THE CIRCULAR ECONOMY AND SAFETY AND HEALTH: THE ROLE OF DIGITALISATION IN THE CIRCULAR ECONOMY AND IMPLICATIONS FOR OCCUPATIONAL SAFETY AND HEALTH UNTIL 2040

The role of digitalisation in the circular economy and implications for occupational safety and health until 2040

A circular economy (CE) aims to renew existing production and consumption systems. To do so, the functionality of materials, processes and products must be optimised and maintained for as long as possible to minimise waste and residues. In short, creating a CE requires fundamental changes throughout the value chain (ECERA, 2020). Here, digital technologies — a crucial driving force behind several industries — play a key role, both directly and indirectly. On the one hand, they make it possible **to create and manage the information required** for complex circular supply chains and business models ('the circular economy's implementation is primarily a problem of information' (WI, 2017)). On the other hand, they are the basis for **products-as-a-service business models**, a crucial part of the dematerialisation process in which customers purchase a desired result (e.g. being transported to their destination) rather than the equipment that delivers that result (e.g. a car). Finally, increasing consumer awareness to enable **better consumption choices and lifestyle decisions** is greatly facilitated by digital technologies **(**EPC, 2020). Overall, digitally enabled transparency, efficiency and convenience are necessary to increase resource productivity and value retention to the point where a CE really begins (EIT Climate-KIC, 2018).

The European Union is currently engaged in realising its **long-term sustainability vision**. It does so by pursuing two major transformation processes: achieving climate neutrality (by 2050) ([1]) and implementing a CE ([2]). At the same time, it is also moving forward with a closely connected policy programme, creating 'a Europe fit for the digital age' (European Commission, 2021), an effort specifically intended to '[s]upport the circular economy', among others by launching a 'circular electronics initiative' and improving communication on the origin, composition (including hazardous and rare materials), end-of-life handling and recycling of products (European Commission, 2020c). Furthermore, the New Industrial Strategy for Europe, released in March 2020, stressed the role that European industry must play in this process (European Commission, 2020d). Currently, however, only a small number of companies are actively realising smart circular strategies and linking their long-term digital and circular plans, and they lack guidance on how to best leverage digital technologies to maximise resource efficiency (Kristoffersen et al., 2020). The pace of this process therefore remains difficult to predict.

In its new foresight cycle, the European Agency for Safety and Health at Work (EU-OSHA) uses scenarios to explore the effects of the implementation of a CE on occupational safety and health (OSH). These scenarios show four different pathways to the future and demonstrate how broad the range of feasible developments is. They are not intended as a type of prediction on what the future might bring; rather, their primary role is to encourage dialogue and reflection about future possibilities. Building on the macro scenario report on the CE and its effects on OSH (EU-OSHA, 2021), this policy brief provides a short look at the scenarios' implications in relation to digitalisation and OSH. A detailed discussion on the OSH outcomes of digitalisation can also be found in a previous report by EU-OSHA (2018) ([3]).

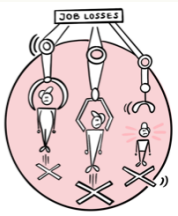
([1]) See the Green Deal Action Plan (European Commission, 2019).
([2]) See the Circular Economy Action Plan (European Commission, 2020a,b) and the Circular Economy Package (European Commission, 2015).
([3]) Specific aspects of digital technologies were also covered by later reports (big data in EU-OSHA (2019a) and artificial intelligence in EU-OSHA (2019b)).

Potential implications for OSH resulting from digitalisation under each scenario

Four different scenarios on the CE were developed for this project, which are all based on the same set of key factors. Different realistic future values were assumed for each key factor and logically grouped together using software to create consistent scenarios. The result is a set of scenarios that represents a range of different possible outcomes for near-future actions and events. Hence, the levels of digitalisation assumed for 2040 differ between scenarios, leading to different implications.

The figure below shows the four EU-OSHA scenarios, which look at the future of the CE over a time horizon to 2040. A short description lists each scenario's characteristics, followed by the most important implications for OSH resulting from digitalisation in the CE.

Figure 1: An overview of the four scenarios and the potential OSH implications resulting from digitalisation.

			
The Roaring 40s — fully circular and inclusive	**Carbon neutrality — of a hazardous kind**	**Staying afloat — amid economic and environmental crises**	**Regional circularities — with European divides**
In 2040, the products that sell best are those that are cradle to cradle and 'net-positive' in terms of social and environmental sustainability. Re-use takes precedent over replacement, environmental and safety considerations dominate decision-making.	The year 2040 marks the achievement of carbon neutrality in Europe. But, with environmental outcomes having been prioritised above all else, this has often come at the expense of job quality and working conditions, with workers widely dispersed and frequently alone.	In 2040, the biggest concern for many is just having a job — not what the job entails. Most people are focused on keeping things afloat, so that there's little consideration for much else — not the environment, social rights or job quality.	In 2040, everyone knows that contracted employees are well looked after, but those in non-standard employment are not. Neither is the environment, with circularity being mostly regional.
Potential implications for OSH in 2040 resulting from digitalisation in the CE			
• Physical hazards are reduced across all industries, but psychosocial risks increase (e.g. from lone-working, performance pressure) due to the increased digitalisation and automation in the CE • Databases for all materials and products reduce hazards in repair, reuse and recycling	• Decentralised deployment of workers makes OSH supervision and monitoring much more difficult • Mobile work means that workers are more likely to work in unsafe environments • Rapid introduction of new materials means that documentation is insufficient, resulting in worker exposure to unknown hazards	• Workers lack the skills necessary to navigate or find employment, increasing the likelihood of employment with low OSH standards • Preponderance of platform work means that responsibility for OSH is unclear ([4]), mental health risks increase, and there is insufficient protection for freelance and contingent workers	• Workers displaced by new technologies are pushed into the informal economy with very low OSH standards • Regionally, digitalisation is very uneven, making the exchange of OSH-relevant information difficult

([4]) Please note that in this scenario, the current EU initiative on platform work (a legislative proposal scheduled for publishing at the end of 2021 which aims to improve the working conditions of platform workers) and the proposed Digital Service Act (DSA) are assumed to have only a very limited impact, and that the workers' collective bargaining potential, and enforceable employer responsibility, remain low.

