Towards a safe and healthy future of work

Evolution or revolution?

ARUP · iosh

Foreword

What if, as an employee, no matter where you worked in the world, there was a minimum standard for workplace safety and health based on harm reduction principles?

Despite continuous change in the world of work, one thing remains constant: harm still happens. At a global level, work-related ill health, accidents and deaths remain alarmingly common, causing long-lasting damage to individuals, families and communities.

What if the future of work changed that fact?

To introduce workplace safety and health harm reduction principles at a global scale, we must prepare. Preparation is, of course, key to effective execution. How well – or not – we execute is where we learn. And turning learning into action through evolution is the process by which we improve. So, I invite you to read Towards a Safe and Healthy Future of Work with the principles of preparation, execution, learning and evolving at the front of your mind.

This report is designed to provoke you to think about the future of work and what is in the 'Art of the Possible'. It aims to challenge everyone who has a part to play in creating healthy and safe work environments for the global workforce, to come together, and to ensure this fundamental right becomes a reality for all. Rather than the current situation, where workplace safety and health remains an aspiration beyond the reach of many.

Changes in technology will continue to reduce exposure to harm. But, as we challenge stakeholders to be forward-thinking in their approaches to addressing the risks of the future world of work, we must ensure that the enduring fundamentals are in place to effectively contain risk and reduce harm.

So, it's over to you. Whatever your role in shaping the workplaces of the future is, you have ownership of the reduction of harm. You can shape the future and create healthy and safe working environments that enable employees to thrive, and drive the sustainability of your organisation forward.

I worry the impact of harm on the future global workforce won't improve. What if as a result of reading this report, workplaces of the future become healthy and safe because of the actions you take. How many lives could we save?

Stuart Hughes CMIOSH
IOSH President and Head of Health and Safety, Mercedes AMG Petronas Formula One Team

Executive summary

Our working lives are expected to change in multiple ways in the coming years, with new technologies, working patterns and even new industries emerging. This future world of work will introduce many opportunities to improve employees' health, safety and wellbeing. But it will present significant challenges to workers globally too.

This report explores the diverse trends and possible 'what if' scenarios that will impact the health, safety and wellbeing of workers in the future. Under three key chapters, The future of work, Future risks and opportunities for health, safety and wellbeing, and The evolving Occupational Safety and Health (OSH) profession, a wide range of topics are explored – from redefined employment models, through to the use of data to improve worker outcomes. Some of these topics will result in evolutionary or gradual change while others will be revolutionary, dramatic and sudden.

The future of work

Flexible and remote working, and changing employment models are challenging traditional conceptions of the employer-employee relationship. These shifts impact the availability and access to labour and social protections, the responsibility employers have towards workers, and the ability for employers to manage or intervene in worker health, safety and wellbeing matters.

There is also increasing societal concern and attention to social responsibility, from the environmental footprint of businesses or the creation of a fairer and more equitable world of work. Health and safety-related decisions and actions can drive a more diverse and inclusive world of work, remove structural inequities and ensure labour market shifts associated with the green transition are just, fair and equal for all workers.

Continuing and gradual global demographic shifts, ranging from an ageing population, to burgeoning youth and migrant populations will require the management of different types of hazards. Future workers also have new expectations, including portfolio careers and 'hybrid' working styles. For employers in affected industries, this will require increased efforts at worker retention, and considering the whole experience of work including improved working conditions, amenities, flexibility, autonomy, career development opportunities and business purpose and values.

What if...

...gig work overtakes secure employment leading to far fewer social protections for workers?

...safety and health improvements lead to greater social equity and fairness?

...the green transition isn't just, fair and equal for all workers?

...key industries aren't equipped to meet the needs of all generations of workers?

...extreme global warming leads to significant increases in workers' occupational risks and vulnerability?

...there is another global pandemic more harmful to health than COVID-19?

...psychological injuries and mental health are regulated in the same way as physical injuries?

...the application of new technologies to improve worker protection creates other health, safety and wellbeing risks?

...technologies inform an employer of a health condition before the worker?

...there is no dividing line between occupational and clinical health?

...deregulation leads to a reduction in OSH standards and makes it more difficult for OSH professionals to influence discussions?

Future risks and opportunities

The profile of health, safety and wellbeing risks and opportunities is changing. Macro-trends such as extreme heat, infectious diseases and environmental degradation are amplifying existing risks and creating new risks. But there are also future opportunities to create a safer and healthier world of work. For instance, improving the mental health of workers by building on the broader societal awareness of the issue.

New technologies and increased digitalisation are rapidly transforming the workplace. For some workers, it may mean they no longer need to work in unsafe conditions or have the ability to perform tasks more safely and efficiently, sometimes beyond their previous abilities. The proliferation of workplace technologies is also generating increasing amounts of data, which can be used to improve health, safety and wellbeing outcomes through, for example, predictive analytics. OSH professionals will need to identify and apply new technology and digital tools to an OSH context, driving rapid improvements and assessing effectiveness, while also managing new ethical, security and physical risks.

The evolving OSH profession

In a changing world of work, the OSH profession is evolving and adapting for the continued prevention of harm and for the protection of workers. Fundamental shifts are challenging traditional definitions of what the profession is, does and stands for. At the same time, governments with agendas towards deregulation are impacting the ability of professionals to influence organisational OSH principles. The focus of influence could also move away from a national government level due to the rising adoption of international or organisational principles-based OSH standards. In recognition of such fast-paced change, businesses and OSH professionals are becoming more aware of the need for resilience, to anticipate rapid change, and quickly adapt to evolving circumstances to ensure worker health, safety and wellbeing.

Conclusion

In highlighting these trends our aim is to support the OSH sector to become more forward-thinking, and to improve the health, safety and wellbeing outcomes of all workers. The 'what if' scenarios highlight future uncertainty, to provoke, inspire and encourage stakeholders to consider the fullest range of possible actions required to achieve a safe and healthy future of work. Our calls to action provide specific guidance on what governments, business, OSH professionals and the Institution of Occupational Safety and Health (IOSH) can do to achieve this common aim: eliminating hazards, reducing risks, harmful exposures and unsafe working conditions, and enhancing the wellbeing of workers.

A critical call to action is for governments to ratify and effectively implement ILO Conventions and Recommendations in every country, so these recommendations can succeed in their intentions to protect workers against sickness, disease and injury related to the work environment. Furthermore, significant action areas across all stakeholders are highlighted and include:

- Driving forward social sustainability by removing structural inequity, enhancing diversity and inclusion and ensuring a fair and just green transition.
- Developing appropriate responses to growing risks linked to climate change, new and emerging technologies and mental health.
- Ensuring OSH professionals and workers have the appropriate OSH awareness, skills and knowledge to build a healthier and safer future generation of workers, including 'soft skills', digital skills and ethical decision making.

Inside this report
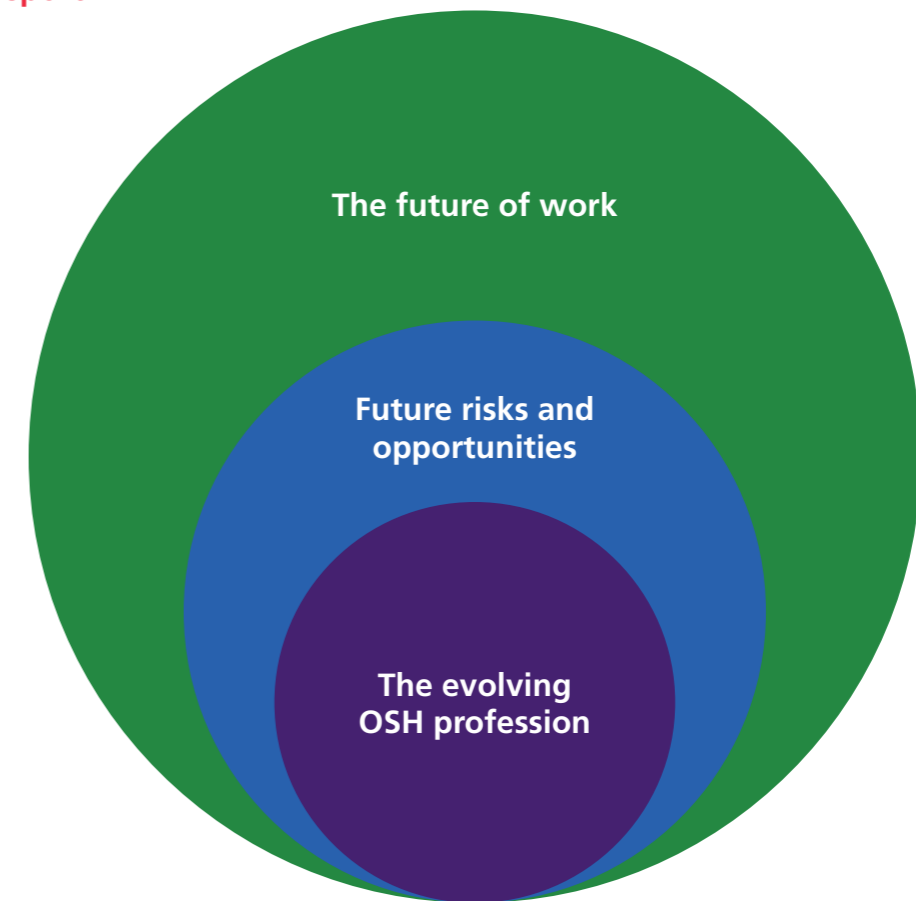
The future of work

An exploration of the future world of work and the implications for health safety and wellbeing. This chapter considers employment models and working patterns, the need for more socially responsible, ethical and sustainable business and the future expectations and demographics of workers.

Future risks and opportunities

An exploration of future health, safety and wellbeing risks and opportunities. Amongst other things this chapter considers extreme heat, infectious diseases, environmental degradation and digitalisation. It also highlights twenty impactful technologies that will create new or amplify existing health, safety and wellbeing opportunities and risks.

The evolving OSH profession

An exploration of the evolving OSH profession. This chapter considers expanding definitions of the OSH profession, agendas towards deregulation, the adoption of principle-based standards and new skills requirements for OSH professionals.

Calls to action

The changes expected in the future world of work will have broad implications for the health, safety and wellbeing of all workers.

Governments, businesses, OSH professionals and IOSH all have an important role to play in shaping positive health, safety and wellbeing outcomes, eliminating hazards, reducing risks, harmful exposures and unsafe working conditions, and enhancing the wellbeing of workers.

A critical and foundational call to action is to ratify and effectively implement ILO Conventions and Recommendations in every country, so these recommendations can succeed in their intentions to protect workers against sickness, disease and injury related to the work environment. Once ratified, they will ensure OSH frameworks, legislation, national OSH plans and policies are in place to protect labour, social protections, and worker rights in a systemic manner. This in turn will create a societal culture where safe, healthy working conditions and working environments are expected across the world of work, businesses of all sizes, in all employment models and in all working patterns.

For governments
A regulatory approach to systemic issues and risks

ILO member states* must ratify ILO OSH Conventions and uphold, reinforce and promote Fundamental Principles and Rights at Work including 'a safe and healthy working environment'.

Protect and preserve human rights, decent work, worker protections, ethics and security regarding new and emerging hazards related to climate change, the green transition and technologies such as AI using the scope of ILO Convention No.155.

Build and strengthen national capacity, OSH capacity and pathways to good mental health and psychosocial risk management in business, OSH systems and occupational health services.

Review, and where necessary, update regulatory frameworks to ensure the changing risk profile of OSH is addressed. For example, considering OSH climate risks and mental health in the workplace.

Equip workers with the necessary OSH awareness, knowledge and skills to build positive and proactive cultures, and a healthier and safer future generation of workers. This can be achieved through education, vocational training programmes and lifelong learning.

* ILO fundamental OSH Conventions: C187 Promotional Framework for Occupational Safety and Health (No. 187) and C155 Occupational Safety and Health (No. 155) as well as other core OSH Conventions including C161 Occupational Health Services (No. 161).

For business
A blueprint for better business

Better understand the structural enablers and barriers to attracting and retaining a diverse and inclusive workforce, protect vulnerable workers and address the unique OSH needs of different worker groups.

Support sustainable development, the UN Sustainable Development Goals and national targets. Apply recommendations from IOSH's 'delivering a sustainable future' report[1] to identify, activate and measure a business's contribution towards the UN Sustainable Development Goals through good OSH.

Identify and address existing and emerging OSH risks and opportunities across all parts of the supply and value chain, including SMEs.

Deliver operational excellence by incorporating effective OSH management into organisational strategies, plans and business continuity and recognising the strong connections between physical safety and psychological safety. Focus the cultural and leadership behaviours that enable workers to feel safe as well as well as be safe.

Collaborate widely on standards, practices, approaches and policies, share evidence and insights, and be a learning organisation that adapts to addresses complex and increasing issues associated with OSH principles and practice such as ethics and inequity.

Key

The future of work: What are the stakeholder actions to prepare for changing employment models and working patterns, a need for more sustainable and socially responsible business and the shifting expectations and demographics of workers?

For OSH professionals
Deliver change on the ground

Contribute to, support and implement socially sustainable work practices and standards within procurement, across supply chains, and in OSH management systems.

Argue for and support the implementation of evaluation and control strategies regarding climate change related.

Argue for safety-in-design, health-in-design, and human-centric approaches within new and emerging technology advancements.

Support the development, application and recognition of training, skills, knowledge, innovations, technologies and experience from other contexts, sectors, regions and organisations to provide better outcomes for worker health, safety and wellbeing.

As the role of the OSH professional evolves, take individual responsibility for championing new approaches and advancing continuing professional development, competency, and improved skills. Including the ability to pilot and evaluate emerging technologies, data analytics, 'soft' skills, critical thinking, systems thinking and ethical decision making.

Future risks and opportunities: What are the stakeholder actions to prepare for future risks and opportunities such as for extreme heat, infectious diseases, environmental degradation and new technologies?

For IOSH
Make working life better

Work alongside international partners including the WHO, ILO, UN Global Compact, and the Commonwealth to harness the collective energy of progressive businesses and make a long-term commitment to driving forward social sustainability.

Define universal OSH metrics that will enable businesses to measure, disclose and continuously improve their social sustainability.

Commission and share primary research on emerging issues related to OSH and occupational health services to support the promotion of a safe and healthy working environment as a fundamental principle and right at work.

Identify and define the skills needed for future workers, and continue to equip the OSH profession through a competency framework, content and tools fit for the future world of work.

Broaden and define the boundaries and position of OSH and the OSH profession, influencing the value of the profession in the changing world of work. Facilitate connections at key points of intersection such as sustainability, occupational health and worker wellbeing.

The evolving OSH profession: What are the stakeholder actions to prepare for expanding definitions of the OSH profession, agendas towards deregulation, the adoption of principle-based standards and new skills requirements?

Introduction

Every single day, 7,500 people are estimated to die as a result of working in unsafe and unhealthy conditions worldwide.[2] And while in June 2022, the International Labour Organization (ILO) adopted a "safe and healthy working environment" as one of its five fundamental principles and rights at work, it is clear that this aspiration remains out of reach for many workers.

In the coming years, many aspects of our working lives are expected to change. The future of work will present significant challenges to workers globally, but it will also introduce opportunities to improve their health, safety and wellbeing. For instance, climate change and associated extreme heat and weather events such as flooding and wildfires will increasingly be recognised as a health, safety and wellbeing issue. But simultaneously, new technologies have the potential – if designed, managed, and implemented safely – to transform how work is planned and conducted, eliminating hazards, reducing harmful exposures, and attenuating unsafe working conditions.

This report explores the diverse trends and developments regarding the future world of work, including redefined employment models and working patterns, sustainable business and the changing needs and expectations of workers. The future risks, challenges and opportunities for health, safety and wellbeing are considered, such as physical worker health and the use of data to improve outcomes for workers. Lastly the evolution of the Occupational Safety and Health (OSH) profession is discussed, including the application of systems thinking, perspectives on regulations and standards, and future skills requirements.

The purpose of this report is to support the OSH sector to become more forward thinking; to prepare and take timely action towards a safe and healthy future of work. The report concludes with calls to action for government, business, OSH professionals and the Institution of Occupational Safety and Health (IOSH) itself to improve the future health, safety and wellbeing outcomes of all workers.

