

# Psychosocial risks and new emerging technologies in dangerous environments

*Izabella Kovacs<sup>1\*</sup>, George Artur Găman<sup>1,2</sup>, Daniel Pupăzan<sup>1</sup> and Alin Irimia<sup>1</sup>*

<sup>1</sup> National Institute for Research and Development in Mine Safety and Protection to Explosion – INSEMEX Petrosani, 32-34 G-ral Vasile Milea Street, Petrosani 332047, Romania

<sup>2</sup> INCD INSEMEX Petrosani - correspondent member of the Romanian Technical Academy, Romania

**Abstract.** Work represents the interaction of different components such as work environment, human factor and equipment. Occupational risks assessment associated with each workplace has the role of preventing work accidents and diseases. Among occupational risks, the psychosocial ones mainly refer to stress, being greatly influenced by individual perceptions. Work related stress represents an ongoing challenge, that occupational health and safety specialists have to deal with. As any other occupational health and safety risk, stress and psychosocial risks can be effectively managed. Many experts in the field have pointed out the need to make the issue of protecting emergency workers against occupational health and safety risks a priority. As new technologies emerge and develop, so do occupational health and safety risks resulted from new demands on personnel, including intervention and rescue personnel. The current paper will discuss work-related stress issues and how occupational stress should be managed in the context of emerging technologies in toxic / flammable / explosive environments.

## 1 Introduction

Work encompasses various elements, including the environment, the equipment specific to each workplace, job demands and responsibilities, and, of course, the most important element, the worker and all his aptitudes, attitudes, motivations, emotions, fears, physical and psychological capabilities.

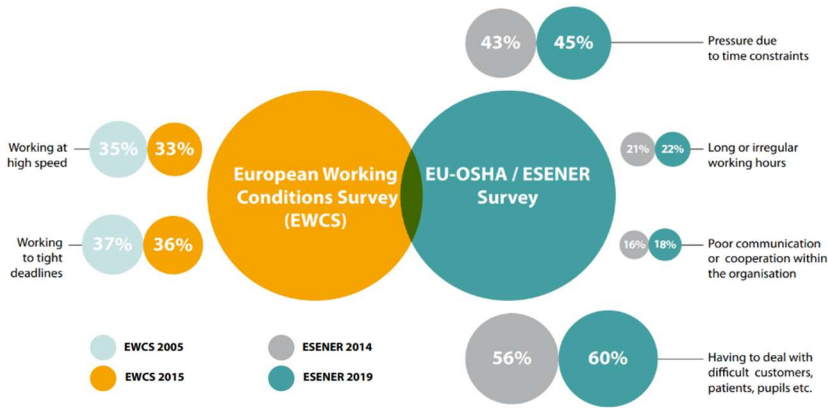
While working, both physical and psychosocial demands are placed on the worker, depending on the nature of activities being performed. Although there is a theoretical distinction between these two types of demands, in reality, there are interconnected relationships between them. Unusual, extreme, unusual or aberrant demands have negative impact not only on the psychological capacity but also on physical capabilities associated with work. For work demands to be considered and perceived as normal and manageable, the aforementioned components of work have to answer certain conditions.

---

\* Corresponding author: [izabella.eisler@insemex.ro](mailto:izabella.eisler@insemex.ro)

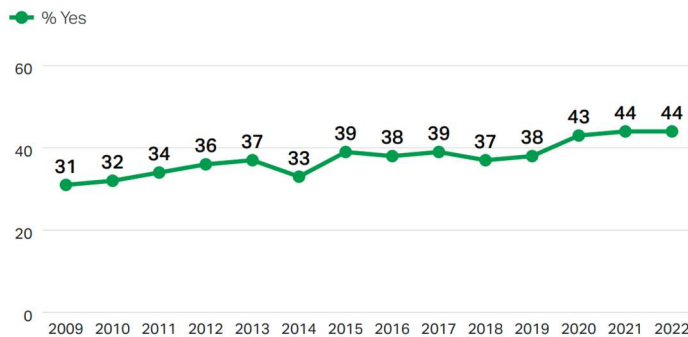
Psychosocial risks at work, as defined by the International Labour Organization (ILO), refer to the potential for harm to workers' psychological and social well-being that arises from work-related factors and the interaction between those factors and the work environment [1]. These risks are associated with the design and management of work, organizational culture, and interpersonal relationships within the workplace. The ILO recognizes that psychosocial risks can impact both mental and physical health and can lead to a range of negative outcomes for individuals and organizations.