European circular economies in 2040: opportunities and challenges for OSH from digitalisation

Some of the specific implications identified for digitalisation in the CE and OSH in 2040 cut across all four scenarios and are described in more detail below.

- **Improved information provision and transfer**

With more data generated than ever before (information being the 'fuel for a sustainable economy'(EPC, 2020)), improved exchange and provision of information is a cornerstone of the CE ([5]): now, companies must know the suppliers of their suppliers and the customers of their customers (ECERA, 2020). Precise and timely data are necessary for the safe processing of concentrated waste streams, safe sharing and recycling of products, increasing product longevity or improving material efficiency/replacing rare inputs with renewables. Shortened supply chains and localised/decentralised production also depend on digitalisation.

Improving connectivity and information sharing, as required in a CE, offers significant OSH benefits, e.g. by using blockchain to securely trace products and materials across their entire lifecycle and in all use environments. The principle of 'repair, reuse and recycle' is only able to be realised safely if workers have access to all of the information they need at all times, and in particular if automated systems exist that alert workers to potential hazards.

- **Empowering citizens and consumers**

To a large extent, any successful transition to a CE will depend on the contributions and collaboration of consumers and citizens, on the way people live and consume materials and products. The better people are informed, the more they are aware of the impact their choices have, and the more rapid this process will be. Moreover, encouraging people to collect data and providing them with tools to make their wishes and concerns heard can improve monitoring of product lifecycles and other variables (EPC, 2020).

Empowering consumers and workers would provide a boost to OSH, in particular regarding early warnings of new hazards connected with longer lifecycle products. People would also be more likely to dispose of end-of-life products safely, reducing OSH hazards in waste processing and recycling. In addition, this might also lead to a greater willingness to report OSH violations in all sectors and improve overall OSH standards.

- **Increased flexibility in the organisation of work**

In the digital CE, the flexibility of working arrangements (regarding working hours and workplaces) is likely to progressively increase, remote work will blur the boundaries between jobs and leisure time, and new organisational tools will further flatten hierarchies. Accordingly, the autonomy of workers grows, a development accelerated by platform/gig work, which creates a working environment in which workers increasingly must rely on themselves.

As flexibility increases, the OSH landscape becomes more fragmented. Locational mobility reduces commuting, but it may lead to people working in unsafe places or with tools that do not conform with OSH regulations. In flattened hierarchies, responsibility for safety arrangements is less clear. In addition, gig work increases the likelihood of workers taking on jobs in which they are not aware of OSH best practices and guidelines. In addition, they may experience higher levels of psychosocial stress as a result of lone-working and greater performance pressure.

- **Cybersecurity, monitoring and surveillance**

To enable a shift to a CE, a high level of digitalisation is required. However, as digital technologies permeate workplaces, the gravity of cybersecurity risks will increase. On the other hand, a proliferation of sensors and artificial intelligence (AI) software makes smart monitoring of worker activities possible. Remote or automated (AI) surveillance and management of work processes removes workers from dangerous or dirty workplaces (e.g. particularly in the transport and waste sectors).

([5]) '[T]he circular economy's implementation is primarily a problem of information' (see WI (2017)).

Overreliance on AI technology may lead to deskilling, particularly in emergency situations, as there is less task variety (e.g. in highly automated areas such as waste processing). If workers become more sedentary and lack physical activities, long-term health risks increase. Improved worker monitoring would reduce OSH risks, especially accidents due to exhaustion or a lack of attention, but they also increase mental health risks (from surveillance stress).

- **Reskilling**

The Just Transition mechanism (see EU-DGIP (2020)) will provide financial support to regions to help them better manage the transition to a more climate-neutral economy. This includes large-scale reskilling of the working population to close the skills gap between lost and newly created jobs and prepare workers for new tasks in the digital economy. However, large-scale displacement of workers results in institutional knowledge being lost.

Continuous reskilling is crucial to ensure that workers can better navigate the increased complexity of more digitalised environments inherent to a CE, reducing the likelihood of OSH events. In addition, insufficiently trained workers are more likely to experience workplace injuries and, on average, have worse OSH outcomes.

Conclusions

Digital technologies will play a key role in Europe's transition to a more circular economy. Without them, a modern economy cannot become truly sustainable. A high standard of OSH in a CE will be achieved only if this process is well managed: reskilling the workforce and building a universal information ecosystem (a safe data space that minimises manipulation risks (ECERA, 2020)) will be crucial, as will a monitoring system to prevent illegal imports of products that may be potentially hazardous during recycling. OSH will have to meet the challenge of keeping pace with rapid change and recognise potential shortfalls early to meet the challenges of both increasing digitalisation and the transition to a CE.

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This policy brief was commissioned by the European Agency for Safety and Health at Work (EU-OSHA). Its contents, including any opinions and/or conclusions expressed, are those of the authors alone and do not necessarily reflect the views of EU-OSHA.