

An Exploratory Study on New and Emerging Occupational Safety and Health Risks Associated with the Digital Market

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Abstract. Europe wants to prepare its businesses and citizens for a sustainable and more prosperous human-centric digital future. The path to the translation into reality of the digital objectives will bring a complement to the existing rights and principles regarding the protection of data and private life, the digital rights of citizens as well as guidelines for companies regarding new technologies. Globally, the occupational health and safety risk assessment process is implemented using hundreds of dedicated tools, used in a flexible and complementary way, according to clearly specified criteria. Customized concepts offer a major potential for improving the management of safety and health at work in economic organizations, regardless of their size, form of ownership or other conditioning categories, sectors of activity or public institutions. This paper aims to make contributions regarding the forecasting and identification of new and emerging OSH challenges related to how digitization would change automated systems, work equipment and tools used, how work is organized, business models, hierarchies and relationships, the characteristics of the force of work, responsibilities for OSH management, skills, knowledge and information needed to work.

1 Introduction

In order to understand and predict the impact of digitization, the potential of the changes brought by the adoption of new technologies in the way we work and live, it is necessary to conceptually know the challenges (opportunities or risks) but also the limitations regarding the available data. There are numerous case studies, analyses, papers on the effects of the adoption of ICT tools, on the one hand information about government policies, private sector initiatives, social partners and on the other hand information about the influence on work, working time / schedule, performance, balance between professional life and private life, occupational safety and health / well-being. At European level, the European Agency for Safety and Health at Work (EU-OSHA) Research Program provides reliable information on the potential impacts of digitization on OSH to decision-makers, researchers and employers, so that they can take quick action and effective to ensure that workers are safe and healthy

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[1]. Certainly the rapid changes brought by digitization require the identification of new and updated solutions for safety and health at work. The temporal and spatial flexibility determined by the emergence of technologies such as Big Data, IOT - the Internet of Things, artificial intelligence (AI), robotics, digital work platforms, remote work creates opportunities for workers and employers, but also new challenges and risks for OSH [2].

The way to achieve the objectives led to the definition of expected trajectories, key performance indicators, Eurobarometer-type instruments to track the progress made in the direction of reaching the digital objectives at the level of the member states [3].

A Eurobarometer survey "Health", "Energy, environment and climate change" and "Employment and better working conditions" monitors the three areas where EU citizens expect the most support under NextGenerationEU. In total, 57% of respondents choose "health" as a priority area to receive EU support, 48% of respondents mention "energy, environmental issues and climate change" and 37% choose "better working conditions". In total, 57% of respondents choose "health" as a priority area to receive EU support, 48% of respondents mention "energy, environmental issues and climate change" and 37% choose "occupation of the work and better working conditions". The remaining areas are selected by between 12% of respondents (digitalization of the economy and society) and 23% of respondents (education), according to figure 1 [4].

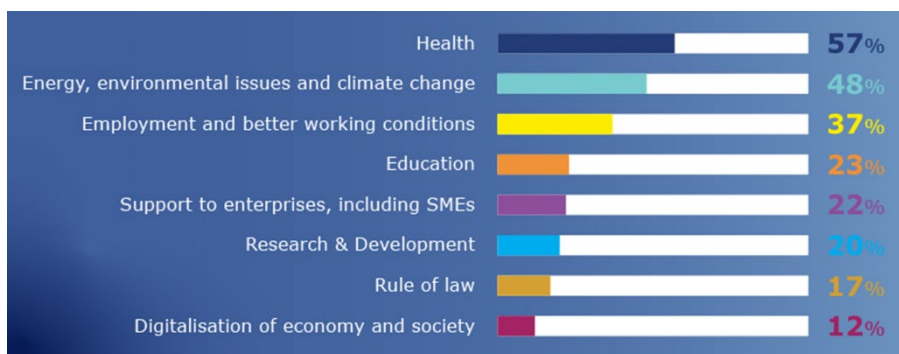


Fig. 1. Eurobarometer results on 'Health', 'Energy, environment and climate change' and 'Employment and better working conditions'

Today's world is characterized by increased connectivity, which has led to a rapid digitization of the economy. The COVID-19 pandemic has accelerated the digital transformation process. The diffusion of digital technology in almost every business and workplace is transforming the world of work, the way labor markets work, including the new types of jobs that have emerged, employment relationships, the skills required and the quality of work [5].