Global deaths due to unsafe working conditions (ILO 2019)[3]

7,500
people die due to unsafe and unhealthy working conditions every day

5–7% deaths globally

6,500 die from work-related diseases

1,000 die from occupational accidents

The future of work

Changing employment models and working patterns, a need for more sustainable and socially responsible business and the shifting expectations and demographics of workers are some of the many factors defining the future of work. But how will the future of work affect the health, safety and wellbeing of workers?

Redefined employment models and patterns

Changing employment models and working patterns are challenging traditional conceptions of the employer-employee contractual relationship.

In a traditional relationship, the employer provides job security, holidays, benefits and a defined work schedule in exchange for the employee's commitment to the company, and adherence to terms, conditions and values. However, this relationship is altering due to an increase in short-term contracts, freelance work, self-employed roles, gig work and platform-based working models. Other developments include a substantial growth in small and medium-sized enterprises (SMEs) and the normalisation of flexible and remote working in many sectors post-COVID-19. These shifts impact the availability of and access to labour and social protections, the responsibility employers have towards workers, and the ability for employers to manage or intervene in worker health, safety and wellbeing matters.

What if...

...gig work overtakes secure employment as the most common source of primary income?

The rise of the gig economy and platform-based work

The gig economy refers to a labour market characterised by short-term contracts and freelance jobs or 'gigs'. In the USA, over 10% of workers rely on gig work for their primary income.[4] These jobs can range from delivery work to freelance tasks on a specific project. They are often easy to access via digital platforms and suit the flexible contemporary lifestyles of many. However, they often come without the social protection and provisions that traditional employment offers, such as private healthcare or paid sick leave.

> Over 10% of US workers rely on gig work for their primary income.

Decades-old primary OSH legislation is based on a traditional employment model and struggles to adequately address the OSH issues of gig work. Given the lack of traditional workplace access, it is also more difficult to engage with gig workers regarding OSH issues. To address this issue, remote monitoring in platform-based work is growing. For example, Uber uses a fatigue monitoring system with its drivers. However, the presence of monitoring, surveillance and algorithmic management presents its own threats to worker wellbeing, data privacy, working conditions and worker autonomy.

Specific demographic groups, such as young people or migrants, are more likely to rely on gig work. A recent study found that over 70% of workers in the app-based delivery sector in Argentina and Chile are migrant workers.[5] This creates structural inequalities, resulting in certain demographic groups with fewer social protections and less regulated, managed or potentially unsafe working conditions.

Growth in Small and Medium-Sized Enterprises (SMEs) and informal economies

There has been substantial growth in the number of SMEs globally, increasing from 204 million to 333 million between 2000 and 2021.[6] SMEs play a major role in most economies and are currently estimated to represent 50% of total employment.[7] They are particularly important in emerging economies, with formal SMEs contributing up to 40% of national income (GDP).[8] However, these numbers are significantly higher when informal SMEs are taken into account.[9]

The informal economy includes all activity that would have market value and tax revenue but is undeclared. These activities play a key economic role, particularly in developing countries, where informal arrangements are common in small businesses, construction, agriculture, social care and childcare. It is particularly common to see a movement towards informal economy employment in rapidly urbanising countries as people move from agriculture to informal jobs in cities. Those working in the informal economy are likely to be more exposed to health and safety risks, such as outdoor work in extreme heat or humidity. There is also less education and knowledge about OSH risks to support how they are managed.

> **Regional insight**
> ### Informal economy
> In Africa, the informal services subsector is estimated to be a source of livelihood for around 90% of the labour force.[10]

SMEs may have less ability or provision to employ OSH professionals in their organisations. Therefore, SMEs may struggle to keep pace with new and changing OSH risks and opportunities, such as those driven by the application of emerging technologies. In many developing markets, workers employed in formal and particularly informal SMEs will experience lower levels of regulation, enforcement and oversight into working conditions at a government or policy level. As a result, improvement in OSH in SMEs, particularly in emerging economies, could significantly improve health, safety and wellbeing at work on a broad scale, while contributing towards economic development.

The prevalence of flexible and remote working

The COVID-19 pandemic, alongside digital transformation, radically altered working patterns and environments. There is a persistent rise in the rate of flexible working (employees establishing working arrangements responsive to their individual needs, often within boundaries or established expectations), hybrid working (typically involving employees sharing time between an office environment and a remote environment) and remote working (employees completing all work from a location other than an office).

In a 2023 UK survey, 60% of respondents said they had flexible working arrangements in their current role, rising from 51% in 2022.[11] Working arrangements can vary depending on the role and organisation and can be both formal and informal agreements, such as a specified number of days per week to work from home, an unspoken agreement that employees can choose the hours that work for them, or job sharing agreements. However, not all sectors allow for the possibility of flexible and remote work, which may create perceived inequity between 'front-line' workers and those who can work remotely.

> 23% of workers report loneliness as a drawback of remote working

Flexible and remote working is giving rise to new and existing health, safety and wellbeing risks and challenges. The lack of social interaction and the increased use of Information Communication Technology (ICT) associated with remote working increases psychosocial and ergonomic risks.[12] In one survey, 23% of workers reported loneliness as a drawback of remote working.[13] The management of workplace health, safety and wellbeing arrangements becomes more challenging with the rise in remote working. For example, it becomes more difficult to develop a strong, unified safety culture with a set of shared values.

Understanding where the workplace – and the professional's role – begins and ends is a key issue. From indoor and outdoor physical locations to virtual platforms, there is an increasing number of spaces that make up what we can consider to be the 'workplace'. Therefore, some workers spend increasing amounts of time in spaces that are not managed or monitored by their employers, resulting in less oversight over health, safety and wellbeing matters.

Socially responsible, ethical and sustainable business

There is increasing societal concern and attention to the socially responsible behaviour of organisations, from their environmental footprint to the treatment of workers.

A broad range of organisations and governments are seeking to reduce their climate and environmental impact. Net Zero targets, the energy transition and the circular economy are influencing the jobs, skills, processes and industries that will exist in the future. At the same time, societal understanding and awareness of inequity is driving a more diverse and inclusive world of work. This includes removing structural inequity, in which specific groups are disproportionately impacted by health and safety risks, or decisions that are made with one specific demographic in mind. For example, a 2022 survey of global experiences found that foreign-born women have a greater experience of violence and harassment in the workplace than their native-born counterparts (30.2% vs 21.5%), an effect that was not seen for men.[14]

Greater consideration of social responsibility and ethics

Consumers increasingly expect social responsibility and ethical behaviours from companies they patronise. A survey across 60 countries found that 55% of online consumers consider a company's environmental and social commitment when deciding where to shop.[15] The legal environment is starting to align with these more socially responsible attitudes. For example, 200 global garment brands and trade unions have signed up to the legally binding International Accord, aiming to ensure safe workplaces in the garment and textile industry. Investors are also increasingly driving businesses to consider their performance on ESG (Environmental, Social and Governance) measures. In response to changing consumer and worker attitudes, an increasingly stringent regulatory environment and investor expectations, businesses will likely be held more accountable for ethical practice or lack thereof.

OSH is becoming more entwined with ethical considerations, with workers making social judgements on the policies and behaviours of organisations. OSH policies are becoming more visible to current, past and future workers on platforms such as Glassdoor, making it easy to view and compare factors such as working conditions and working hours. Organisations are therefore more widely recognising the importance of being ethical and values-driven on business performance, including worker recruitment and retention.

Regional insight
Exploitation

Nearly half of victims of exploitation in Asia are in Southeast Asia,[16] significantly higher than the proportion of the population who live in this sub-region.

What if...

...safety and health improvements lead to greater social equity and fairness?

Removing structural inequalities

Studies indicate that specific demographics and marginalised groups are disproportionately exposed and impacted by health, safety and wellbeing risks. For example, a European study found that women, migrant and LGBTI workers are all at heightened risk of developing occupational health issues and musculoskeletal disorders.[17] Similarly, ILO data looking into global accident rates found that younger and older workers are particularly vulnerable to injuries – a figure with particular relevance given many counties are experiencing ageing populations. Furthermore, health, safety and wellbeing decisions are often made with one demographic in mind. For example, only male anthropometric data is typically used in the design of safety equipment and personal protective equipment (PPE), and some specific items, such as face masks, are based on a European facial profile.

Organisations will increasingly find their OSH policies challenged from the perspective of fairness, inclusiveness and equity. Who is making the decisions, based on what data, and who is affected by the outcome? Equalising voices and strengthening advocacy, awareness, and research into marginalised groups' vulnerability to OSH hazards and risks will support the removal of existing structural inequity.

Case study
The first female crash test dummy

While crash test dummies have been used for over 50 years, they are only legally required to be shaped like the average man in locations such as the US and EU. Researchers at the Swedish National Road and Transport Research Institute have developed a female crash test dummy. On average, females are shorter and lighter than males, with different muscle strengths, torso, hip and pelvis shapes to men. The new dummies could change how future cars, driver seats and other vehicle safety features are designed, making driving safer for female drivers. This will help to boost gender equality in safety.

More diverse and inclusive workplaces

As a result of regulation and changing social attitudes, employers have a growing responsibility to provide for the needs of a diverse workforce, by providing accessible and inclusive workplaces, EDI policies and initiatives, and equal opportunity hiring. During and following the COVID-19 pandemic, 80% of countries introduced some form of labour market policy to support recovery, with a disproportionate positive impact on marginalised groups who were worst affected by the pandemic.[18] However, while progress is being made, a lack of diversity and inclusivity prevails. According to the UN, at the current rate of progress, it may take another 286 years to remove discriminatory laws and close prevailing gaps in legal protections for women and girls.[19] In addition, the 2023 World Gender Gap report estimates it will take 131 years to reach full parity in pay equity for men and women at the current rate of progress.[20]

> It may take another 286 years to remove discriminatory laws and close prevailing gaps in legal protections for women and girls.

The OSH profession is characterised by a lack of diversity. For example, the US SH&E Industry 2022 Salary Survey found that male safety, health, and environmental professionals outnumber females four to one.[21] To achieve diversity and inclusivity in the sector there will need to be a better understanding of enablers and barriers. Organisations will also need to better understand and address the unique OSH requirements of different groups of workers and a more diverse workforce. This includes a more neurodiverse workforce, as people who think differently will assess and perceive risk in a different way.

What if...

...the green transition isn't just, fair and equal for all workers?

The green transition

The green transition and drive towards Net Zero will increasingly shape the future world of work. It will result in a labour market shift and reduce employment in specific sectors over time (such as fossil fuel extraction), while opening up new job opportunities in fields such as nature-based solutions, technologies to reduce and remove carbon and the circular economy. It is estimated that the circular economy alone will create 700,000 jobs in the EU by 2030.[22]

Industries, jobs, methods, materials and fuels arising from this labour market shift will introduce new health, safety and wellbeing risks, challenges and opportunities. Low carbon materials and fuels, be they timber, ammonia or hydrogen, come with their own health and safety risks and some are more volatile or flammable than traditional alternatives. Moreover, the urgency of the green transition may mean health and safety knowledge around these new materials, fuels and methods remains underdeveloped. However, new processes and methods such as construction using Design for Manufacture and Assembly (DfMA) will have benefits, removing labour exposure to hazards and improving safety for workers on sites.

> Regional insight
> ### Net Zero Economy
> In Latin America and the Caribbean, the IDB and ILO project that 15 million new jobs will have been created in the zero carbon economy by 2030.[23]

A just transition

The ILO defines such a 'just transition' as "greening the economy in a way that is as fair and inclusive as possible to everyone concerned, creating decent work opportunities and leaving no one behind". However, in Europe, only half of citizens agree that the EU is doing enough to ensure the green transition is fair, 50% say the same about their regional, city or local public authorities, and 47% believe their national government are providing adequate support. Only 43% agree that the private sector is doing enough.[24]

The circular economy highlights the need for more action on delivering a just transition. The role of workers is not mentioned in the EU's circular economy action plan.[25] Yet following the reduction in waste being sent to landfill and the associated increase in waste processing, there have been higher rates of accidents and illnesses of waste processing workers.[26]

To deliver a just transition, all levels of government will need to establish policy and regulatory frameworks. Businesses also have a significant role to ensure labour and human rights (including fundamental principles and rights at work) are respected as new industries and jobs arise.

> 50% of citizens agree the EU is doing enough to ensure the green transition is fair.

The future worker

The future worker will have different expectations and face new health, safety and wellbeing risks and opportunities.

Large-scale global demographic shifts, ranging from an ageing population, to burgeoning youth populations and migrant populations will require the management of different types of hazards, but also new expectations for careers, such as portfolio careers. The cost-of-living crises in many countries are also increasing worker agency and collective action. For employers in affected industries, this will require increased efforts at worker retention, considering the whole experience of work including improved working conditions, amenities, flexibility, autonomy, career development opportunities and business purpose and values.

Changing demographics

Older populations are the world's fastest-growing demographic group, outnumbering younger children for the first time in 2018.[27] Europe, Australasia and East Asia are experiencing the most significant ageing populations. As people live longer and retire later, the composition of the workforce changes with some organisations employing four or five generations of workers. By contrast, in some regions, such as the Middle East and Sub-Saharan Africa, youth populations are growing. Many of these young people, who are typically more educated than past generations, want better jobs than their parents had access to, requiring a transformation of the economy and improved employment security.[28]

> **Regional insight**
> ### Youth population growth
> By 2050, 271 million children, adolescents and youth (0-24 years) will live in the MENA region.[29]

An older workforce has distinct health, safety and wellbeing needs, and will be exposed to specific types of risks, resulting in accidents, injuries and ill health. For example, slips, trips and falls are more common among older workers, and the resulting occupational injuries are more likely to result in hospitalization, fatalities and fractures, particularly among older women.[30] A youthful workforce is more vulnerable to mental health issues, but also tend to be overrepresented in temporary, precarious and agency work, particularly in the service sector where there is less supervision and training.[31] Both older workers and younger workers will therefore require distinct health, safety and wellbeing controls and interventions, for example diversity sensitive risk assessments.

> **Regional insight**
> ### Migrant workers
> Over 40% of all workers in the Arab States are migrant workers,[34] the highest ratio in the world.

What if...

...key industries are not equipped to meet the needs of all generations of workers?

Demographics are impacted by migration, with international migration continuously evolving with changing socio-economic, political or climate situations within countries and regions. There are about 281 million international migrants (persons living in a country other than where they were born) in the world according to most recent data – which equates to about 3.6% of the global population.[32] An estimated three-fifths of these international migrants – approximately 169 million people – are migrant workers. When compared to men, women are shown to face greater obstacles as migrant workers, both economic and non-economic.[33]

Migrants, who are more likely to be separated from support networks and have limited financial resources are more vulnerable to exploitative labour systems, and are likely to undertake insecure work with less rigorous health and safety standards. To manage health, safety and wellbeing, OSH professionals will have to communicate and work with a variety of languages and cultural norms. A recent policy brief by the European Centre for Social Welfare Policy and Research found that language barriers prevented OSH professionals from effectively monitoring and investigating health and safety concerns of European workers who had been posted to another EU country.[35]

Portfolio careers and shorter tenures

The future worker will have very different career expectations. In some economies it is no longer the norm for people to want long careers with a single employer, with workers more likely to choose portfolio careers, having multiple jobs and multiple streams of income. A 2021 study of 2,000 adults in England by the Department of Education found that 63% of workers either already have multiple roles as part of a portfolio career, or plan to do so in the future.[38] These expectations mean tenures are getting shorter, and younger generations in particular are more likely to view individual career decisions as 'stepping stones' to the next move.[39]

> 63% of workers in England either already have multiple roles as part of a portfolio career, or plan to do so in the future.

