilience strategies is essential for the successful operation of the organization.

- Technology and innovation: Technology and innovation extend to the development of hazard detection sensors and risk reduction procedures.
- Flexibility and adaptation: Flexibility in adapting to extraordinary situations and the level of adaptation are such that in higher-level decision-making, the usual delay in the organization disappears, and immediate local actions are taken to mitigate dangers and risks.
- Monitoring and feedback: Monitoring, based on sensors and employee feedback, analyses and tracks safety performance.

5.2 A Possible Implementation of Monitoring

Supporting the research on organizational resilience can be more effective if a product outline can be presented to the target audience, the management, which also highlights the practical outcome of the research.

The practical implementation results in a dashboard where the changes in measurable resilience-related data of the organization are visible, as well as the current performance compared to the pre-event performance level and the performance difference ratio. In addition to showing the current state, it also provides information about which phase of the process, shown in Fig. 3, the organization is currently experiencing.

6. CONCLUSIONS

In this paper, we reviewed various aspects of OR and the associated research challenges, the differences between resilience and resistance, as well as the conceptual relationship between risk management and disaster response. We examined the positive and negative effects of academic competition, with particular attention to the issues arising from competition between different scientific disciplines. We also addressed the difficulties of data collection in empirical research and the challenges of studying dynamic processes. We discussed the possibilities for developing OR, including the role of workplace safety culture, leadership commitment, technology, and innovation, as well as the importance of monitoring and feedback.

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Provocările cercetării rezilienței organizaționale în siguranța ocupațională

Lucrarea discută complexitatea cercetării rezilienței organizaționale și provocările asociate acesteia. Pe lângă prezentarea diferențelor dintre reziliență și rezistență, analizează, de asemenea, conexiunile conceptuale dintre managementul riscului și intervenția în caz de dezastru. O atenție specială este acordată efectelor pozitive și negative ale competiției academice, subliniind pericolele prezentării unor cercetări incomplete ca fiind lucrări finalizate și problemele care decurg din competiția între diferite discipline științifice. Lucrarea evidențiază, de asemenea, dificultățile colectării datelor în cercetările empirice și provocările studierii proceselor dinamice. În plus, oferă o examinare detaliată a posibilităților de dezvoltare a rezilienței organizaționale, subliniind importanța culturii siguranței la locul de muncă, a angajamentului conducerii, a inovației tehnologice și a monitorizării continue. Scopul lucrării este de a oferi o privire de ansamblu cuprinzătoare asupra abordărilor teoretice și practice ale rezilienței organizaționale și de a oferi îndrumări pentru cercetările conexe.

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