The present work aims to highlight a conceptual research model, applied as a case study on a critical sector, that of research, development and innovation, which will provide information to interested parties, benchmarks to ensure decent work for workers, respectively minimal OSH risks in the context of digitization. The paper provides a perspective with an emphasis on the use of current technologies, i.e. what impact their use has on specific processes during digital transformation. The evolution of ICT technologies themselves, the IT life cycle, emerging technologies or how blockchain influences the future of work are only present to provide aspects related to ICT dynamics. This synthesis has the potential and purpose of providing a perspective on [6]:

- Profiles of workers favored in the digital transformation of the labor market in terms of the impact on people's skills, mental health and well-being, as well as on the social cohesion of the community;
- The profiles of disadvantaged workers in the digital transformation of the labor market and the preventive measures taken so as not to be left behind (especially women and young people); groups that are at risk of being marginalized in the digital economy are addressed, examining youth, women, minorities, persons with disabilities and refugees/displaced persons and migrants.
- The need for changes to existing education and social protection systems to retrain and improve people's skills to adapt to current and future work demands;
- How governments are changing their policies to attract global digital talent and create more decent jobs through digitization.

2 Methodology and integrated conceptual approach

A series of current projects that build on previous research by EU-OSHA, ILO, other entities with attributions in occupational safety and health, map the opportunities, challenges and risks of work impacted by the adoption of digital tools and aim to raise awareness among the workers involved, employers and other relevant stakeholders [7].

The approach proposed by EU-OSHA is to define scenarios, which have proven to be a valuable tool for analyzing future OSH challenges and opportunities. However, they are not predictions, and the future OSH for different sectors and regions contains elements of each of the scenarios in a combination that cannot be predicted. Using scenarios to develop and test future strategies and policies should reduce risk and help maximize the potential to generate opportunities [8].

The proposed conceptual model is to build a project team which in turn consults with specialists in ICT and OHS and which is based at the start on the knowledge acquired from previous projects for forecasting and scanning the digital horizon. The information would be recorded in a structured database, consisting of five main categories: society, technology, economy, environment and politics. To mitigate the risks of this reallocation, it is important that the education system adapts. According to this view, job automation threatens not only routine tasks with rule-based activities but also, increasingly, jobs defined by pattern recognition and non-routine cognitive tasks.

If a job has strong engineering bottlenecks, then technological advances will have little chance of replacing a human with a robot/computer, whereas if the job involves little creative intelligence, social intelligence, or perceptual tasks, then there is a much higher likelihood large for Machine Learning and Artificial Intelligence leading to its digitization [8].

Starting from an analysis that estimates the probability of computerization of jobs and the graphic representation as in figure 2, the results are only predictions, but the findings are challenging [9]. In line with the vision zero approach and the goal of reducing occupational fatalities to zero in the EU Strategic Framework on Health and Safety at Work 2021-2027, as well as the objectives of the European Digital Strategy, it is aimed to place OSH in the wider EU political debate, while also taking into account the gender dimension and the needs of specific groups of workers exposed to increased risk, as regards [10]: Remote work; Work on digital platforms; Advanced robotics and artificial intelligence; Intelligent digital systems; Managing workers with the help of artificial intelligence.