Portfolio careers allow workers to raise their incomes during difficult economic conditions. It may include monetisation of skills to build additional income streams – from a 'side hustle' to an eventual full career change. Portfolio careers can also be necessary for those in industries where work is more precarious, such as creative industries, and workers in these sectors may be forced to have portfolio careers even if they would prefer full-time paid work with a single employer.[40]

Due to portfolio careers and a faster rate of staff turnover, there will be a greater variety of OSH knowledge and skills across workers. Employers may not wish to devote extensive training support to workers who will likely not return the value of new qualifications to the organisation. Instead, employers may use flexible and agile learning opportunities to ensure health and safety knowledge and skills are consistent. For OSH professionals, past knowledge and information will be carried with them across their career, benefitting from transferable skill sets, knowledge bases or 'passporting schemes' that are recognised across sectors. Furthermore, in the future there may be a smaller pool of OSH professionals of deep technical expertise. Workers with career portfolios may have less interest in investing full-time into gaining a particular skill set or qualification, with some choosing to deprioritise specialisation.

Increasing industrial action

Rapid rises in inflation and the cost of living have prompted industrial action in many regions, including Europe and the UK. Over recent years, UK strikes have taken place (or have been threatened) across the rail industry, at airports, within the Post Office, by criminal law barristers, in various parts of the NHS, and among other public sector workers and teaching unions.[36] The UK's Office for National Statistics (ONS) restarted gathering data in 2022 following 30 years of historically low numbers in industrial action. In the year to September 2023 nearly 4 million working days were lost due to labour disputes.[37]

Poor working conditions and low satisfaction can drive industrial action. Furthermore, health, safety and wellbeing is often used as a political argument in industrial disputes. Workers and their representatives can use moral issues related to OSH to reframe a much broader dispute or portray an employer unfavourably. Examples include removal of train guards, the workload for junior doctors and the psychological burden on teachers. When OSH issues are drawn into much broader industrial disputes on issues such as decent wages, these can raise awareness and push businesses to improve worker conditions and satisfaction.

Future risks and opportunities

Extreme heat, infectious diseases, environmental degradation and new technologies are shaping future risks and opportunities for workers. What new and emerging risks and opportunities do you need to consider that will impact the health, safety and wellbeing of workers?

Social and environmental

The profile of health, safety and wellbeing risks and opportunities are changing. Many of these shifts are driven by social, environmental and economic macro-trends such as infectious disease, globalisation, climate change or environmental degradation.

For example, air pollution is now one of the world's leading risk factors for death, with death rates especially high in low- and middle-income countries. These changes will amplify existing risks, such as overheating in outdoor work. But there are also future opportunities to create a safer and healthier world of work, improving the mental health of workers by building on the broader societal awareness of the issue.

Regional insight

Climate-related health and safety risks

India, China and Bangladesh lose 259, 722 and 32 billion hours annually due to the impacts of humid heat on labour.[44] In Central and South America, rises in chronic diseases are linked to increasing temperature.[45]

What if...

...extreme global warming leads to significant increases in workers' occupational risks and vulnerability?

Climate as a health and safety issue

With 2023 the warmest year on record,[41] we are reminded that climate change will increasingly be recognised as a health, safety and human rights issue. Climate change's impacts range from natural disasters, to disruption of critical services and increased seasonal heat or cold. There is an enormous body of evidence to demonstrate the impacts of climate change on communities and workers. Research published in 2021 in the journal Nature Climate Change suggested that 100,000 heat-related deaths per year were caused by climate change.[42] Another study, published in the journal Environmental Research Letters, looked at data on humid heat. It suggested almost three quarters of the global working-age population are already living in locations where background climate conditions are associated with about a hundred hours of heat-associated lost work per person per year.[43]

> 100,000 heat-related deaths per year are caused by climate change.

Climate adaptation will likely fall, in part, under the remit of the OSH profession. Workplaces will need to become resilient both to sudden shocks – such as extreme weather events – and more gradual changes over time, such as hotter and drier summer weather and greater exposure to tropical diseases. Adaptation will include changes to worker welfare facilities as well as championing legislation on working hours. Climate impacts will also hit unequally across the world, creating a huge demand for knowledge, mentoring and international collaboration in OSH.

The need for broader action on wellbeing

Personal wellbeing is driven by many factors including physical and mental health, relationships, personal finance, the economy, the natural environment, where we live and how we spend our time (including in the workplace). Employment in healthy working environments and meaningful work can positively contribute to personal wellbeing, while harmful working environments can have significant negative impacts on personal wellbeing.[46] To enhance wellbeing at work, organisations need to also consider factors such as working relationships, working conditions, purpose, culture and physical workplace. This diversity of factors results in a wide range of preventative and structural changes that can be implemented to improve the wellbeing of workers. When organisational wellbeing is meaningfully addressed, and workers are happy, there is evidence that productivity is increased.[47]

Mental health is a key driver of personal and worker wellbeing, with its impact on individuals, organisations, and society now receiving much greater public attention. Globally, mental health conditions are highly prevalent, with about one in eight people living with a mental health disorder.[48] Workplace stress leads to physical or mental health problems, which can in turn impact the ability to carry out work effectively.[49] Despite the significant number of individuals living with mental health issues globally, there are considerable gaps in terms of adequate access to care or effective treatment.[50] Around half the world's population lives in countries where there is just one psychiatrist to serve 200,000 or more people.[51]

> Around 50% of the world's population lives where there is just one psychiatrist to serve 200,000 or more people.

Industries are affected differently by mental health issues. UK construction workers are three times more likely to take their own lives than workers in other sectors.[52] This can be attributed to several factors, including lone working, unsociable hours, work pressures and a male-dominated workforce or workplace culture.[53] In the healthcare sector, the increased pressure on 'front line' workers during the COVID-19 pandemic has not relented, with continuing difficulties resulting in overwork, stress and worker exhaustion. This is impacting the welfare of workers in the sector and staff retention. In the USA, health employment is over 1% below pre-pandemic levels despite the rising demand for healthcare.

The increased focus on organisational wellbeing is changing OSH professionals' responsibilities. There is greater focus on psychosocial risks – aspects of the design, management, and social and organisational context of work, including stress, that could cause psychological or physical harm.[54] There is also a broader understanding of the range of preventative actions and structural organisational changes that OSH professionals can support. This could include management capabilities, culture, resourcing, job design, flexible working, or the use of healthcare technology (such as wellbeing apps or health surveillance approaches to monitor potential issues and prevent progression to longer-term or larger-scale health problems). Yet many employers focus on individual-level interventions that remediate symptoms rather than resolve chronic workplace stress, which causes employee burnout.[55][56] There is also a lack of rigorous research on cause and effect, and hence which interventions really work.[57]

What if...

...psychological injuries and mental health are regulated the same as physical injuries?

Workers' physical health

The steady global health progress of the past 70 years will not necessarily continue in the next 70 years, with recent studies highlighting the negative impact of three Cs on progress—COVID-19, climate change and conflict.[58] There are also other factors that will impact global and therefore worker health, including ageing populations, antimicrobial resistance and obesity. In 2019, an estimated 38.2 million children under the age of five years were overweight or obese, with overweight and obesity now on the rise in low- and middle-income countries, particularly in urban settings.[59] Common health consequences of a raised Body Mass Index (BMI) include cardiovascular diseases, diabetes, musculoskeletal disorders and some cancers.

Regional insight
Healthcare treatment delays

In 2022, one in six UK adults had a pressing need for medical examination or treatment, but were unable to get access, with almost half of these cases due to the length of waiting lists, according to data from YouGov and Eurostat. This was the highest figure out of 36 European countries and almost triple the EU average.[60]

Case study
Health check-ups in Japan

To improve population health through early detection, health check-ups are available to almost all segments of the Japanese population throughout their lives. Based on health check-up results, individual's effort to manage their own health condition through better lifestyles are promoted. These secondary prevention strategies are unique in the OECD.[62]

Access to timely healthcare treatment is also a common global issue, with delays creating issues of increasing chronic illness. If workers are not physically fit to perform their roles and absence levels rise, there is a significant burden on employers.

To improve public health there has been a rise of preventative models in clinical healthcare, focussing on lifestyle-based change and early intervention.[61] Governments are also recognising the benefits of a preventative approach with New Zealand's 'wellbeing budget', launched in 2019, encouraging and enforcing preventive models.

What if...

...there is another global pandemic more harmful to health than COVID-19?

Infectious diseases and future pandemics

Infectious diseases are on the rise globally due to increased international travel, population growth, environmental degradation, and related issues such as sanitation.[63] Global migration, transport, and logistics patterns, especially growth in air travel, aid the dispersion of diseases. Concern around infectious disease has an impact on workplace design (for example, to reduce contact points and increase hygiene) and working patterns such as remote and hybrid working.[64] Employers may be more open to OSH provisions to prevent and manage large-scale threats to health following the disruption caused by the COVID-19 pandemic.

Since the COVID-19 pandemic, data indicates rising levels of long-term sickness and absence from the workplace. Figures from the USA indicate that the number of workers missing work due to illness in January 2022 had more than doubled from the previous year, from 3.7 million to 7.8 million.[65] This includes the rise of 'long COVID', a condition relatively poorly understood but with long-term impact. One study by the Brookings Institution found that 1.1m people in the USA were out of work at any one time due to long COVID, not just through long-term absence but also due to decreased working hours relating to fatigue.[66]

The growing burden of disease associated with air pollution exposure

Air quality is a significant risk to public health in developed and emerging countries. An estimated seven million people die prematurely each year from diseases linked to air pollution according to the WHO, with around half from outdoor (ambient) air pollution and the rest from indoor air pollution.[67] The WHO puts air pollution on a par with smoking and unhealthy eating. The impact is uneven globally, with low- and middle-income countries suffering the most, due to their reliance on fossil fuels for economic development.[68]

The intersectionality of air pollution with other health conditions is being uncovered. A study by the Committee on the Medical Effects of Air Pollutants found that cognitive decline in older people is more likely to be accelerated by exposure to ambient air pollutants.[69] There is increasingly available technology to monitor both indoor and outdoor air quality and reduce emissions, presenting a new awareness of the health and quality of the spaces in which we work.

Seven million people are estimated to die prematurely each year from diseases linked to air pollution.

Technology and digitalisation

New technologies and increased digitalisation are transforming the workplace and impacting health, safety and wellbeing, bringing both opportunities and risks. For some workers, it may mean they no longer need to work in unsafe conditions or be exposed to potentially harmful environments.

For others it could mean the ability to perform tasks more safely and efficiently, sometimes beyond their traditional abilities. The proliferation of workplace technologies also means the generation of increasing amounts of data, which can be used to improve health, safety and wellbeing outcomes, for example through predictive analytics. Whilst new technologies and digitisation present many opportunities, they also will create new ethical, security and physical risks. OSH professionals will need to identify and apply new technology and digital tools to a health, safety and wellbeing context, driving rapid improvements and assessing effectiveness, while also managing these new risks.

Digital transformation in the workplace

Digital transformation, a broad term referring to the integration of digital technologies into all parts of an organisation, is reshaping work. Advances in technologies and their deployment in the workplace will create job opportunities. However, it may also cause unemployment in certain sectors, impacting regions with high proportions of workers in manual or administrative roles. Some predict that up to 81% of tasks completed by certain jobs are automatable.[70]

> 70% of individuals would gladly delegate tasks to AI to ease their workloads.

Artificial Intelligence (AI) is a significant and rapidly developing technology, with the potential to impact all industries and parts of life. AI is technology which can simulate human cognitive functions, such as logical reasoning. It is an umbrella term encompassing fields such as Machine Learning (ML, a subfield of AI focused on computer systems that can learn and adapt independently of instructions using algorithms and statistical models), Generative AI (using ML techniques to produce media, such as text and images) and Natural Language Processing (NLP, using ML techniques to enable computers to understand human language). Workers have mixed reactions towards AI and its future application and management. Microsoft's 2023 Work Trend Index revealed that 70% of individuals would gladly delegate tasks to AI to ease their workloads.[72] However, another survey found that more than 60% of the British public would feel more comfortable if the use of AI technologies was guided by appropriate laws and regulations.[73]

What if...

...the application of new technologies to improve worker protection creates other health, safety and wellbeing risks?

Safeguards will be key to building a responsible innovation landscape and ensure that the use of new technological developments, such as AI, do not come at the expense of worker rights and protections.

Digital transformation has huge potential health, safety and wellbeing benefits. For example, Connected Autonomous Vehicles (CAVs) have the potential to reduce human error, a factor in more than 80% of injury-causing accidents.[74] However, it can also bring with it new or emerging risks, such as cybersecurity, as well as public scepticism. In a 2021 study surveying 125,911 people across 121 countries, 65% of people said they would not feel safe being driven in a car without a human driver.[75]

> Some predict that up to 81% of tasks completed by certain jobs are automatable.

The impact of digital transformation on health, safety and wellbeing is varied across sectors. In customer facing sectors, digitalisation such as digital ticketing, changes the role of workers and their interaction with customers. For workers this can affect wellbeing, as the increased efficiency and greater traffic places greater burdens on individual workers, while minimising face-to-face interaction with customers. In manufacturing, robotics and new industrial approaches utilising the Internet of Things have the potential to reduce hazards. For example, monitoring systems can automatically trigger accident prevention procedures, alerts and alarms, and reporting.

> **Regional insight**
> **Technological advances**
> The Automation Readiness Index puts East Asian countries including Japan, Singapore, and South Korea and European countries including Germany and France as some of the most technologically advanced in the world.[71]

History tells us that technological innovation can lead to major improvements to health, safety and wellbeing for society, as demonstrated by the invention of seatbelts, for example. OSH professionals therefore have an important role in effectively identifying, risk assessing, adapting and applying technological innovation from across different sectors in a health, safety and wellbeing context. OSH professionals can be key advocates for safety in design and human-centric approaches to digital transformation, ensuring worker participation. The use of technology could also shift the focus for OSH professionals further towards safe systems of work and away from standards and procedures. However, whilst the application of new technologies can provide significant opportunities, it is unlikely to solve structural issues that impact on health, safety and particularly wellbeing, such as culture or workload.

The use of data to improve health, safety and wellbeing outcomes

Businesses, technology firms and OSH professionals will be required to identify and utilise increasing amounts of high quality data with the proliferation of technology in work. This information spans from live incident reporting through to live data on training completion, worker tenure, and retention. OSH professionals also have access to a significant volume of free-field textual data that currently require manual analysis, such as audit reports, investigations and inspections. Utilising technological advancements such as AI, ML and NLP, this data can be used in a variety of ways to improve health, safety and wellbeing outcomes. Organisations will be able to process Big Data (large and complex data sets) and then perform new types of risk analysis and prediction. For example, they will be able to develop health indicators, implement preventative strategies through predictive analytics, and generate actionable insights from behavioural data in order to maximise efficiency of their organisation and employees. OSH professionals will also have a key role in reducing data silos, in particular between operational data and health and safety data. OSH professionals will increasingly need data analysis skills and critical thinking to fulfill this role, requiring a broader view of recruitment, learning and assessment in the sector.

While data analytics creates potential to improve worker health, safety and wellbeing, new sources of data and methods of data collection will generate increased risks associated with cybersecurity, privacy, ethical guidelines, consumer protection, sector-specific regulations and legal restrictions. A WEF report found that 39% of organisations were affected by a third-party cyber incident in the past two years.[76] These new risks can lead to unease among workers, especially where organisations have unclear or insufficient guidance and support for managing this increase in data.

> 39% of organisations were affected by a third-party cyber incident in the past two years.

OSH professionals will need to be responsive to and adapt rapidly to changing data risks with regular and constant learning, development, training and new knowledge. OSH professionals will increasingly deal with large volumes of personal data, requiring adaptive knowledge and skills to deal with changing legal and ethical guidance around safe handling of personal data. Those who do not follow legislation face the risk of prosecution, significant fines and reputational damage.

Case study

OSH Barometer, European Agency for Safety and Health at Work

Pulling data from a range of sources dating back to 2010, the EU OSH Barometer is a data visualisation tool covering the most important OSH facts and figures in the EU, Iceland, Norway and Switzerland. The tool aims to inform the public of key OSH indicators within the region, including charts such as national OSH strategies, work accident trends, and OSH culture and health awareness. Maintained by EU-OSHA, the tool is constantly updated with high quality data in collaboration with EU institutions and member state contact points.

20 technologies impacting the world of work

We have identified twenty technologies that will have a significant impact on the future of work, but will also create new (or amplify existing) health, safety and wellbeing opportunities and risks.