When investigating work related stress, numbers are at least to say worrying. In Europe, based on the Occupational Safety and Health Administration (OSHA), stress is the second most frequently reported work-related health problem [2]. Approximately 25% of European employees experience stress throughout most of their work schedule, and a quarter of them indicate that work negatively affects their health. Nearly half of employed individuals in Europe believe that stress is not effectively addressed in their workplaces. This is primarily because, despite approximately 80% of managers expressing concern about work-related stress, less than one-third of companies have implemented dedicated procedures to address stress [2]. The European survey on new and emerging risks 2023 (ESENER) showed that also psychological risk factors were reported by European jobs, as illustrated by fig 1. [3]



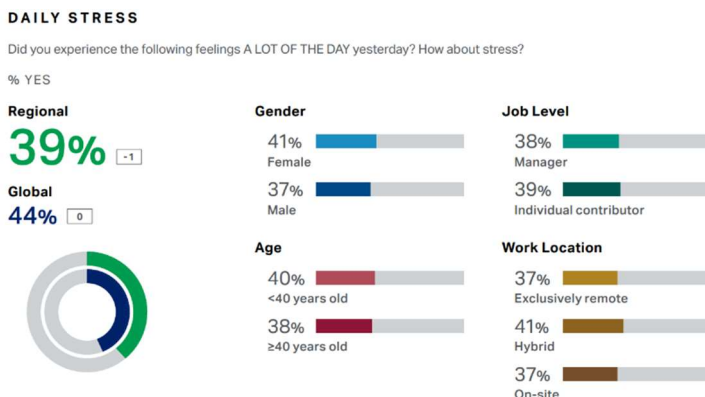
**Fig.1.** Risk factors that can adversely affect mental wellbeing – EWCS and ESENER [3]

Other sources and figures show that, worldwide, forty-four percent of employees said they experienced a lot of stress the previous day, repeating the record high in 2021 and continuing a trend of elevated stress that began almost a decade earlier (fig.2) [4].



**Fig. 2.** Did you experience the following feelings during A LOT OF THE DAY yesterday? How about stress? [4]

Also, the same report cited above shows that in Europe, almost half of the employees feel that they have experienced stress at work during the past day, the number not showing much differences when it comes to gender, work location, age or job level. (fig.3)



**Fig. 3.** Daily stress experienced by European workers [4]

In conclusion, work stress is a prevalent issue that impacts a significant number of workers in various regions, including Europe. Reports from Occupational Safety and Health Administration (OSHA) highlight that stress ranks second among work-related health problems reported by employees. A substantial portion of European workers experience stress throughout their work schedule, with many stating that it has a negative effect on their health. Moreover, a significant percentage of employees feel that stress is not effectively managed in their workplaces. This indicates a need for greater attention and action to address work-related stress. While managers show concern about stress, the implementation of specific stress-related procedures remains limited in companies. It is crucial for organizations to recognize the detrimental effects of work stress and take proactive measures to create supportive work environments, implement stress management strategies, and prioritize employee well-being. By doing so, employers can promote healthier and more productive workplaces, benefiting both individuals and the overall success of the organization.

## 2 New emerging technologies

New emerging technologies are continuously shaping the world we live in, driving innovation, transforming industries, and influencing various aspects of our lives. Among the notable new emerging technologies, we may mention: Artificial Intelligence (AI) and Machine Learning, Internet of Things (IoT) that finds applications in smart homes, industrial automation, healthcare monitoring and environmental monitoring, Virtual and Augmented Reality (VR immerses users in a simulated digital environment, while AR overlays digital information onto the real world), 5G and next-generation networks, renewable energy technologies, biotechnology and genetic engineering, robotics and automation, biometrics and facial recognition and so on.