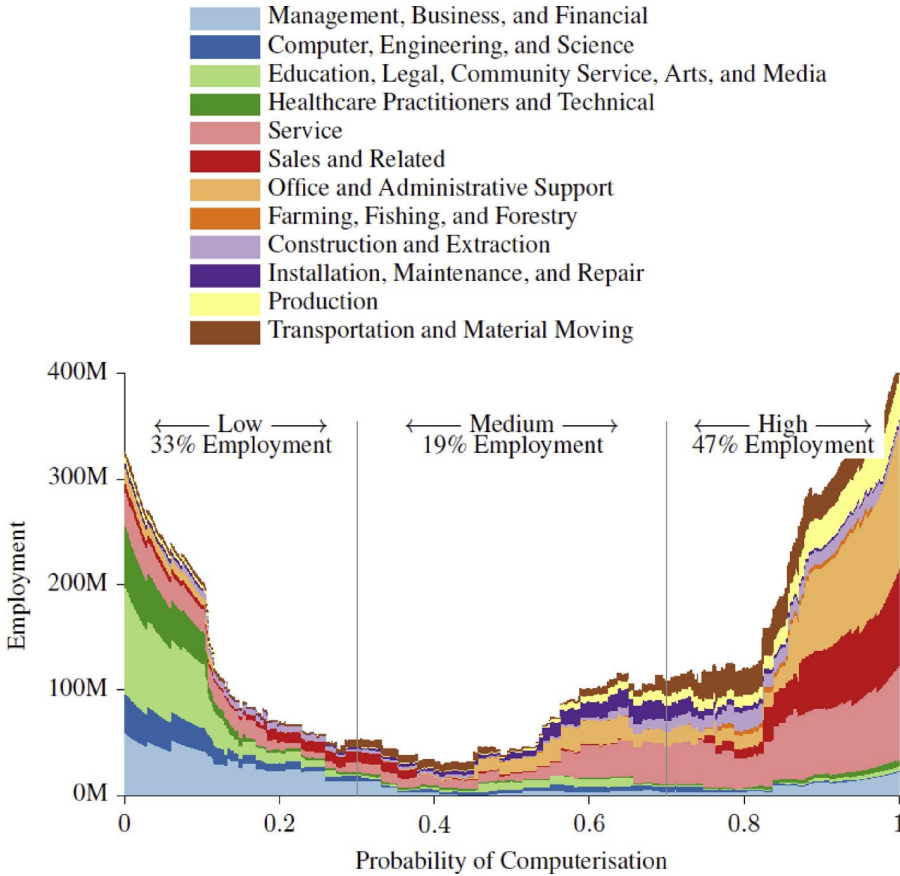


Fig. 2. The 2010 Bureau of Labor Statistics (BLS) distribution of employability by likelihood of digitalization, along with the share of low, medium, and high likelihood categories [9]

a. Telework or remote work

Telework has existed since the 1970s, when telecommuting was developed in the information industry in the American state of California [11]. Based on ICT, mobile work emerged later when wireless devices such as laptops and mobile phones allowed employees to work not only from home, but from virtually any location. In fact, the adoption of these work practices has been much slower than anticipated, due to various human, social and organizational factors including basic human factors associated with people's needs to meet other needs with people face to face [11]

Remote work comes with opportunities, challenges and risks, which need to be considered when considering future developments, including implications for the gender and diversity dimensions of the workforce, as well as the differential impact across sectors and occupations, in addition to new and emerging technologies, including augmented reality and virtual reality, which are expected to play a role in making remote work available to more businesses and workers [12].

b. Work on digital platforms

Work on digital platforms is any type of paid work performed through or on an online platform or mediated through an online platform, i.e. an online marketplace that operates

with digital technologies that facilitate the matching of labor demand with labor supply. Work performed through platforms can be extremely diverse: it can involve complex or simple tasks, cognitive or manual tasks, can be performed online and can be completely virtual or on-site and performed in person [13].

Working on digital platforms offers employment opportunities to workers in geographical areas where these opportunities are lacking or to marginalized groups of workers, but also involves a number of challenges and risks to the occupational safety and health of workers that need to be addressed. Research projects in the field of work on platforms aim [14]:

- analyzing and debating the opportunities, challenges and risks of working on platforms;
- mapping the types of work on the platforms, as well as the related risks and opportunities;
- identifying examples of policies to prevent OSH risks for workers on online platforms; and
- supporting the development of practical tools for prevention in the field of OSH.

c. Managing workers with the help of artificial intelligence

AI technologies have given rise to new forms of worker management. Unlike previous forms of management that rely heavily on human supervisors, managing workers using AI refers to new systems and tools that collect real-time data about worker behaviors from various sources to inform management staff, leadership and to support automated decisions based on algorithms. Research in this area identifies and debates the opportunities offered by these new systems for AI-based management, as they can support decisions aimed at improving OHS in the workplace, when they are built and implemented transparently and workers are informed and consulted [15].

The research also maps and debates the legal, regulatory, ethical and privacy challenges and risks and concerns for OSH, particularly in relation to the psychosocial risk factors that these new forms of monitoring also give rise to and managing workers. AI-based systems and advanced robotics are transforming way people's work is performed. These systems, which are either embedded (e.g. robotics) or non-embedded (e.g. smart applications), are capable of performing actions – with some degree of autonomy – to perform physical or cognitive tasks and achieve specific goals. This has significant positive implications, not only for business productivity, but also for OSH. For example, workers can be removed from hazardous environments and tasks and workloads can be optimized [15].

However, there are a number of OSH challenges related to the use of these AI-based systems in the workplace, mainly arising from the interaction of these systems with workers, for example unexpected collisions, over-reliance and others, but also related to psychosocial and organizational, and these challenges must be solved. The compass for the digital dimension at the level of community and organizational entities contains milestones such as:

- **secure, efficient and sustainable digital infrastructures**; by 2030, all EU households should have gigabit connectivity and all populated areas should be covered by 5G technology; production of cutting-edge and sustainable semiconductors in Europe should represent 20% of world production; 10,000 highly secure, climate-neutral edge computing nodes should be deployed in the EU, and Europe should have its first quantum computer;
- **digital transformation of enterprises**; by 2030, three out of four companies should use cloud computing services, big data systems and artificial intelligence, more than 90% of SMEs should reach at least a basic level of adoption of digital technologies, and the number of unicorn start-ups in the EU should double;

- **digitization of public services**; by 2030, all essential public services should be available online, all citizens will have access to their electronic medical records.