The technologies are agnostic to any application and are organised into three categories. We describe each technology, their potential application, possible opportunities and risks for health, safety and wellbeing and their Technology Readiness Level (TRL). TRLs assess a technology's maturity level, ranging from TRL 1 ('basic principles observed and reported') to TRL 9 ('actual system proven through successful operations').[77] The TRL level does not reflect the market scale or ubiquity of the technology.
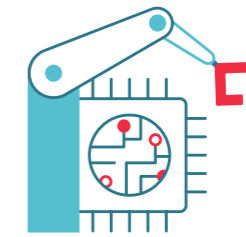
Manufacturing, hardware and applications

- Air monitoring
- Smart sensors
- Autonomous products
- Cobots
- Drones
- Jetpacks
- Additive and modular manufacturing
- Soft robotics
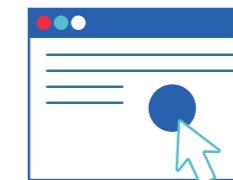
Experiences and interfaces

- Virtual Reality
- Digital twins
- Wearables
- Exoskeletons
- Augmented Reality
- Human implant technology
- Brain-computer interfaces

Advanced computing, data and AI

- Internet of Things (IoT)
- Next-generation voice assistants
- Artificial Intelligence
- Computer vision
- Quantum computing
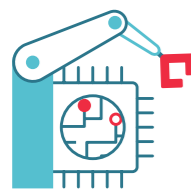
Manufacturing, hardware and applications

Air monitoring (TRL 9)

Air monitoring refers to the measurement of airborne contaminants in indoor and outdoor spaces. It involves testing the concentration of pollutants over a given time. Common pollutants include ozone (O_3), carbon dioxide (CO_2), carbon monoxide (CO), nitrogen dioxide (NO_2) and total volatile organic compound (TVOC). Poor air quality, one of the major factors in workplace ill health in the global population, will continue to increase as global warming intensifies events such as wildfires and smog.

✅ Improved monitoring can help identify when workers are exposed to potentially dangerous levels of pollution at indoor and outdoor locations.

✅ Monitoring can help protect sensitive equipment, preventing equipment failure.

❌ Monitoring can be challenging in a non-enclosed environment.

Smart sensors (TRL 9)

Smart sensors use wireless connection and microprocessors to monitor, analyse and track information from the physical environment. Their popularity in a vast range of industries has increased significantly over the past few decades due to their ability to improve efficiency. For example, the advanced manufacturing industry is using them to link devices and sensors in the IoT in order to help streamline the value chain and inhibit any failures.

✅ Smart monitoring systems can automatically trigger accident prevention procedures, alerts and alarms, and reporting.[78]

❌ OSH professionals need to ensure that smart sensors are performing functions that have been modified to fit the specific context in which they are used, rather than generic functions.[79]

Autonomous products (TRL 9)

Autonomous products can engage in specific tasks independent of human interaction. Products include autonomous smart home devices, vehicles, and robots, and their tasks may include vacuuming, mopping or delivering packages. Autonomous products can use algorithms, sensors and ML and are designed to be simple to use and operate. Compared to Cobots or other more complex machines, they perform single tasks and are relatively straightforward.

✅ The automation of monotonous tasks allows workers to focus on more complex or specialised tasks.[80]

✅ Automation of repetitive movements can reduce physical strain.

❌ Imperfectly programmed robots introduce new OSH concerns around liability for accidents or collisions.[81]

Cobots (TRL 9)

Collaborative robots – or Cobots – are designed to interact with humans in a shared space. The degree of interaction of Cobots with people can vary; they can support either with simple or very complex tasks. Cobots will likely be integrated into various stages of industrial settings, including manufacturing, production, and construction. Recent advances in AI and machine vision have facilitated the ability of Cobots to be aware of their surroundings and perform useful tasks alongside humans.

✅ Augmentation technologies present an opportunity to eliminate the riskiest work by delegating these tasks to robots or reducing stress on workers' bodies.

❌ If Cobots and human augmentation technologies become more widely available and ubiquitous, new safety procedures will be needed rapidly as technological change accelerates.

❌ Augmentation technologies can reduce the autonomy of workers, posing a threat to worker wellbeing and physical health.[82]

Drones (TRL 9)

A drone is an unmanned aerial vehicle which is used to perform a diverse range of tasks, from home deliveries to military operations to avalanche rescues. Drones can travel at different heights and distances, and their features can be tailored to the unique demands of varied industries. They have increasingly been used in the mainstream, as evidenced by Amazon's launch of ultra-fast drone deliveries in some locations in 2023.[83] Broadly, there are two degrees of autonomy for drones. The first is remotely piloted, whereby the drone's movement is controlled by a person. The second is advanced autonomy, which relies on sensors and software to automatically determine how best to carry out tasks.

✅ They can be used for inspections deemed dangerous or high-risk.[84]

❌ Drones present new OSH risks, from privacy to physical safety.[85]

Additive and modular manufacturing (TRL 9)

Additive manufacturing – often referred to as 3D printing – refers to manufacturing a three-dimensional product layer by layer. Recently, 4D printing has become more popular because it enables additive manufacturing processes to react to changes in surrounding conditions, such as changes in temperature or moisture in the air over time. Modular manufacturing is an additive manufacturing technique which allows elements to be produced off-site and then later assembled, which can improve reduce lead times and enhance productivity. These technologies could reduce labour exposure on site by reducing the number of people needed in construction.

✅ Additive manufacturing could reduce exposure to potentially hazardous manufacturing conditions for complex parts.[86]

❌ 3D and 4D printing relies heavily on digital design files and software. Cyber-attack could lead to the manipulation of part design that is difficult to detect.

Jetpacks (TRL 8)

Jetpacks allow individuals to hover or fly for a limited amount of time through propulsion. Often, jetpacks are in the style of backpacks, which strap to the individual's back, or hover boards which strap to the individual's feet. Jetpacks have been explored for many decades, but emerging jetpack technology includes automation and more sophisticated controls for next-generation individual flight.

✅ Jetpacks could be used for emergency crews to access difficult-to-reach locations quickly and safely, aiding the safety of remote or lone workers.[87]

✅ Jetpacks have potential to eliminate otherwise risky jobs, such as abseiling from a helicopter.[88]

❌ Jetpack technology is still emerging, so practical applications and their OSH implications are not well understood.

❌ Jetpacks can be difficult to manoeuvre and could pose significant safety risks to users.

Soft robotics (TRL 3)

In contrast to traditional robots, which move in linear fashion and are made of hard materials, soft robotics mimic locomotion mechanisms of soft bodies existing in nature to achieve complex motion. Soft robotics are often constructed of pliable or easily deformable materials, such as fluids and elastomers, which are materials capable of returning to their original shape after being deformed.

✅ Mimicking muscular function is a common application of soft robotics, which can be used to develop comfortable prosthetics that can aid disabled workers in performing certain functions.

✅ In environments with high robot and human interaction, soft robotics can present fewer physical risks.

❌ Soft robotics are often less precise and could place workers at risk if they cannot perform a task accurately.[89]
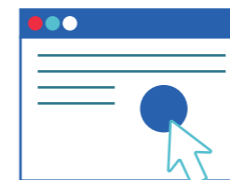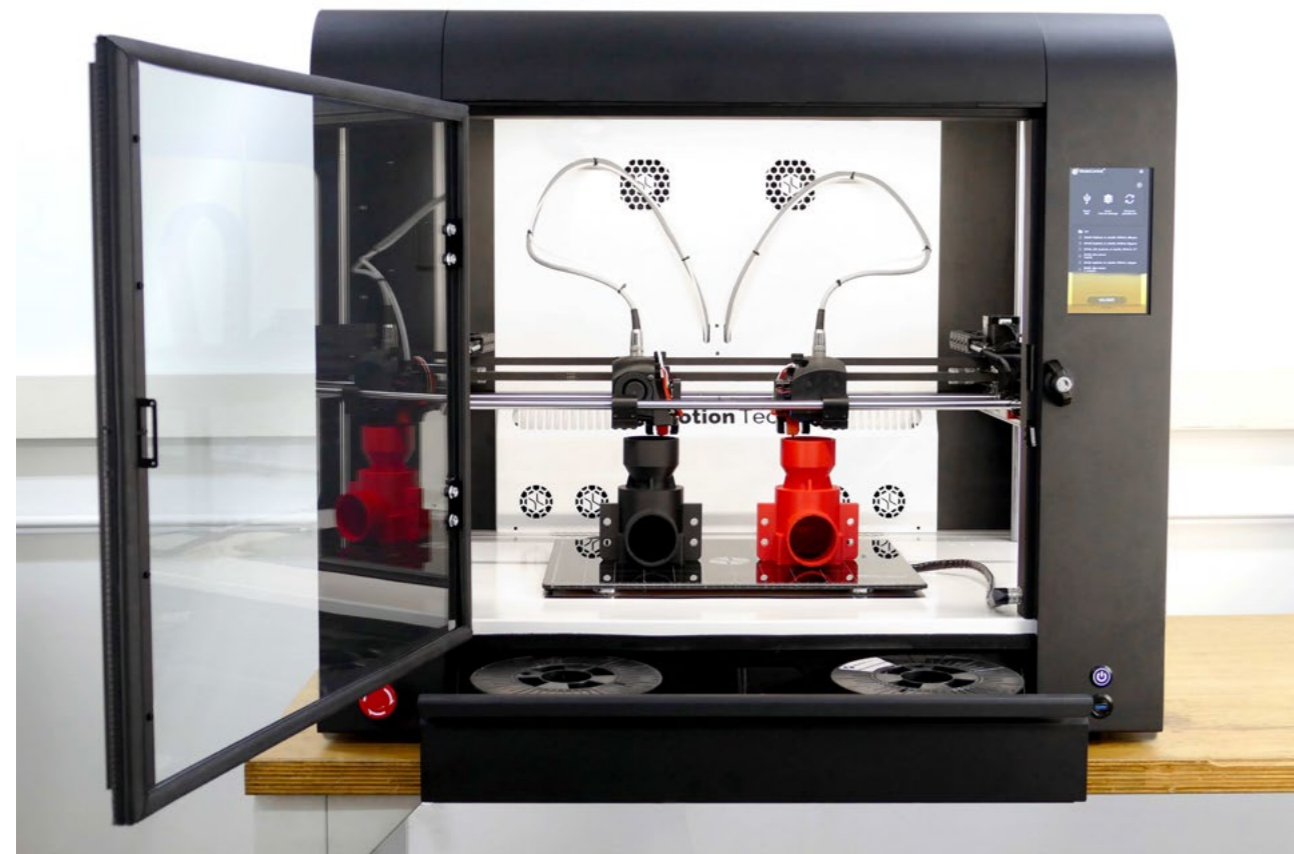
Experiences and interfaces

Virtual Reality (TRL 9)

Virtual Reality (VR) is a rapidly growing market, with the global market size predicted to increase over 80% between 2022 and 2025, from $12 billion to $22 billion.[90] VR creates a computer-generated simulation of a 3D experience, which puts users at the centre. Often, this simulation is accessed through physical hardware – such as a helmet – and sensors which track movement. An example of VR is the Metaverse, which provides an immersive, shared experience of the world which allows people to work, play and socialise. Some deem it the future of the internet as a key place to connect with others socially and economically, but the Metaverse has yet to gain traction in mainstream culture.

✅ Reduce in-person physical risks associated with worker tasks.

✅ VR/AR training has been shown to be more effective for learning than traditional classroom training in some instances.[91]

❌ VR could pose ergonomic risks, such as headaches and neck and back pain.

❌ Psychosocial risks associated with lack of social interaction.[92]

Digital twins (TRL 9)

Digital twins are virtual representations of the real world. Digital twins can be used to visualise objects, services, products, or systems at different stages of their lifecycle. They are useful for many industries and can support a range of purposes, including testing, monitoring, and maintenance of assets. Digital twins, as opposed to simulations, typically study several processes rather than one. Furthermore, digital twins can be used in real-time alongside simulations, logical reasoning and ML to help to make informed decisions in the real world.

✅ Digital twins can help workers gain a better understanding of a complicated site, with real-time updates to any spatial changes, and improve navigation.

✅ Human-focussed digital twins, an emerging application that represents human workers as well as other physical assets, could be used to support and guide workers in future environments, including recording the context of failures or accidents.[93]

❌ The level of data collection required for human-focused digital twins could present serious legal or ethical challenges.

❌ Access to a digital twin allows insights and control of the system or asset it replicates. A bad actor could influence decision-making with physical impacts that could cause catastrophic harm.

Wearables (TRL 9)

Wearables are hands-free technologies which can monitor and analyse information. Wearables can collect information from the human body directly, such as heart rate monitors, or can be devices for monitoring or interacting with the surrounding world, such as body-worn cameras or access control chips. They can either be worn as accessories, implanted into skin, inserted into clothing or even tattooed onto the skin. They typically use a mixture of biosensors, GPS, RFID, and other networking and communications technologies to track location and provide real-time data. They have a wide range of uses, from health to work monitoring. As such, they could be used to monitor heart rate during exercise, or investigate employee behaviour and performance through tracking computer use during working hours.

- ✅ Help reduce physical risks, such as overexertion or inappropriate reaching or lifting by tracking body movements.
- ✅ Large-scale tracking may allow automation of OSH professionals tasks (such as monitoring of fatigue and health).
- ✅ Wearables can transform accident investigations by providing access to point-of-view information or allowing workers to directly capture conditions.[94]
- ✅ Use of data from wearables to support accident investigations.
- ❌ Constantly monitoring productivity can introduce mental stress.[95]
- ❌ Increase in stress, anxiety, overworking or undesired behaviours due to a lack of agency.
- ❌ The quantity and variety of data produced is a challenge to sense-making; data used for performance indicators needs to result in tangible health and safety outcomes.[96]
- ❌ May pose a threat to worker privacy.
- ❌ They could prove unpopular with employees. A 2022 Morning Consult survey of 750 tech workers showed that half would rather quit than have their employer monitor them during the workday.[97]
- ❌ May pose ethical challenges due to sensitive data held by employers.

What if...

...technologies inform an employer of a health condition before the worker?

Exoskeletons (TRL 9)

Exoskeletons – sometimes referred to as wearable robotics, powered clothing or exosuits – are mechanical devices which can be worn by people for certain applications. Exoskeletons can be made from different materials, such as elastic, metal and carbon. They can be used to augment, reinforce, or restore human body functionality, facilitating new movements or load bearing.

- ✅ Exoskeletons can reduce loading on muscles and joints, reducing the risk of stress injuries.
- ✅ Workers experiencing a short-term or long-term disability can use exoskeletons to improve mobility and enable them to safely perform different movements.[98]
- ❌ There are lingering questions regarding the effectiveness and/or scalability of exoskeleton technologies.
- ❌ Poorly designed exoskeletons can redistribute stress to other regions of the body, causing the potential for new kinds of injuries.[99]
- ❌ Classification of exoskeletons as PPE or as technical support devices can be difficult due to lack of consensus on their benefits.
- ❌ Research suggests front-end workers dislike them because they feel restricted in performing their jobs properly and comfortably.[100]

Augmented Reality (TRL 9)

Augmented reality (AR) occurs when sensory information is superimposed onto an individual's real-world experience. This is done through both low-end technologies, such as mobile applications, and high-end technologies, such as headsets. It is different to Virtual Reality (VR) in that it adds to the current environment, as opposed to creating a new, cyber environment. AR may include the addition of visual, auditory and somatosensory information, with an example being the use of visual cues to support machine maintenance in industrial settings, thereby reducing human error.

- ✅ AR technology can enable workers to practise operations, procedures and tasks in a controlled and safe environment, reducing the risk of human error at work.
- ✅ AR can help workers and safety inspectors visualise complicated exit plans and difficult-to-navigate facilities.
- ✅ AR can help provide additional detail to those on-site, assisting in ensuring high-quality inspections and investigations into working practices.[101]
- ❌ Workers using AR technologies may lose real-world awareness and a shared consensus of reality, leading to accidents such as experiencing a hazard with different views or tripping over obstacles.[102]
- ❌ Spending too much time in augmented reality could impact social awareness and mental health.