Among these, emerging renewable energy technologies are playing a vital role in addressing the global energy transition and reducing greenhouse gas emissions, offering sustainable alternatives to traditional fossil fuel-based energy generation. Advanced solar technologies, wind energy innovations, energy storage systems, geothermal energy innovations, bioenergy and biofuels, hydrogen fuel cells hold significant promise for a sustainable and low-carbon energy future contributing to reducing greenhouse gas emissions,

mitigating climate change, and enhancing energy security. Continued research, development, and investment in these technologies are essential to further their deployment, improve efficiency, and drive down costs, making renewable energy more accessible and widespread.

These emerging technologies bring immense potential for innovation, economic growth, and societal transformation. However, they also raise challenges and ethical considerations related to privacy, security, job displacement, and equitable access. It is essential to navigate these advancements responsibly, ensuring that the benefits are shared widely while addressing potential risks and implications. Thus, although new emerging technologies bring exciting opportunities, they also come with a set of challenges that organizations and society need to address. Some of the most common challenges associated with new emerging technologies are listed below [5,6]:

- Uncertainty and unpredictability. Emerging technologies often operate in dynamic and rapidly evolving environments, making it difficult to predict their long-term impacts and potential risks. This uncertainty can create challenges in decision-making, resource allocation, and strategic planning.
- Ethical and societal implications. New technologies can raise ethical concerns related to privacy, security, fairness, and social impact. It is crucial to consider and address these ethical and societal implications to ensure responsible and inclusive deployment of emerging technologies.
- Skills gap and workforce adaptation. Rapid technological advancements can create a gap between the skills required by emerging technologies and the existing workforce's capabilities. Organizations and individuals may face challenges in adapting to new skill requirements and ensuring a skilled workforce ready to leverage the potential of emerging technologies.
- Security and cybersecurity risks. Emerging technologies may introduce new vulnerabilities and security risks. As organizations adopt new technologies, they must address potential cybersecurity threats, data breaches, and privacy concerns associated with the collection, storage, and use of data.
- Regulatory and legal considerations. Emerging technologies often outpace existing regulatory frameworks, making it challenging to establish appropriate guidelines and standards. Developing comprehensive and adaptive regulations that balance innovation and risk management is crucial for ensuring the safe and responsible use of new technologies.
- Access and equity. There can be disparities in access to emerging technologies, creating digital divides and exacerbating existing inequalities. Ensuring equitable access to emerging technologies is essential to prevent further marginalization and to promote inclusive societal benefits.
- Environmental impact. New technologies may have unintended consequences for the environment. It is important to consider the life cycle assessment of emerging technologies and promote sustainable practices to minimize their carbon footprint and ecological impact.

By proactively addressing these challenges, organizations and society can harness the potential of emerging technologies while mitigating risks and maximizing the benefits for individuals and communities.

### **3 Psychosocial risks**

Psychosocial risks refer to the potential hazards that can arise in the workplace from the interaction between social and psychological factors, work organization, and job content. These risks primarily stem from how work is designed, organized, and managed, as well as the social and interpersonal dynamics within the work environment. Psychosocial risks can have detrimental effects on employees' mental and physical health, job satisfaction, and

overall well-being. They are often associated with increased stress levels, burnout, and decreased productivity [7].

Taking a look at the main sources of psychosocial stress, summarized in the table below (table 1), one can easily notice that many of the challenges listed above represent occupational health and safety (OHS) risks that organizations need to address.