At the EU resident citizen level, it is under discussion:

- **digitally literate citizens and highly skilled digital professionals**; by 2030, at least 80% of adults should have basic digital skills and there should be 20 million specialists employed in the ICT sector in the EU; also, more women should occupy such positions and 80% of citizens should use an electronic identification solution.
- **digital identity** for every European.
- **personal digital wallet** for every EU citizen and resident.

Although new work situations bring opportunities, they can also create new risks and challenges for workers and employers, which in turn require political, administrative, technical and regulatory interventions to ensure that good safety standards are maintained and occupational health [16].

3 Case study – the R&D field

The objective of the case study is to identify and provide high-quality, credible data on new and emerging occupational safety and health (OSH) risks in the Research and Development (R&D) sector to meet the needs of policy makers, researchers and intermediaries in the workplace and to enable them to act in a timely and effective manner. As the initial database, a wide range of relevant information will be identified for trends and factors of change in relation to ICT and their impact on the nature of work, especially on the workplace in the R&D sector. Potential sources to be targeted are:

- Publications of OSH regulatory authorities in a number of countries (current publications);
- Popular science publications (limited to the previous 10 years);
- Journals and websites of relevant professional bodies;
- Technology blogs and websites;
- University and European framework research; and
- Documents and information published by EU-OSHA.

Romania adopted the National Research, Development and Innovation Strategy 2014-2020, identifying four areas for smart specialization (bioeconomy; IT, space and security; energy, environment and climate change; eco-nanotechnologies and advanced materials). Romania is a modest innovator. Indicators on innovators, firm-level investment and human resources show the weakest dimensions of innovation. Innovation-friendly environment and sales impact are the strongest dimensions of innovation [17].

Equally, Romanian research must be part of the world research system in order to facilitate the synchronization of Romanian research from the point of view of the professional level as well as from the technological point of view. Romania has an important gray resource, dissipated in the international research system, for which we must create the conditions to be able to generate value in Romania. These two strategic directions, internal and external, will be the basis for prioritizing the policies that will be implemented in the period 2021-2024 [18].

The digital transformation process involves fundamental changes at different levels of an organization:

- at the **process level** (the use of an increased percentage of automation in production and data integration in processes and supply chains, leading to increased productivity and resource efficiency),
- at **product level** (incorporating ICT into as many product categories as possible) and, last but not least,

- at the **level of business models** (intelligent and connected products adapt to changes in customer behavior).

The entire Romanian economy must make a transition as quickly as possible to the new economy (Digital Economy) capitalizing on all the advantages of the new industrial revolution. After the conclusion of the evaluation of the national research policies, it will proceed to the evaluation of the national research system [19].

Partnerships in the R&D sector are vital to help create lasting impact, to enable both the private and public sectors to drive systemic change and progress towards a more inclusive, equitable and sustainable future" [20].

The target groups in the RDI sector are established, nationally representative entities and six distinct scenarios of the future in the RDI sector are created that allow decision makers to consider a range of potential OSH impacts, address critical issues that could have an impact on SSM, are plausible, with plausible path from the present and internally consistent. According to the concept model in each scenario it goes to [20]:

- Identifying trends and factors of change;
- Consolidation of trends and change factors;
- Selection of key trends and change factors;
- Development of scenario axes;
- Creation of scenario descriptions;
- Testing and strengthening scenarios.

The development of the scenarios allows highlighting the following relevant aspects:

- ICT offers opportunities to reduce existing OSH risks or to manage them better.
- Existing risks will be identified in new contexts and professional sectors, as a result of increased ICT application and innovation.
- Psychosocial and organizational factors are expected to be increasingly important as ICT may cause changes in: the types of work available; work pace; how, where and when it is done; and how it is managed and supervised.
- Solutions to OSH challenges and how they are implemented must take into account the current and possible future socio-economic environment.