Human implant technology (TRL 9)

Human implants are electronic devices that typically contain a unique ID number and are implanted into the human body. The implant is then linked to personal information, from medical history to social media profiles, stored in an external database. The most common human implant is a microchip inserted under the skin via an injection.

- ✅ Medical information could be easily accessible by first responders if an injured person is incapacitated and unable to share important medical details.[103]
- ❌ Implanted technology takes agency away from workers to easily remove or switch off the chips.
- ❌ Human implants could be used to track employees without consent or awareness, including outside of work activities and locations. This is a privacy violation and could be used to discriminate against employees.
- ❌ Implants could pressure workers to modify their typical behaviour, leading to increased stress and anxiety.[104]

Brain-computer interfaces (TRL 7)

A brain-computer interface (BCI) facilitates the communication of a brain and another device, such as a robotic leg or a computer. BCIs work by tracking brain signals from the cortex through a device either on top of the scalp (non-invasive) or planted in the brain (invasive). Use cases are currently largely focused on medical purposes, for example helping paralysed people control assistive devices using their thoughts. However, there is a broad range of potential applications for non-medical, non-invasive BCIs for civilians across sectors such as gaming, education, world of work, sport and wellness, including enhancing an individual's sensory-motor ability or cognitive behaviour.

- ✅ Fatigue detection could be improved.
- ✅ Could improve communication between humans and robots in occupational environments where they work collaboratively.
- ❌ Exposure of workers to potential physical and psychosocial threats, from malicious data collection and cyber-attacks, to remote cognitive influence.[105]
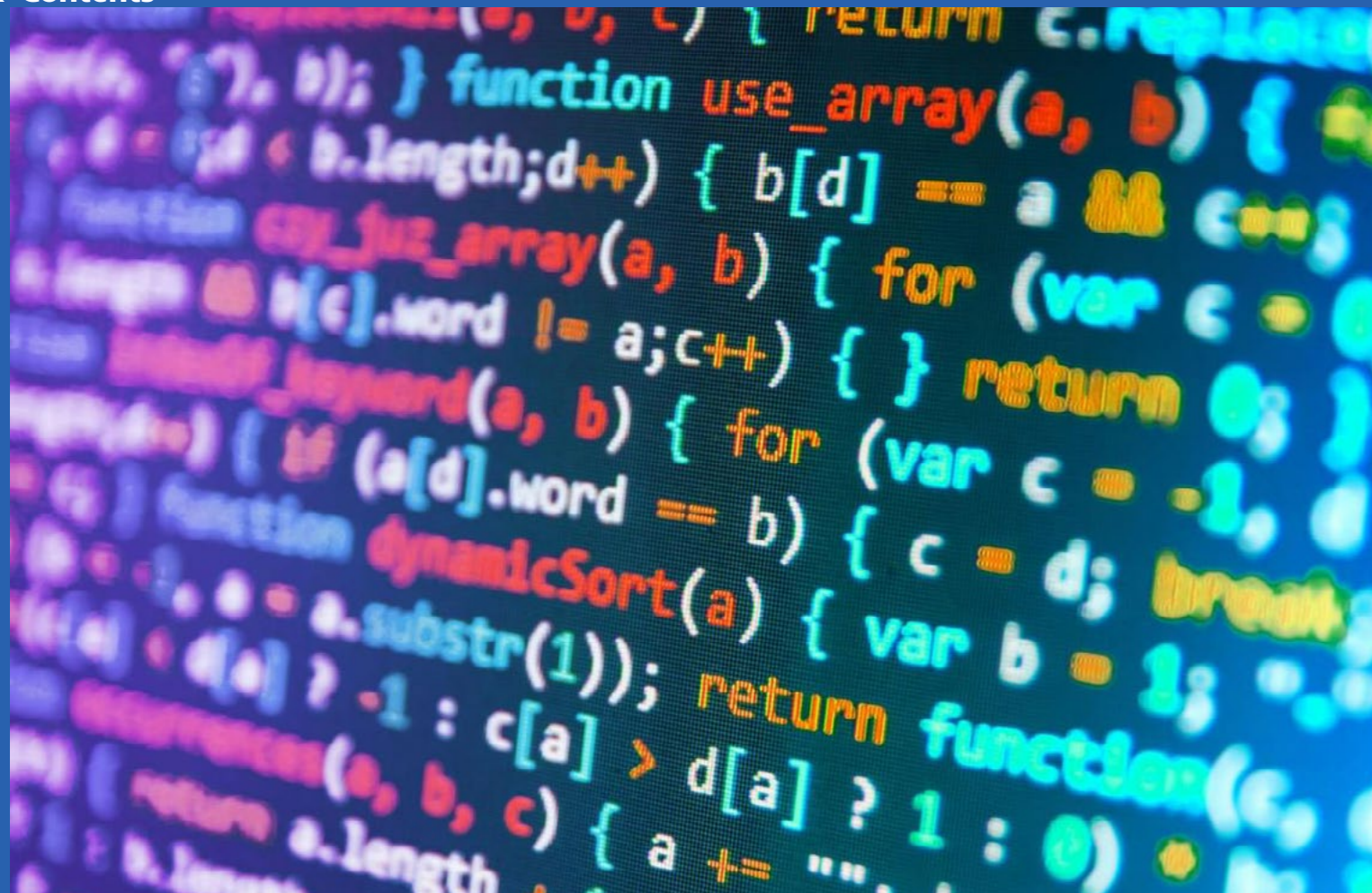
Advanced computing, data and AI

Internet of Things (TRL 9)

The Internet of Things (IoT) is a network of objects (i.e. 'things') which are connected by sensors and other technologies, and which exchange data with other 'things' via the internet. This usually occurs via cloud-based centralised servers but can also process data in a decentralised way. The IoT allows real-time data from the physical world to be analysed and fed back into the network. Advances in technology and cloud computing, and the increased uptake of mobile devices, means that the IoT is widely used across varied industries. This includes healthcare, education, construction, and technical support. The user of IoT spans from the individual to companies. As such, it can used in the management of venues to monitor people and identify crowded areas, enhancing safety. Equally, it can provide information – such as deliveries or messaging – to individuals through wearable devices or smartphones.

- ✅ New digital tools and the growth of the IoT enable both fully and partially remote auditing, inspection, and maintenance. This can dramatically reduce safety risk for individual workers, allowing high risk activities to be carried out at a distance.

- ✅ Ability to deliver new remote service offerings across healthcare and learning.

- ❌ IoT systems are reliant on the quality, accuracy and success of remote software and information-gathering devices, which are susceptible to failure, introducing new risks to industrial processes.

- ❌ Remote services change the roles and responsibilities of workers, leading to greater workloads and technology-related OSH concerns, such as eye strain.[106]

- ❌ Growth in the number of interconnected IoT devices leads to higher vulnerability from cyberattacks, data breaches, and mistrust.[107] This could lead to catastrophic harm.

Next-generation voice assistants (TRL 9)

Next-generation voice assistants can perform tasks or provide services to their users. They use AI technology to interpret information from humans and react by answering questions or executing tasks. They often do this through connecting with other technologies. Next-generation voice assistants are an evolution of simpler voice-controlled machines as they are able to respond to complex questions or commands with a level of intuition or human reasoning.

- ✅ Voice assistants can enable workers to get immediate assistance without needing to free up their hands, enabling them to sound an alarm or ask a question from any position.

- ✅ Digital assistants can offer support to caregivers, healthcare providers, and other service providers and reduce the burden of difficult professions.[109]

- ✅ Can overcome poor written communication skills.

- ❌ Voice recordings can be used to commit fraud, identity theft and other crimes against individuals.

- ❌ Voice assistants can create a pressure for workers to fit more work into the same amount of time, which can lead to burnout or undue stress.[110]

- ❌ 'Always on' microphones can create a privacy risk when workers believe they are speaking confidentially.

Case study
RiskTalk

RiskTalk is a voice technology-powered tool which enables conversations about risk assessments, safety observations and hazard and incident reporting. RiskTalk aims to improve record keeping of OSH conversations and live, remote oversight and sign-off ability.[108]

Artificial Intelligence (TRL 9)

Artificial Intelligence (AI) is a technology which can simulate human cognitive functions, such as logical reasoning. It has the potential to impact all industries and parts of life. The AI industry is large and constantly growing, with the global market predicted to increase from $406 billion in 2022 to $554 billion in 2024.[111] ML is a subfield of AI which has increased in popularity. ML refers to the use of algorithms and computer models to learn from data, identify patterns and make predictions accordingly without being specifically programmed to do so.

- ✅ Large-scale collection and analysis of Big Data could automate some of OSH professionals' responsibilities, providing more time for other activities that require competencies beyond AI's capabilities, such as critical thinking.

- ✅ Some jobs may change or be replaced by artificial intelligence, and new highly skilled jobs operating or interacting with AI and automation technology will emerge.

- ✅ Automation is an opportunity to reduce high risk roles, particularly in industry and site-based work (such as remote inspection).

- ✅ Workers will need additional learning to understand how they can work with and alongside automation.

- ✅ ML can enable computers to identify patterns and make decisions without being explicitly programmed to do so, making it possible for these algorithms to learn OSH risks independently over time.

- ✅ NLP can efficiently generate insight from free field textual data that currently requires manual analysis.

- ❌ Emerging applications of AI can perpetuate bias and discrimination. Potential bias in AI algorithms can exacerbate issues of discrimination.[112]

- ❌ Automated or AI based approaches to safety are relatively untrialled and may not improve safety.

- ❌ Increased tracking and monitoring through AI can lead to micromanagement, increasing worker stress and anxiety.[113]

Computer vision (TRL 9)

Computer vision refers to the use of AI to interpret visual information. Through AI algorithms and programming, computers can recognise visual objects, identify movements and store any changes. When this vision is used in manufacturing, it is often referred to as 'machine vision'. Typically, this will help with quality assurance and testing.

✓ Computer vision can quickly detect rogue objects, anomalies, or dangerous situations simultaneously across many input feeds, enabling quick accident prevention beyond human capability.[114]

✗ Computer vision algorithms must be accurately trained, and reliance on them can lead to complacency and overconfidence.[115]


Case study

Protex AI

The company's privacy-preserving software plugs into existing CCTV infrastructure to use its computer vision technologies to capture unsafe events autonomously in settings such as warehouses, manufacturing facilities and ports. Working with a large UK retailer, Protex AI has been able to decrease incidents in the workplace by 80%.[116]


Quantum computing (TRL 4)

Quantum computing leverages the principles of quantum theory to solve problems that are too complex for classical computing. This multidisciplinary field is rapidly emerging, with researchers, companies and governments aiming to reach a quantum advantage through a combination of computer science, physics and mathematics. Quantum advantage has the potential for a massive leap forward in computing capability, solving problems in specific use cases that could not be reasonably simulated by a classical computer.

✓ Quantum Safety is an emerging area of OSH that leverages this technology to understand OSH in a complex modern world using multidimensional models and complex analysis.[117]

✓ Quantum computing has a broad range of potential applications, such as improving indoor environmental quality assessment.[118]

✗ If quantum computing is increasingly used for complex decision making, those processes could become more opaque.

✗ Quantum computing could soon be capable of breaking encryption schemes that are in widespread use across web-based platforms.
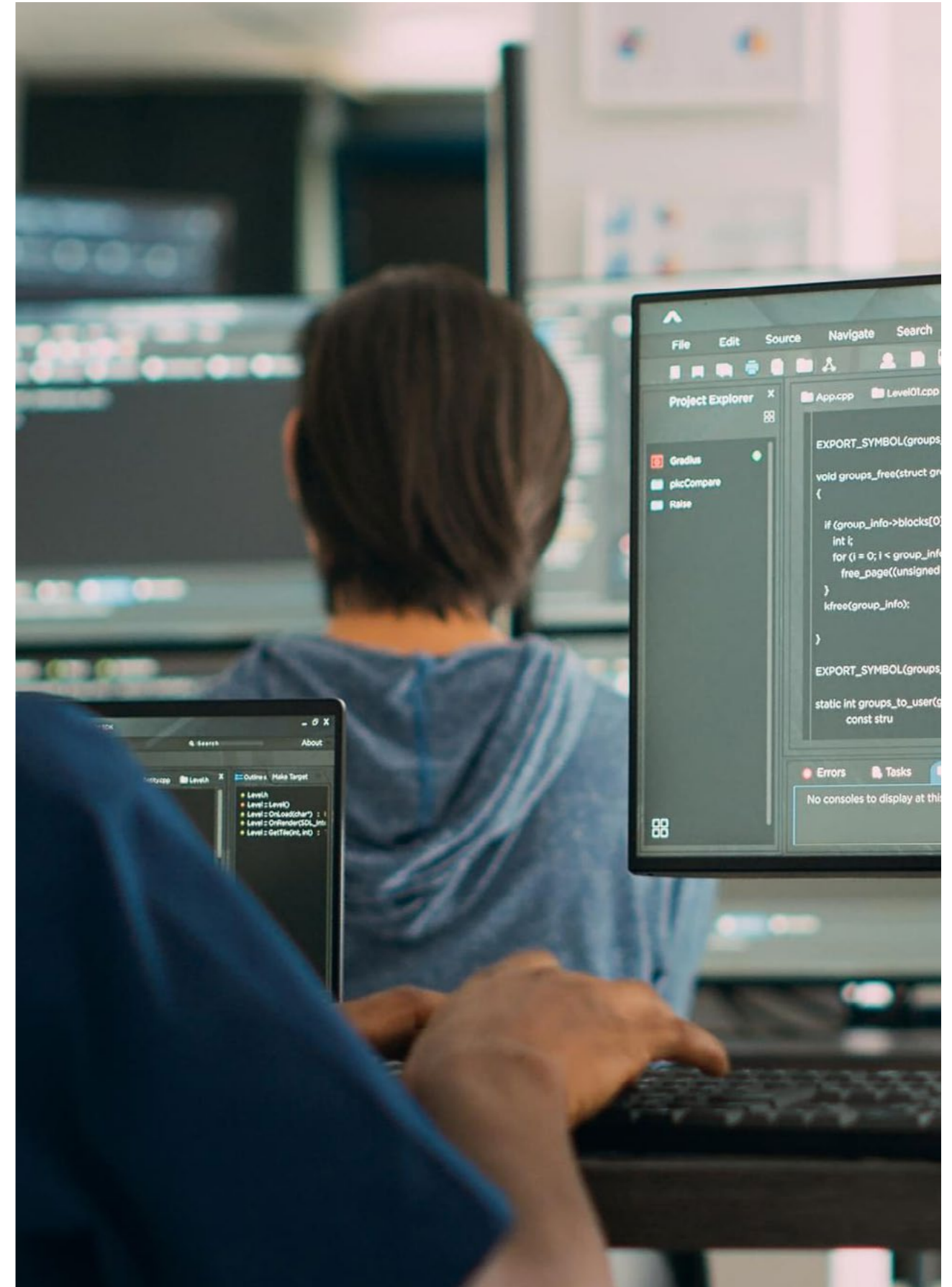
The evolving OSH profession