**Table 1.** Main sources of psychosocial stress in organizational environments [5]

Risk	Conditions that define the risk
The activity it self	Monotony of work, short work cycles, fragmented, unnecessary work, insufficiently used skills, high degree of uncertainty, permanent contact with clients, patients, difficult students, etc.
Workload and work pace	Over / undersized workload, pace determined by automation, high levels of time pressure and permanent deadline pressure.
Work time	Working in shifts, night shifts, inflexible work schedule, unforeseen working time, extended or maladapted work schedule.
Control	Low degree of participation in decision-taking, lack of control over workload, work pace, working in shifts, etc.
Work environment and equipment	Low availability, inadequacy or inadequate maintenance of work equipment; unsuitable environmental conditions, such as lack of space, low lighting and excessive noise.
Position and organizational culture	Poor communication, low level of support for problem solving and personal development, lack of leadership support; lack of definition for organizational objectives or agreement upon them.
Interpersonal relationships at work	Social or physical isolation, poor relationships with superiors, interpersonal conflicts, lack of social support, harassment, intimidation, inappropriate leadership style and violence from third parties.
Role played in the organization	Role ambiguity, conflicting roles and responsibility for people.
Career development	Career stagnation and uncertainty, low wages, under/overpromotion, job insecurity, low social value of work.
Family time/work time interface	Antagonistic requirements in the personal-professional life relationship, low level of support at home and problems related to the fact that both partners are working (double career).

When it comes to management of occupational stress, interventions can be categorized into primary, secondary, or tertiary. Primary interventions in the management of occupational stress are proactive measures aimed at preventing or reducing the occurrence of stressors in the workplace and mitigating their impact on employees' well-being. These interventions focus on addressing the root causes of occupational stress to create a healthier and more supportive work environment [7, 8].

Some examples of primary interventions for managing occupational stress include:

- Job design and organizational structure: Redesigning job tasks and roles to enhance control, autonomy, and variety can reduce job-related stress. Optimizing the organizational structure, such as reducing hierarchical layers and improving communication channels, can also contribute to a healthier work environment.
- Workload management: Ensuring that workloads are reasonable and manageable for employees, considering their skills and capacities, helps prevent excessive job demands that

can lead to stress. Proper workload distribution, realistic deadlines, and workload assessments can be part of primary interventions.

- Supportive leadership and management practices: Implementing leadership styles that prioritize employee well-being, open communication, and participatory decision-making can foster a positive work environment. Training managers on effective stress management and promoting supportive supervision are crucial aspects of primary interventions.

- Work-life balance initiatives: Promoting policies and practices that support work-life balance, such as flexible working hours, telecommuting options, and family-friendly policies, can help employees manage their responsibilities and reduce stress from conflicting demands.

- Employee participation and involvement: Encouraging employee involvement in decision-making processes, seeking their input on work-related matters, and providing opportunities for feedback and suggestions can enhance their sense of control and reduce stress.

- Training and education: Providing training programs on stress management, resilience building, and coping strategies equips employees with the skills and knowledge to handle workplace stress effectively. Educating employees about stress-related topics, such as recognizing symptoms and accessing support resources, is also beneficial.

By implementing primary interventions, organizations can proactively create a healthier and more supportive work environment, thereby preventing or minimizing the occurrence of occupational stress and its negative impacts on employees' well-being and performance.

### **3.1. Psychosocial risks in the context of new emerging technologies**

Addressing OHS risks associated with emerging technologies requires a proactive approach, involving collaboration between governments, industry, academia, and civil society. Some strategies to tackle these challenges include [6,9]:

- Conducting thorough risk assessments specific to the emerging technologies to identify potential hazards and develop appropriate control measures.

- Investing in research and development to enhance understanding and mitigate potential risks associated with emerging technologies.

- Providing comprehensive training and education programs to enhance workers' understanding of the new technologies, their associated risks, and the necessary safety precautions.

- Fostering a culture of safety and encouraging workers to report any safety concerns or near misses related to the emerging technologies.

- Engaging workers in the design and implementation of safety protocols and procedures, considering their input and expertise.

- Regularly reviewing and updating OHS policies and procedures to align with the evolving nature of the emerging technologies and associated risks.

- Collaborating with technology developers, manufacturers, and industry experts to stay informed about the latest advancements, safety guidelines, and best practices.