Although the scale and impact will differ, it is therefore highly likely that the risks associated with digitization will be present in the real future and are:

- Potential of automation to introduce new risks influenced by worker understanding and transparency of underlying algorithms.
- Increasing work-related stress, particularly the impact of increased monitoring of workers made possible by advances and increased ubiquity of portable ICT, 24/7 availability and the GIG economy.
- Increasing ergonomic risks due to the increase in online work and the use of mobile devices in non-office environments.
- New risks associated with new human-machine interfaces, such as gesture-controlled interfaces that could cause MSDs or systems that involve high visual, vocal and/or cognitive load.
- Increase in the number of workers treated (rightly or wrongly) as self-employed, who may fall outside the existing OSH regulation.
- Changing employment hierarchies due to the growth of online (teamwork), flexible working and AI, which have the potential to disrupt current OSH risk management mechanisms.
- Workers who do not have the necessary skills to be able to use ICT, cope with changes and manage their work-life balance.
- OSH risks associated with more frequent job changes and a longer working life [21].

We believe that additional dissemination workshops in different R&D entities with objectives are needed:

- Presentation of the forecast project, the developed scenarios and the new and emerging risks identified.
- Demonstrating how participants can use scenarios as a tool to develop and test existing policies and strategies that address identified OSH challenges.

The purpose of the case study also includes the identification of specific research, development, technological transfer and human capital development projects. It will aim to increase the quality of education and support the accelerated transition to digital skills and the use of technology. Within the project, target groups will also be analyzed, as follows:

- the employment outcomes of digitization between men and women could vary significantly, as the jobs they usually hold are affected differently;
- people with disabilities, One approach that has been suggested is to build an inclusive digital labor market, given that the digital economy has the potential to provide better access to employment opportunities for people with disabilities. This is particularly relevant due to the rise of remote work
- the unemployed, ethnic minorities and migrants.

The assessment process considered the impact of major developments on workplaces and OSH. Multidisciplinary contributions from policy makers, OSH experts and experts from other R&D sector disciplines are needed to gain future insights and explore the applications and implications of the forecast findings.

4 Conclusions

The result of the prospective case study and the context overview paper has the role of anticipating risks and identifying priorities, to contribute to the development of OSH practices and policies in the field of CDI, as a result of the impact of digitization in view of places of safe, ecological work in which the elimination/minimization of psychosocial risks is a priority. The approach considered to be effective is the one that involves key institutions, social partners and other stakeholders and focuses on three key priorities:

1. **anticipating and managing changes** in the context of green, digital and demographic transitions;
2. improving the **prevention of work accidents and occupational diseases** and making efforts towards an approach based on the principle of "zero deaths at work";
3. increasing **preparedness to respond** to current and future health crises.

The foresight project will analyze the potential impact on activities of digitization and the rapid development of ICT, including AI and robotics, as well as the resulting impact on OSH in the R&D sector. The project aims to provide decision-makers, unions and employers with the information they need about changes in ICT, their impact on the nature and location of work and the emerging OSH challenges they may bring. These objectives can be achieved by:

- comprehensive assessment of trends and drivers of change in ICT and the workplace, as well as the potential impact these changes may have on worker safety and health, taking into account the potential for new and emerging OSH risks over a time horizon ;
- using a set of scenarios up to 2030 (developed during the project) that take into account the potential impacts that ICT developments and workplace changes could have on the safety and health of workers in the R&D sector.

The evaluation of the results based on the defined scenarios will allow the identification of new and emerging OSH challenges related to how ICT could change the automated systems, work equipment and tools used; how work is organized and managed; business models, hierarchies and relationships; labor force characteristics; responsibilities for OSH management; and the skills, knowledge and information needed to change business models

and employment hierarchies due to online growth and flexibility, the operation and introduction of algorithmic management and AI that have the potential to disrupt current mechanisms for OSH management. OSH risks identified:

- cyber security risks due to the increasing interconnectedness of things and people;
- increasing ergonomic risks due to the increase in online work and the use of mobile devices in non-office environments;
- the risks associated with new human-machine interfaces, especially related to ergonomics and cognitive load;
- risk to employee well-being algorithmic management can be seen as an invasive form of control over employees a threat to their safety and psychological autonomy.

Strategies to reduce risks related to digitization have been identified, as follows:

- developing an ethical framework for digitization and codes of conduct;
- strong "prevention by design" approach, which integrates user/worker centered design;
- the involvement of workers in the implementation of any digitization strategies;
- advanced workplace risk assessments, using the unprecedented opportunities offered by ICT;
- a regulatory framework to clarify OSH responsibilities and accountabilities in relation to new systems and new ways of working;
- an adapted education and training system for workers;
- providing effective OSH services to digital workers.
- companies must adopt a culture of constant evaluation. Only when decisions are correct and of high quality will people accept the added value of algorithmic management.

The paper is intended to help stimulate discussion about a wide range of issues that may arise in the future, allowing different perspectives and priorities to be taken into account when making decisions about how to manage risks and uncertainties to minimize their possibilities to exert an unfavorable impact.

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