Expanding definitions of the OSH profession, agendas towards deregulation, the adoption of principle-based standards and new skills requirements are transforming the OSH profession. What does the evolving OSH profession mean for you?
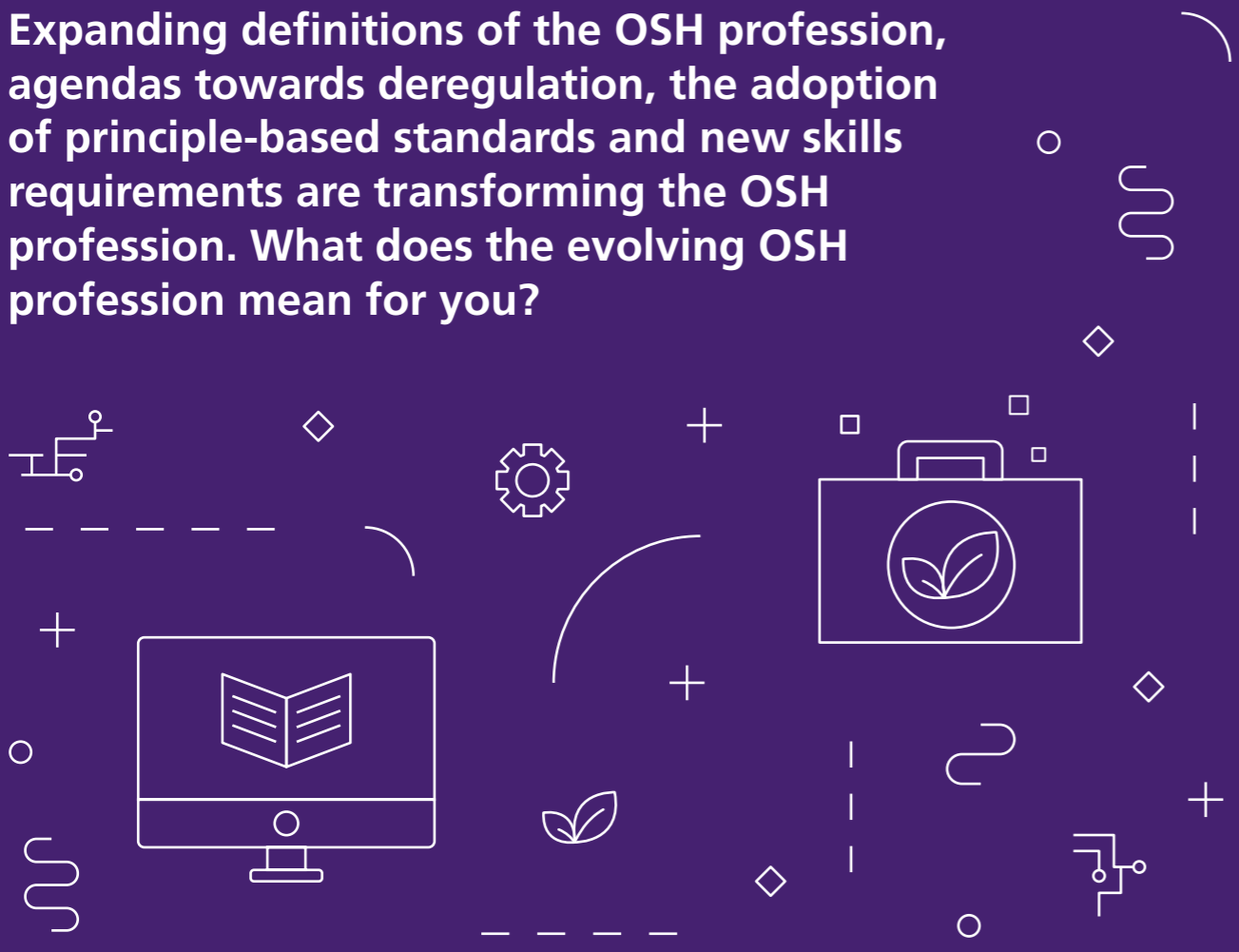
In a changing world of work the OSH profession is evolving and adapting for the continued prevention of harm and protection of workers. There are fundamental shifts occurring that are challenging traditional definitions of what the profession is, does and stands for. Professionals will require new skills as this shift occurs.

At the same time, governments with agendas towards deregulation, reduction in health and safety standards or countries without regulation or OSH standards already in place, are impacting the ability of professionals to influence organisational OSH principles and deliver the wider benefits of OSH. Furthermore, the rising adoption of international or organisational principles-based OSH standards will create greater consistency between countries and could alter the focus of influence away from a national government level. Beyond shifts in policy and standards, the COVID-19 pandemic, ongoing geopolitical instability and globalisation have made businesses more aware of the need for resilience, to anticipate rapid change, and rapidly adapt to evolving circumstances to ensure worker health, safety and wellbeing.

Complex systems and the expanding definitions of health and safety

Responses to complex issues, such as climate change, will require understanding of the wider system that could redraw the definition, roles, skills and responsibilities of the OSH profession. The OSH sector has already expanded from its origins in industry and high-hazard sectors. It has aligned with previously disparate technical professions to include additional roles such as sustainability and resilience.

A key point of intersection is the growing environmental industry. Environmental job postings are rising 8% annually, and there are high rates of people from other careers transitioning into the industry, creating a large new sustainability workforce.[119] The intersection is shown by OSH regulations in the EU changing to include consideration of the environment (e.g., OSH+E accreditation in Germany).

> Environmental job postings are rising 8% annually.

Another key point of intersection is clinical health. More remote working, a greater appreciation of health and wellbeing at work, deficiencies in public healthcare systems and possible future pandemics point towards greater blurring of lines between clinical and occupational health in the future. The COVID-19 pandemic brought public and clinical health and its management directly into the workplace. This created new streams of work (such as organisation of in-workplace testing and management of workplace capacity), and new relationships between regulators, health practitioners, and the workplace. In the UK, Public Health England began policing the pandemic response in the workplace, representing a departure from previous involvement, largely in cases of injury.

Professionals were not necessarily trained to respond to these developments and did not have medical training. However, they may still be best placed to respond to future pandemics and other, similar large-scale health threats.

What if…

…there is no dividing line between occupational and clinical health?

As we look to the future, we expect this redrawing of OSH to continue as systems and resilience thinking becomes more important. At the same time linkages and outcomes between health, wellbeing and safety strengthen. Eventually OSH will become more synonymous with operational excellence and business efficiency. OSH professionals could have a central role in bringing fields together such as security, sustainability and resilience through integrated safety management approaches. The evolution of the profession could create new skills, roles and sector identity.

Influencing the performance and resilience of business

In the future we may see OSH professionals having less focus on compliance (i.e., the adherence to rules and standards), and more on enabling and delivering value (i.e., efficiency, productivity and equity). Through championing new approaches and integrating and raising their profile within businesses, OSH professionals can influence the performance of businesses at the highest level.

New approaches to safety management will include taking a more proactive approach. A 'Safety-II' perspective is an evolutionary development of conventional safety thinking, referred to as 'Safety I'. In simple terms, 'Safety-II' moves from ensuring that 'as few things as possible go wrong' to ensuring that 'as many things as possible go right'.

OSH professionals can also utilise other aligned techniques such as appreciative enquiry. This focuses on what is working (rather than what isn't working). This approach engages workers in appreciative conversations to share learning and collaborate to enhance organisational performance.

Lastly, organisations may need to shift to a scenario-based approach to anticipate and prepare for complex hazards from climate change to pandemics and technological advancements. Scenarios can help to explore and understand the organisational and systemic context that leads to accidents, disease and ill health. Organisations and OSH professionals will need to design spaces, operations and systems for normal scenarios, pandemic scenarios, climate crisis scenarios, supply chain resilience scenarios and even multi-hazard scenarios.

What if...

> **...deregulation leads to a reduction in OSH standards and makes it more difficult for OSH professionals to influence discussions?**

Changing perspectives on regulation and standards

Globally, OSH standards and incident rates vary enormously. Countries with few OSH-related laws or enforcement, and a high proportion of high-hazard industries present high levels of risk to workers. In contrast, developed countries are experiencing decreasing levels of risk in high-tech industry and increasing regulation for psychosocial risk management. For example, changes in 2023 to the Australian Work Health and Safety Regulations give more specific details on how to meet duties and protect workers from psychosocial hazards and risks.

Aside from the regulation of psychosocial risk, some developed countries are minimising or removing regulation and liberalising restrictions on industry. This can be seen, for example, across the Deregulation Agenda of the Australian government,[120] delegation of safety responsibility from the regulator to private companies in the United States,[121] and deregulation in the United Kingdom following the withdrawal from the EU. The loss of regulation as a driving/limiting force may decrease overall activity and oversight of OSH in business, giving professionals less leverage to influence. We may also see the emergence of opt-in OSH best-practice guidance (national and international) driven by organisations.

As we look to the future, rapid changes driven by technology, population and climate shifts may outstrip the adaptive capacity of prescriptive standards. Internationally consistent, principle-based OSH standards will create greater consistency between countries and regions. This is something already being demonstrated regarding specific hazards such as the use of lithium batteries. The push from the market and consumer, as well as employee expectations could create organisation-led voluntary international standards that transcend state boundaries. Agreement of such standards will require international collaboration of OSH professionals and best practice knowledge sharing across borders.

There will also likely be greater harmonising of standards across industry so they can be delivered in a more convenient and accessible way for workers, as well as help manager worker shortages. An example is the International Association of Oil and Gas Producers who worked with industry to harmonise 25 different lifesaving rules.

Misinformation and misconceptions of OSH

Our digital lifestyles have changed how we share and access information and news. This has led to conflicting information, and the rise in 'fake news', misleading content, and myths. While the public recognition of 'fake news' is increasing, new technologies could exacerbate the issue. Academics, cybersecurity researchers and AI experts warn that advanced language processing technology, such as ChatGPT, could be used by bad actors to sow dissent and spread propaganda on social media.[122] These technologies make it much less labour intensive to scale up operations and spread misinformation.

Misinformation could impact the ability of OSH professionals to identify, access and use credible sources of information and research when developing and implementing assessments, processes and communications in the workplace. It could also result in misconceptions about OSH and the ability to preserve the integrity of good OSH information. An example is the confusion around 'COVID-safe' behaviour in the workplace. OSH professionals will need to manage misconceptions and potential risk-taking behaviour, and greater training requirements for workers may be needed to identify and overcome misinformation.

A greater focus on digital and soft skills

The labour market is becoming increasingly digital and automated. In the future, skills requirements will focus less on specific competencies and expertise, and more on flexibility, adaptation and critical thinking, to add value beyond what can be achieved through AI automation. Literacy in data, cybersecurity, and digital systems will be key,[123] as will soft skills in communication, people management, and application of knowledge.[124] For OSH professionals, the capability to develop, pilot and deploy emerging technology to improve health, safety and wellbeing outcomes will also be hugely critical. This will require human-centric approaches, safety by design, worker participation and risk assessment. Furthermore, professionals will need the skills to navigate the complex ethical considerations of new technologies.

Regional insight
Digital Skills

Digital skills are increasing in demand in the Asia–Pacific (APAC) region, with 75% of employers in four countries reporting a rise in demand for new hires with digital skills over the last five years.[125]

An increased need for learning, relearning, and reskilling

In parts of the world where the workforce is ageing and careers are becoming longer, there is an increased need for learning, relearning, and reskilling across the lifespan of a worker.[126] In the OSH profession specifically, lifelong learning can help to manage new and emerging risks to improve OSH outcomes. There will also be a greater range of ages in the workforce, and it may be challenging to develop OSH learning methods relevant to both young and older staff. In a 2019 survey, 84% of Americans said learning will become more self-service the older you get and 59% said YouTube will become the primary learning tool.[127]

> **59% of Americans believe YouTube will become the primary learning tool.**

New learning formats and approaches

Learners will increasingly expect on-demand and personalised learning that can be conducted outside traditional learning and development patterns, and that fit around more flexible working. Access to numerous digital platforms such as e-learning and Moodle-style courses is supporting these changes, reinventing what learning pathways look like. From 2011 to 2021, the number of learners reached by massive open online courses (MOOCs) increased from 300,000 to 220 million.[128]

> **From 2011 to 2021, the number of learners reached by massive open online courses increased from 300,000 to 220 million.**

Looking further ahead, a focus on collaborative, immersive, gamified, and adaptable content is emerging. This includes both face-to-face and virtual collaboration that is highly tailored to individual needs and learning styles, coaching and on-the-job training. OSH professionals will need to adapt to the expectations of workers to ensure effective learning and the health, safety and wellbeing of the workforce. However, new learning methods may be relatively untrialled regarding effectiveness, particularly over the long term.

The education and assessment landscape

The education landscape is changing, with a greater range of education pathways available and a greater focus on vocational education and training alongside traditional academic, subject based training. This is seen in Europe, with the priorities set out in the European Year of Skills 2023. This shift may result in increasing numbers of people following non-traditional routes into the OSH sector, a requirement for employers to invest in their own development and learning (for example through apprenticeships) and the need for a highly inclusive, open, and accessible culture.

With regard to assessment, there is a shift away from test-based evaluation towards on-the-job or alternate assessment, incentivised by emerging technology and AI. A move to digital assessments also means that effective assessment will face future challenges, as software tools to produce (or cheat with) assignments become more sophisticated. For example, AI software like ChatGPT can generate human language in real time, evaluated as comparable to a third-year medical student on medical licensing exams.[129] OSH professionals will need to adapt to changing approaches to assessment to ensure the competence of the workforce in relation to health, safety and wellbeing.

Case study
ChatGPT, OpenAI

ChatGPT is a language model developed by OpenAI, trained on a large amount of text data to interact in a conversational way. It has the ability to generate human-like text, answer questions, and complete various language-based tasks. According to OpenAI, the dialogue format makes it possible for ChatGPT to answer follow-up questions, admit its mistakes, challenge incorrect premises, and reject inappropriate requests. ChatGPT is proving popular and beneficial, with a 2023 survey of American business leaders finding that just under 50% of companies using ChatGPT had saved over $50,000.[130] The implication of ChatGPT and other language models for assessment is currently unknown. For example, there could be a greater use of pen and paper exams or it could be incorporated into student assessments.

Conclusion

This report has described some of the trends and developments that will have an impact on workers' health, safety and wellbeing in the future.

These include changing employment models and working patterns, flexible and remote work, the green transition, the drive for social equity, new technologies and digitalisation, climate change and deregulation agendas. Some of these changes will be gradual and evolutionary, while others will be dramatic and fast-paced. All require attention and the development of adequate responses from the OSH profession and other stakeholders.

In this report we have explored significant areas of future uncertainty through 'what if' scenarios. These aim to inspire and encourage stakeholders to remain agile, think broadly and consider the fullest range of possible actions to shape a safe and healthy future of work.

Our calls to action provide specific guidance on what governments, business, OSH professionals and IOSH can do. Their timely action will help to achieve common aims:

- eliminating hazards
- reducing risks, harmful exposures and unsafe working conditions
- enhancing workers' wellbeing.

A critical call to action (page 8) is for governments in every country to ratify and effectively implement ILO Conventions and Recommendations that aim specifically to protect people against sickness, disease and injury related to the work environment. The report highlights significant action areas that apply to all stakeholders. These include:

- **Driving forward social sustainability** by removing structural inequity, enhancing diversity and inclusion and ensuring a fair and just green transition. Specific actions address the need to build a better understanding of enablers and barriers, collaborate with partners and better measure and monitor progress towards social sustainability.

- **Developing appropriate responses to growing risks** linked to climate change, new and emerging technologies and mental health. Actions identified range from safety-in-design approaches to regulatory changes and new evaluation and control strategies for emerging occupational hazards.

- **Ensuring OSH professionals and workers have the appropriate OSH awareness, skills and knowledge** to build a healthier and safer future generation of workers. These include 'soft skills', digital skills and ethical decision-making. Actions involve clearly defining the boundaries and position of OSH and the OSH profession, identifying specific future skills needs and developing appropriate education, vocational training and lifelong learning.

References

[1] IOSH (2024) Sustainable Development. Available from: https://iosh.com/collections/social-sustainability/sustainable-development (Accessed: 23 February 2024)

[2] International Labour Organization (2019) Safety and health at the heart of the future of work: Building on 100 years of experience. Available from: https://safety4sea.com/wp-content/uploads/2019/05/ILO-Safety-and-health-at-the-heart-of-the-future-of-work-2019_05.pdf

[3] International Labour Organization (2019) Safety and health at the heart of the future of work: Building on 100 years of experience. Available from: https://safety4sea.com/wp-content/uploads/2019/05/ILO-Safety-and-health-at-the-heart-of-the-future-of-work-2019_05.pdf

[4] U.S. Bureau of Labor Statistics (2018) Contingent and Alternative Employment Arrangements – May 2017. Washington, DC: U.S. Department of Labor. Available from: https://www.bls.gov/news.release/pdf/conemp.pdf.

[5] International Labour Organization (ed.) (2021) World Employment and Social Outlook 2021: The role of digital labour platforms in transforming the world of work. Geneva: International Labour Organisation.