- Providing appropriate personal protective equipment (PPE) and ensuring its proper use when dealing with new technologies.

- Monitoring and addressing workers' psychological well-being by promoting work-life balance, offering support programs, and providing resources for stress management.

## **Conclusions**

In conclusion, occupational stress management is of paramount importance in ensuring the well-being of employees and the overall success of organizations. The negative effects of stress in the workplace can lead to decreased productivity, increased absenteeism, higher turnover rates, and compromised physical and mental health of employees. The introduction of new emerging technologies in the workplace can pose additional psychosocial risks for already stressed workers. The rapid changes and demands associated with new technologies can further exacerbate existing stress levels and impact workers' psychological and social well-being.

Stressed workers already face challenges such as high workloads, lack of control, and inadequate support. The integration of new technologies may add to their burden by requiring them to learn new skills, adapt to unfamiliar systems, and navigate increased job demands. This can lead to heightened stress, feelings of overwhelm, and a sense of being unable to keep up with the pace of change.

Organizations must recognize the potential impact of introducing new technologies on already stressed workers and take proactive measures to address psychosocial risks. This includes providing comprehensive training and support to help employees effectively navigate and integrate new technologies into their work processes. Additionally, fostering a supportive work culture that encourages open communication, teamwork, and work-life balance can help alleviate some of the stressors associated with technological changes.

By addressing psychosocial risks in the context of new emerging technologies, organizations can not only protect the well-being of their already stressed workers but also optimize the adoption and utilization of these technologies. It is essential to prioritize the holistic well-being of employees, ensuring their mental and emotional resilience as they navigate the challenges presented by the intersection of new technologies and existing workplace stress.

By implementing effective stress management strategies, organizations can create a supportive work environment that promotes employee satisfaction, engagement, and optimal performance. This involves recognizing and addressing the root causes of stress, providing resources and support systems for employees, and fostering a culture that prioritizes work-life balance and mental well-being.

Effective occupational stress management not only benefits individual employees but also has wider organizational advantages. It can enhance employee morale and motivation, improve job satisfaction, and foster a positive organizational culture. Additionally, it can reduce healthcare costs associated with stress-related illnesses and minimize the financial burden of employee turnover.

Ultimately, investing in occupational stress management demonstrates a commitment to the well-being of employees and serves as a foundation for creating a healthy, productive, and sustainable work environment. It is a crucial aspect of responsible and effective management that yields positive outcomes for both individuals and organizations as a whole.

## References

1. International Labour Office Geneva, Psychosocial risks, stress and violence in the world of work, *International Journal of Labour Research* 2016 Vol. 8 Issue 1–2, (2016)
2. EU-OSHA, ESENER 2019, Third European Survey of Enterprises on New and Emerging, online at: <https://visualisation.osha.europa.eu/esener#!/en/survey/overview/2019>
3. Occupational safety and health in Europe: state and trends 2023, online at <https://osha.europa.eu/en/publications/occupational-safety-and-health-europe-state-and-trends-2023>
4. State of the Global Workplace: 2023 Report, online at <https://www.gallup.com/workplace/349484/state-of-the-global-workplace.aspx>

5. T. Cox, *Stress Research and Stress Management: Putting Theory to Work, Health and Safety Executive*, pp. 36, (1993)
6. S. O. Hansson, *The ethics of technology: methods and approaches, Philosophy, Technology and Society Rowman & Littlefield*, 175-193, (2017)
7. I. Kovacs, G. A. Gaman, D. Pupazan, et al., psychological training program for intervention and rescue personnel, *Environmental engineering and management journal*, 18 (4), 853-864, (2019)
8. A.D. LaMontagne, T. Keegel, A.M.L. Louie, A. Ostry, P.A. Landsbergis, A systematic review of the job-stress intervention evaluation literature, 1995-2005, *International Journal of Occupational Environmental Health*, Vol. 13, pp. 268-280, (2007)
9. V. Forastieri, Prevention of psychosocial risks and work-related stress, *International Journal of Labour Research*, Vol. 8 Issue 1–2, (2016)