[6] Statista (2023) Estimated number of small and medium sized enterprises (SMEs) worldwide from 2000 to 2021.

[7] The World Bank (2022) Small and Medium Enterprises (SMEs) Finance. Available from: https://www.worldbank.org/en/topic/smefinance (Accessed: 24 February 2024)

[8] World Bank (2022) Small and Medium Enterprises (SMEs) Finance. Available from: https://www.worldbank.org/en/topic/smefinance (Accessed: 24 February 2024)

[9] World Bank (2022) Small and Medium Enterprises (SMEs) Finance. Available from: https://www.worldbank.org/en/topic/smefinance (Accessed: 24 February 2024)

[10] Gig Economy Data Hub, How many gig workers are there?. Available from: https://www.gigeconomydata.org/basics/how-many-gig-workers-are-there

[11] CIPD (2023) Flexible and hybrid working practices in 2023: Employer and employee perspectives. Available from: https://www.cipd.org/uk/knowledge/reports/flexible-hybrid-working-2023/

[12] European Commission (2021). EU strategic framework on health and safety at work 2021-2027 Occupational safety and health in a changing world of work. Available from: EU Strategic Framework on Health and Safety at Work 2021-2027 | Safety and health at work EU-OSHA (europa.eu)

[13] Buffer (2023). State of Remote Work Report 2023. Available from: https://buffer.com/state-of-remote-work/2023

[14] Lloyd's Register Foundation (2023) World Risk Poll 2021: Safe at Work? Global experiences of violence and harassment. Available from: https://wrp.lrfoundation.org.uk/LRF_2021_report_safe-at-work.pdf

[15] Nielsen (2014) Doing Well by Doing Good: Global survey on Corporate Social Responsibility. Available from: https://www.unioncamere.gov.it/sites/default/files/articoli/2022-04/corporate-social-responsibilty-nielsen%20%283%29.pdf

[16] Counter-Trafficking Data Collaborative (2024). Victims Exploited in Asia. IOM. Available from: https://www.ctdatacollaborative.org/story/victims-exploited-asia

[17] European Agency for Safety and Health at Work (2020). Preventing musculoskeletal disorders in a diverse workforce: risk factors for women, migrants and LGBTI workers. Available from: https://osha.europa.eu/en/publications/preventing-musculoskeletal-disorders-diverse-workforce-risk-factors-women-migrants-and

[18] International Labour Organisation (2022) Labour market policies for inclusiveness. ILO Working paper 78. Available from: https://www.ilo.org/wcmsp5/groups/public/---dgreports/---inst/documents/publication/wcms_855080.pdf

[19] World Economic Forum (2023). Global Gender Gap Report 2023. Available from: https://www.weforum.org/publications/global-gender-gap-report-2023/

[20] World Economic Forum (2023). Global Gender Gap Report 2023. Available from: https://www.weforum.org/publications/global-gender-gap-report-2023/

[21] e Board of Certified Safety Professionals and the National Safety Council (2022) SH&E Industry Salary Survey 2022. Available from: https://www.bcsp.org/wp-content/uploads/2023/10/Safety-Salary-Survey-2022-2023.pdf

[22] European Commission (2020) Circular Economy Action Plan. Available from: https://environment.ec.europa.eu/strategy/circular-economy-action-plan_en

[23] International Labour Organisation & Inter-American Development Bank (2022) Jobs in a net-zero emissions future in Latin America and the Caribbean. Available from: https://www.ilo.org/wcmsp5/groups/public/---americas/---ro-lima/documents/publication/wcms_752069.pdf

[24] European Union (2022). Fairness perceptions of the green transition. Available from: https://europa.eu/eurobarometer/surveys/detail/2672

[25] European Commission (2020). Circular Economy Action Plan. Available from: https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1583933814386&uri=COM:2020:98:FIN

[26] EU-OSHA (2023). Workers' safety and health in green jobs, European Agency for Safety and Health at Work. Available from: https://osha.europa.eu/en/emerging-risks/green-jobs (Accessed: 15 December 2023).

[27] Centre for Aging Better (2022) The State of Aging 2022. Available from: https://ageing-better.org.uk/state-of-ageing

[28] Fox, L. and Gandhi, D. (2021) Youth employment in sub-Saharan Africa: Progress and prospects. AGI Working Paper #28. Africa Growth Initiative at Brookings. Available from: https://www.brookings.edu/articles/youth-employment-in-sub-saharan-africa-progress-and-prospects/

[29] UNICEF (2019) MENA Generation 2030. Available from: https://data.unicef.org/resources/middle-east-north-africa-generation-2030/

[30] Appeadu, M.K. and Bordoni, B. (2023) 'Falls and fall prevention in older adults', in StatPearls. Treasure Island (FL): StatPearls Publishing. Available from: http://www.ncbi.nlm.nih.gov/books/NBK560761/ (Accessed: 14 December 2023).

[31] European Agency for Safety and Health at Work (2017). Young people and safety and health at work. Available from: https://osha.europa.eu/en/themes/young-workers (Accessed: 24 February 2024)

[32] IOM (2021) World Migration Report 2022. Available from: https://worldmigrationreport.iom.int/wmr-2022-interactive/

[33] International Labour Organization (ed.) (2021) ILO Global Estimates on International Migrant Workers: Results and methodology. Third edition. Geneva, Switzerland: ILO. Available from: https://www.ilo.org/wcmsp5/groups/public/---dgreports/---dcomm/---publ/documents/publication/wcms_808935.pdf

[34] International Labour Organisation. Labour Migration in Asia and the Pacific. Available from: https://www.ilo.org/asia/areas/labour-migration/lang--en/index.htm (Accessed: 24 February 2024)

[35] Zólyomi, E. and Danaj, S. (2019) Language barriers and the occupational safety and health of posted workers. Policy Brief. European Centre for Social Welfare Policy and Research. Available from: https://www.euro.centre.org/publications/detail/3474

[36] Future of Work Hub (2022). Industrial Action: 2022 emerging themes. Available from: https://eightdrivers.lewissilkin.com/emerging-themes/industrial-action

[37] The Office for National Statistics (2023). LABD: Labour disputes in the UK. Available from: LABD: Labour disputes in the UK – Office for National Statistics (ons.gov.uk)

[38] Urquhart, J. (2021). Two-thirds of workers taking on multiple jobs, study finds. People Management. Available from: https://www.peoplemanagement.co.uk/article/1743090/two-thirds-workers-taking-multiple-jobs-study-finds

[39] Nelson, M. & Braekken, K. (2017). A Generational Change: An Empirical Exploration of the Gen Y's Workplace Expectations. Athens Journal of Businesses & Economics. 3(2). pp. 123-142. Available at: https://doi.org/10.30958/ajbe.3.2.3

[40] Haapakorpi, A. (2022) 'The quality of a professional portfolio career in the post-industrial era', Journal of Education and Work, 35(4), pp. 441–454. Available from: https://doi.org/10.1080/13639080.2022.2073340.

[41] Met Office (2024). 2023: The warmest year on record globally. Available from: https://www.metoffice.gov.uk/about-us/press-office/news/weather-and-climate/2024/2023-the-warmest-year-on-record-globally

[42] MacNamara, K. (2022) Climate change worsening toll of humid heat on outdoor workers: study. PhysOrg. Available from: https://phys.org/news/2022-01-climate-worsening-toll-humid-outdoor.html

[43] MacNamara, K. (2022) Climate change worsening toll of humid heat on outdoor workers: study. PhysOrg. Available from: https://phys.org/news/2022-01-climate-worsening-toll-humid-outdoor.html

[44] MacNamara, K. (2022) Climate change worsening toll of humid heat on outdoor workers: study. PhysOrg. Available from: https://phys.org/news/2022-01-climate-worsening-toll-humid-outdoor.html

[45] Kiefer, M., Rodríguez-Guzmán, J., Watson, J., van Wendel de Joode, B., Mergler, D., & Soares da Silva, A. (2016) Worker health and safety and climate change in the Americas: issues and research needs. Rev Panam Salud Publica. 2016;40(3):192–97. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5176103/

References

46 World Health Organization (2022) WHO guidelines on mental health at work. Geneva: World Health Organization. Available from: http://www.ncbi.nlm.nih.gov/books/NBK586364/ (Accessed: 14 December 2023).

47 Dr. Clement Bellet Prof. Jan-Emmanuel De Neve Dr. George Ward (2023). Does Employee Happiness Have an Impact on Productivity? Available from: https://wellbeing.hmc.ox.ac.uk/publications/does-employee-happiness-have-an-impact-on-productivity-2/

48 World Health Organization (2022). Mental disorders. Available from: https://www.who.int/news-room/fact-sheets/detail/mental-disorders

49 World Bank Group (2022) Social Protection for Recovery: Europe and Central Asia Economic Update. Available from: https://openknowledge.worldbank.org/bitstream/handle/10986/38098/FullReport.pdf?sequence=11&isAllowed=y

50 World Health Organisation (2024) Mental health. Available from: https://www.who.int/health-topics/mental-health#tab=tab_1

51 World Health Organization (2022) World Mental Health Report: Transforming mental health for all. Available from: https://www.who.int/publications/i/item/9789240049338

52 Bevan, S., Meek, S. and Lucy, D. (2022) Supporting the mental health of self-employed construction workers. IES Report 580. Mates in Mind and The Institute for Employment Studies (IES). Available from: https://www.employment-studies.co.uk/resource/supporting-mental-health-self-employed-construction-workers

53 Reynolds, M. (2022) Construction industry can pave way to better support on mental health. Financial Times. Available from: https://www.ft.com/content/456d0726-e3c4-4c51-8bb9-cc80c0a58112

54 IOSH (2023) Psychosocial hazards (Including stress), Occupational Health Toolkit. IOSH. Available from: https://iosh.com/health-and-safety-professionals/improve-your-knowledge/occupational-health-toolkit/psychosocial-hazards-including-stress/

55 McKinsey Health Institute (2022) Addressing employee burnout: Are you solving the right problem? Available from: https://www.mckinsey.com/mhi/our-insights/addressing-employee-burnout-are-you-solving-the-right-problem

56 World Health Organization (2019) 'Burn-out an "occupational phenomenon": international classification of diseases'. Available from: https://www.who.int/news/item/28-05-2019-burn-out-an-occupational-phenomenon-international-classification-of-diseases

57 Jack, A. (2022) Workplace wellbeing: how to make it better — and what makes it worse. Financial Times. Available from: https://www.ft.com/content/c8c3ea99-8832-42b1-8069-5d19397c753d

58 Natalia Kanem, Christopher J L Murray, Richard Horton (2022) .The Lancet Commission on 21st-Century Global Health Threats. Available from: https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(22)02576-4/fulltext

59 WHO (2021) Obesity and overweight. https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight

60 Burn-Murdoch, J. (2022) Britons now have the worst access to healthcare in Europe, and it shows. Financial Times. Available from: https://www.ft.com/content/de8fc348-0025-4821-9ec5-d50b4bbacc8d

61 Arup (2020) Future of Healthcare Ecosystems. Available from: https://www.arup.com/perspectives/publications/research/section/future-of-healthcare-ecosystems

62 OECD (2019). OECD Reviews of Public Health: Japan: A Healthier Tomorrow, OECD Reviews of Public Health. Available from: https://doi.org/10.1787/9789264311602-en.

63 World Economic Forum (2021). What is the likelihood of another global pandemic like COVID-19? Available from: https://www.weforum.org/agenda/2021/09/pandemics-epidemics-disease-COVID-likelyhood/

64 Stephens, P. (2022): How companies can ensure a COVID-free workplace. Financial Times. Available from: https://www.ft.com/content/bdebb5ee-fb91-49d3-a36b-f35d490874cf

65 US Bureau Of Labor Statistics (2022) 7.8 million workers had an illness-related work absence in January 2022. Available from: https://www.bls.gov/opub/ted/2022/7-8-million-workers-had-an-illness-related-work-absence-in-january-2022.htm#:~:text=About%207.8%20million%20workers%20missed,3.7%20million%20in%20January%202021.

66 Brookings (2022) Is 'long COVID' worsening the labor shortage? Available from: https://www.brookings.edu/articles/is-long-covid-worsening-the-labor-shortage/

67 Roser, M. (2021) Data Review: How many people die from air pollution? Our World in Data. Available from: https://ourworldindata.org/data-review-air-pollution-deaths

68 Roser, M. (2021) Data Review: How many people die from air pollution? Our World in Data. Available from: https://ourworldindata.org/data-review-air-pollution-deaths

69 Committee on the Medical Effects of Air Pollutants (COMEAP) 2022 Annual Report. Available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1162711/COMEAP-annual-report-2022.pdf

70 World Economic Forum (2023), Jobs of Tomorrow: Large Language Models and Jobs. Available from: https://www.weforum.org/publications/jobs-of-tomorrow-large-language-models-and-jobs/

71 ABB & The Economist (2018) The Automation Readiness Index (ARI): Who Is Ready for the Coming Wave of Innovation? Available from: https://new.abb.com/docs/librariesprovider138/events/abb_ari_report.pdf

72 Microsoft (2023) Work Trend Index Annual Report Will AI Fix Work? Available from: https://www.microsoft.com/en-us/worklab/work-trend-index/will-ai-fix-work

73 Ada Lovelace Institute and The Alan Turing Institute (2023) How do people feel about AI? A nationally representative survey of public attitudes to artificial intelligence in Britain. Available from: https://adalovelaceinstitute.org/ report/public-attitudes-ai .

74 HM Govt (2022) Connected & Automated Mobility 2025: Realising the benefits of self-driving vehicles in the UK. Available from: https://assets.publishing.service.gov.uk/media/62ff438c8fa8f504c-dec92df/cam-2025-realising-benefits-self-driving-vehicles.pdf

75 LR Foundation (2022) World Risk Poll 2021: A Digital World Perceptions of risk from AI and misuse of personal data. Available from: https://wrp.lrfoundation.org.uk/LRF_2021_report_a-digtial-world-ai-and-personal-data_online_version.pdf

76 WEF (2022) Global Cybersecurity Outlook 2022. World Economic Forum. Available from: https://www.weforum.org/publications/global-cybersecurity-outlook-2022/

77 Manning, C. G. (2023). Technology Readiness Levels. NASA. Available from: https://www.nasa.gov/directorates/somd/space-communications-navigation-program/technology-readiness-levels/

78 OIZOM. (2023). Air Quality Monitoring for Environment, Health and Safety (EHS). Oizom. Available from: https://oizom.com/usecase/ehs-air-quality-monitoring-for-industries/

79 European Agency for Safety and Health at Work. (2022). Smart digital monitoring systems for occupational safety and health: Uses and challenges : report. Publications Office. Available from: https://data.europa.eu/doi/10.2802/25469

80 European Agency for Safety and Health at Work. (2023). Smart automation to reduce physically demanding work in manufacturing of steel products. Available from: https://osha.europa.eu/en/publications/smart-automation-reduce-physically-demanding-work-manufacturing-steel-products-id12

81 Moore, Dr. P. V. (2021). AI, Robotics and digitalization: New potentialities and new risks [Interview]. https://phoebevmoore.wordpress.com/2021/05/13/ai-robotics-and-digitalization-new-potentialities-and-new-risks/

82 Canadian Centre for Occupational Health and Safety. (2022). Robots and Cobots Factsheet. OSH Answers Fact Sheets. Available from: https://www.ccohs.ca/oshanswers/safety_haz/robots_cobots.html

83 Amazon (2023) Amazon is launching ultra-fast drone deliveries in the UK, Italy, and a third location in the U.S. Available from: https://www.aboutamazon.com/news/operations/amazon-prime-air-drone-delivery-updates

84 The Health and Safety Executive (2023) 'Drones used to spray pesticides in great britain | hse media centre', HSE, 5 June. Available from: https://press.hse.gov.uk/2023/06/05/drones-used-to-spray-pesticides-in-great-britain/ (Accessed: 13 December 2023).

85 Sequeira, J. S. (2023). Unmanned Aerial Vehicles: Implications for Occupational Safety and Health [Discussion Paper]. European Agency for Safety and Health at Work. Available from: https://osha.europa.eu/sites/default/files/Unnamed-aerial-vehicles-and-OSH_en.pdf

86 European Agency for Safety and Health at Work. (2019). 3D printing and additive manufacturing—The implications for OSH. OSH WIKI. Available from: https://oshwiki.osha.europa.eu/en/themes/3d-printing-and-additive-manufacturing-implications-osh

87 Kumar, A. (2020). Jet suit technology could massively cut rescue times. SHP – Health and Safety News, Legislation, PPE, CPD and Resources. https://www.shponline.co.uk/technology-2/jet-suit-technology-could-massively-cut-rescue-times/

88 Debusmann Jr, B. (2021). Is the use of jetpacks finally about to take off? BBC News. Available from: https://www.bbc.com/news/business-57652297

89 Yasa, O., Toshimitsu, Y., Michelis, M. Y., Jones, L. S., Filippi, M., Buchner, T., & Katzschmann, R. K. (2023). An overview of soft robotics. Annual Review of Control, Robotics, and Autonomous Systems, 6(1), 1–29. Available from: https://doi.org/10.1146/annurev-control-062322-100607

References

[90] Alsop, T. (2023). Virtual Reality. Statista. https://www.statista.com/topics/2532/virtual-reality-vr/

[91] Zhao, D., & Lucas, J. (2015). Virtual reality simulation for construction safety promotion. International Journal of Injury Control and Safety Promotion, 22(1), 57–67. Available from: https://doi.org/10.1080/17457300.2013.861853

[92] Souchet, A. D., Lourdeaux, D., Pagani, A., & Rebenitsch, L. (2023). A narrative review of immersive virtual reality's ergonomics and risks at the workplace: Cybersickness, visual fatigue, muscular fatigue, acute stress, and mental overload. Virtual Reality, 27(1), 19–50. Available from: https://doi.org/10.1007/s10055-022-00672-0

[93] Park, J.-S., Lee, D.-G., Jimenez, J. A., Lee, S.-J., & Kim, J.-W. (2023). Human-focused digital twin applications for occupational safety and health in workplaces: A brief survey and research directions. Applied Sciences, 13(7), 4598. Available from: https://doi.org/10.3390/app13074598

[94] Patel, V. et al. (2022) 'Trends in workplace wearable technologies and connected worker solutions for next generation occupational safety, health, and productivity', Advanced Intelligent Systems, 4(1), p. 2100099. Available from: https://doi.org/10.1002/aisy.202100099.

[95] Aksüt, G., Eren, T., & Alakaş, H. M. (2023). Using wearable technological devices to improve workplace health and safety: An assessment on a sector base with multi-criteria decision-making methods. Ain Shams Engineering Journal, 102423. https://doi.org/10.1016/j.asej.2023.102423

[96] European Agency for Safety and Health at Work (2022) Monitoring Technology: The 21st Century's pursuit of wellbeing? OSH-Wiki. Available from: https://oshwiki.osha.europa.eu/en/themes/monitoring-technology-21st-centurys-pursuit-wellbeing

[97] Teale, C. (2022) Many Tech Employees Say They'd Quit Rather Than Be Monitored During Work. Morning Consult. Available from: https://pro.morningconsult.com/trend-setters/tech-workers-survey-surveillance

[98] Sadowski, J. (2014). Exoskeletons in a disabilities context: The need for social and ethical research. Journal of Responsible Innovation, 1(2), 214–219. Available from: https://doi.org/10.1080/23299460.2014.918727

[99] European Agency for Safety and Health at Work. (2019). The impact of using exoskeletons on occupational safety and health. Available from: https://osha.europa.eu/sites/default/files/2021-11/Exoskeletons%26OSH.pdf

[100] National Safety Council (2020) Work to Zero Safety Technology 2020: Mapping Technology Solutions for Reducing Serious Injuries and Fatalities in the Workplace. Available from: https://www.nsc.org/faforms/work-to-zero-safety-technology-2020

[101] Pillai, A. (2021). The benefits of augmented reality for workplace safety. World Economic Forum. Available from: https://www.weforum.org/agenda/2021/11/augmented-reality-benefits-for-workplace-safety/

[102] Adamska, I. (2023). Navigating the risks: The hidden dangers of augmented reality. Available from: https://nsflow.com/blog/navigating-the-risks-the-hidden-dangers-of-augmented-reality

[103] Wang, Y. (2022). A review of microchip implant in human. In G. Ali, M. C. Birkök, & I. A. Khan (Eds.), Proceedings of the 2022 6th International Seminar on Education, Management and Social Sciences (ISEMSS 2022) (Vol. 687, pp. 92–97). Atlantis Press SARL. Available from: https://doi.org/10.2991/978-2-494069-31-2_12

[104] Firfiray, S. (2018). Microchip implants are threatening workers' rights. University of Warwick Knowledge Centre. Available from: https://warwick.ac.uk/newsandevents/knowledgecentre/business/work/microchipping/

[105] Brocal, F. (2023). Brain-computer interfaces in safety and security fields: Risks and applications. Safety Science, 160, 106051. Available from: https://doi.org/10.1016/j.ssci.2022.106051

[106] European Agency for Safety and Health at Work. (2022). Remote work, remote workplaces and implications for OSH. OSH WIKI. Available from: https://oshwiki.osha.europa.eu/en/themes/remote-work-remote-workplaces-and-implications-osh

[107] McKinsey (2021). IoT value set to accelerate through 2030: where and how to capture it.

[108] RiskTalk. (2023). RiskTalk. Available from: https://risktalk.com.au/

[109] Baxt, J. (2021). Making voice assistants accessible for older patients. UC San Diego. Available from: https://today.ucsd.edu/story/making-voice-assistants-accessible-for-older-patients

[110] Srikanth, B. (2023). The next generation of AI voice assistants. Medical Economics. Available from: https://www.medicaleconomics.com/view/the-next-generation-of-ai-voice-assistants

[111] Arup (2021) Future of Offices in a Post-Pandemic World. Available from: https://foresight.arup.com/publications/future-of-offices/

[112] Fisher, E., Flynn, M. A., Pratap, P., & Vietas, J. A. (2023). Occupational safety and health equity impacts of artificial intelligence: A scoping review. International Journal of Environmental Research and Public Health, 20(13), 6221. Available from: https://doi.org/10.3390/ijerph20136221

[113] Moore, P. V. (2019). Osh and the future of work: Benefits and risks of artificial intelligence tools in workplaces. In V. G. Duffy (Ed.), Digital Human Modeling and Applications in Health, Safety, Ergonomics and Risk Management. Human Body and Motion (Vol. 11581, pp. 292–315). Springer International Publishing. https://doi.org/10.1007/978-3-030-22216-1_22

[114] Tamir, M. (2022). Computer vision as a solution to safety challenges in industrial facilities -. Occupational Health & Safety. Available from: https://ohsonline.com/articles/2022/05/05/computer-vision.aspx

[115] Guo, B., Zou, Y., & Chen, L. (2018). A review of the applications of computer vision to construction health and safety. The 18th International Conference on Construction Applications of Virtual Reality, Auckland, New Zealand. Available from: https://www.researchgate.net/publication/329181986_A_review_of_the_applications_of_computer_vision_to_construction_health_and_safety

[116] Oxtoby, K. (2023). Transforming Health and Safety with AI. IOSH Magazine, January/February 2023. Available from: https://www.ioshmagazine.com/2022/12/19/how-artificial-intelligence-transforming-health-and-safety

[117] Stretton, P. (2022). Quantum safety: The new approach to risk management for the complex workplace (1st ed.). Productivity Press. https://doi.org/10.4324/9781003175742

[118] Kapoor, N. R., Kumar, A., Kumar, A., Kumar, A., Arora, H. C., & Jahangir, H. (2023). Quantum computing for indoor environmental quality: A leapfrogging technology. In A. K. Tyagi (Ed.), Advances in Systems Analysis, Software Engineering, and High Performance Computing (pp. 191–216). IGI Global. https://doi.org/10.4018/978-1-6684-6697-1.ch011

[119] LinkedIn Economic Graph (2020) Global Green Skills Report 2022. Available from: https://economicgraph.linkedin.com/research/global-green-skills-report

[120] Karp, P. (2021). Scott Morrison says sweeping deregulation will save businesses $430m a year on red tape. The Guardian. Available from: https://www.theguardian.com/australia-news/2021/apr/20/scott-morrison-says-sweeping-deregulation-will-save-businesses-430m-a-year-on-red-tape

[121] Cohen, S (2019) The Dangers of Deregulation. State of the Planet, Columbia University. Available from: https://news.climate.columbia.edu/2019/12/02/the-dangers-of-deregulation/

[122] Silverberg, D. (2023) Could AI swamp social media with fake accounts. BBC. Available from: https://www.bbc.com/news/business-64464140

[123] Department for Education (2022) Understanding current and future skills needs: Policy report. Skills and Productivity Board. Available from: https://www.gov.uk/government/publications/understanding-current-and-future-skills-needs

[124] Goulart, V. G., Liboni, L. B., & Cezarino, L. O. (2022). Balancing skills in the digital transformation era: The future of jobs and the role of higher education. Industry and Higher Education, 36(2), 118–127. Available from: https://doi.org/10.1177/09504222211029796

[125] Asian Development Bank (2022) Digital Jobs and Digital Skills: A shifting landscape in Asia and the Pacific. Asian Development Bank. Available at: https://dx.doi.org/10.22617/SPR220348

[126] ILO (2019) Global Commission for the Future of Work. Available from: https://www.ilo.org/global/topics/future-of-work/WCMS_569528/lang--en/index.htm

[127] Pearson (2019). The Global Learner Survey. Available from: https://www.pearson.com/content/dam/global-store/global/resources/Pearson_Global_Learner_Survey_2019.pdf

[128] Diaz-Infante, N., Lazar, M., Ram, S. & Ray, A. (2022). Demand for online education is growing. Are providers ready? McKinsey & Company. Available from: https://www.mckinsey.com/industries/education/our-insights/demand-for-online-education-is-growing-are-providers-ready

[129] Gilson, A., Safranek, C. W., Huang, T., Scrates, V., Chi, L., Taylor, R. A., Chartash, D.(2023) How Does ChatGPT Perform on the United States Medical Licensing Examination? The Implications of Large Language Models for Medical Education and Knowledge Assessment. Available from: https://doi.org/10.2196/45312

[130] Statista (2023) Amount of money companies in the United States saved by using ChatGPT as of February 2023. Available from: https://www.statista.com/statistics/1379027/chatgpt-use-us-companies-money-saved/

Further information

About IOSH

We are the Institution of Occupational Safety and Health (IOSH), the Chartered body for health and safety professionals. Founded in 1945, we are a charity with a simple vision – a safe and healthy world of work for everyone. With more than 50,000 members in over 130 countries, we're the world's largest professional health and safety organisation.

Our training and consultancy solutions help businesses solve real health and safety problems in the workplace using practical and effective tools, processes and knowledge.

Working with global bodies such as the UN and the Commonwealth, we provide expert analysis on safety and health and raise awareness of OSH issues at a global level.

About Arup

Arup is the creative force at the heart of many of the world's most prominent projects in the built environment and across industry. Working in more than 140 countries, the firm's designers, engineers, architects, planners, consultants and technical specialists work with our clients on innovative projects of the highest quality and impact.

Arup University is the firm's global excellence programme of directed learning, expert skills development, collaborative research, foresight, and knowledge and information management. Arup's Foresight team analyse the major trends shaping the future of the built environment.

Credits

Authors

Rosamund Vose
Senior Foresight Consultant, Arup

Claudia Nielsen
Foresight Analyst, Arup

Contributors

Cameron Jacobs
Associate Principle Health and Safety, Australasia, Arup

Dr Christopher Davis
Thought Leadership Manager, IOSH

Gill Kernick
Director, Arup University Leadership, Arup

James Pomeroy CMIOSH
Global Health and Safety Leader, Arup

Marcus Morrell
UKIMEA Foresight Lead, Arup

Ruth Edwards
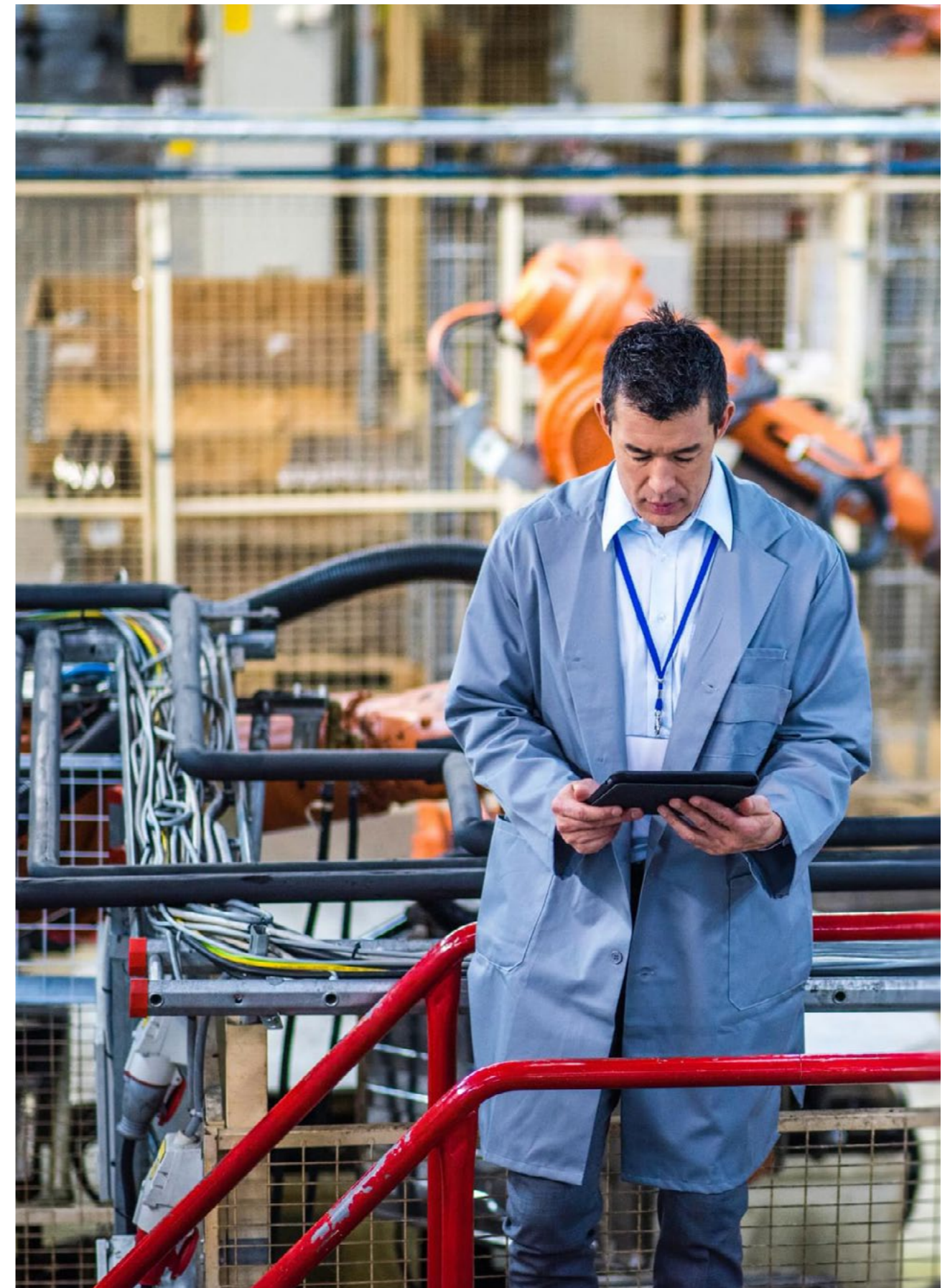Head of Brand and Marketing, IOSH

Ruth Wilkinson CMIOSH
Head of Policy and Public Affairs, IOSH

Sophie Egler
Senior Designer, Arup

Yolande Knock
UKIMEA Wellbeing Leader, Arup

Contact

James Pomeroy
Global Health and Safety Leader, Arup
e: James.Pomeroy@arup.com

IOSH enquiries
e: media@iosh.com