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Institut National de Recherche et de Sécurité

A circular economy in 2040

What impact on occupational safety and health? What prevention?

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Project group

Benoît Courrier (INRS), Fanny Debil (Anses), Cécile Desaunay (Futuribles), Olivier Gaudeau (Indra), Frédéric Goetz (Cnam et Veolia), Catherine Gomy (Envie), Laurent Grégoire (CentraleSupÉlec), Michel Héry (INRS), Lucie Lambolez (Veolia), Louis Laurent (INRS), Pierrick Le Guirrinec (Cnam et CFDT), Rémy Le Moigne (Gate C), Marc Malenfer (INRS), Catherine Montagnon (INRS), Anne-Claire Richardot (CCI France), Dominique Schaeffner (Cramif), Luc Thomasset (Carsat Rhône-Alpes), Anne-Sophie Valladeau (INRS)

INRS group for the OSH expertise

Nicolas Bertrand, Séverine Brunet, Pierre Canetto, Laurent Claudon, Christine David, Fabien Gérardin, Nathalie Guillemy, Patrick Laine, Jacques Leïchlé, Stéphane Miraval, Bernard Siano, Éric Silvente

ABOUT THE CIRCULAR ECONOMY

The linear economic model which consists of extracting raw material, producing goods, consuming them then disposing of them, is being challenged increasingly. In fact, it appears to be the main cause of global warming, environmental pollution and difficulties in the supply of resources. Faced with these environmental concerns, businesses, public authorities and NGOs are on the hunt for a sustainable economic model.

In this context, the concept of a circular economy, developed in the early 2000's, appears to be a relevant alternative. It is based on pillars that question operating modes that are well-rooted in today's economy: sustainable supply, eco-design, industrial and territorial ecology, functional economy, sustainable consumption, extended use duration and recycling.

Players are already taking part in this transformation, often in a concerted manner: local authorities, private businesses, players in the social and solidarity economy are turning a critical eye on their development model and are innovating to modify it.

With regard to occupational safety and health, the challenge is key. A circular economy offers above all, the chance for better integration of prevention ahead of the creation of new production modes, new services and new products. But it can also result in negative effects if concern for the protection of workers' health is not taken into account, swept under environmental interests. The potential risks are high when it comes to revising production processes or using other raw materials (particularly from recycling), rolling out new technology, developing repair and reuse activities, transforming waste for it to be reused, etc.

INRS partnered up to explore the possible futures of a circular economy for 2040 and to identify the occupational safety and health challenges. The goal of this prospective exercise is not to attempt to predict the future of this economic model, but to explore the mechanisms in order to identify the impact on working conditions that its development implies. The product of this reflection is a series of questions (and not recommendations) on topics that call for economic players to be vigilant so as to conciliate environmental preservation and occupational risk prevention in the new production and consumption modes introduced by the circular economy.

Methodology and scenarios

The goal of a prospective exercise is not to describe the future but possible futures. The method chosen for this exercise is the "contrasting scenarios" method. This method is based on a system of variables, i.e. a set of factors identified as having an influence on the future of the topic in question. Below is a list of those variables for the circular economy. For each of these variables, hypotheses of development in the future are formulated. The combination of these hypotheses leads to the drafting of scenarios. Lastly, specific outcomes in terms of occupational risks are associated with the scenarios.

The 16 variables:

1. Global resource demand
2. Quality of environments
3. Energy mix
4. Management of mineral resources
5. Biomass
6. Digital economy (information and communication technologies)
7. Logistics and transport
8. Actions by public authorities
9. Business fabric
10. Levers and mechanisms changing behaviours
11. Behaviour and consumption (environmental awareness, relationship with ownership)
12. Reuse, remanufacturing
13. Product-service system
14. Sharing economy
15. Reorganisation of production
16. Management of waste and recycling

The scenarios

1. Circular economy driven by globalisation

The circular economy is developing on a world scale, driven by private players. This economic model is made possible by major technological innovations disassociating economic growth and consumption of resources, especially fossil energy. This transition occurs against an innovation race among major operators. Its virtuous aspects respond to customers' expectations. Public authorities support the transformations.

2. European political voluntarism

The circular economy is developing heavily in northern and western Europe. The rest of the world does not follow immediately (little opportunity, lack of financial and technical resources, etc.). Europe is motivated by global geopolitical instability, climate change, concerns about imported resource supply and short-term crises. It runs policy at European, national and regional levels. In 2040, the situation is more favourable.

3. Linear globalisation

The priority of dominant players remains the pursuit of economic and consumption growth, particularly in Asia and Africa. This produces shortages, aggravation of social, economic and political tensions, but also heightened climate change and deterioration of eco-systems. Public and private players promote technological development actions to optimise consumption of resources and limit environmental impacts.

4. Transition managed locally

Despite the impacts of climate change and pressure from citizens, States are reluctant to undertake coordinated actions. While certain businesses perceive an opportunity for growth in the circular economy, some citizens have chosen "frugal self-organisation". Local transitional ecosystems multiply: local production, reuse and sobriety are priorities. But often, sobriety is imposed rather than chosen.

A new way to design products: an opportunity to incorporate prevention

The very principle of circular economy implies not only a new economic model but also transformations in operating modes at all stages in the life of a product. All of the functions at each of these stages are affected. Therefore, to engage in a circular economy, businesses shall have to profoundly reshape many jobs which will possibly have repercussions on occupational risks. Researchers have modelled different practices presenting design principles increasingly in favour of a circular economy.

- **Re-pair** reduces the negative impacts of a product that has already been designed, and focuses on its repair or recycling;
- **Re-fine** fine-tunes the processes existing over the entire life cycle of a product so that it uses less raw material and energy both during its elaboration and manufacture;
- **Re-design** is a more ambitious approach which consists in redefining the functions of a product as from when it is designed. It is about ensuring it can be adapted and maintained in the future;
- **Re-think** is a long-term approach, still in its early stages, but more audacious and innovative since it pertains to an entire production system and not a single product/service.

These new conception modes require collaboration among numerous functions in the business that do not have the same culture and are not accustomed to working together, and have to make decisions between economic and ecological performance. Technology such as virtual reality could be used to design products and simulate work situations. It offers the possibility of integrating prevention very early on ahead of processes, provided that field operators are involved in the approach.

Very different jobs can be affected, with major consequences on occupational safety and health. For example:

- The tools used by marketing and "market" studies will be modified and will have to be rethought; different factors will have to be integrated such as resources, waste, consumers' and society's demands. Provisions must be made, at each stage in the life cycle, data exchanges with the businesses involved in the same loop; this revolution could have major consequences on work conditions and occupational risks (radical change in the purpose of jobs and risk of unsettling workers);
- Sorting, verification, selection operations, which will increase, probably will not all be able to be automated; new technology will have to be used to lighten operators' workload.

Maintenance:
a job to be renovated and re-invented

Extending the length of product use is one of the pillars of the circular economy. Its implementation may be reflected by very different work organisations with major consequences on operators' working conditions.

With an economic model based on function or use, suppliers propose a service rather than a good. The equipment made available to the client therefore must be more resistant, but also mode suitable to more frequent maintenance and repair operations. These specific operations must be thought out as from the design stage so that they can be performed under the right conditions: equipment handling, well-designed workshops for repairs, general use protocols that will prevent maintenance from being performed under unsuitable conditions (in the field for example, without having the necessary tools available), etc. In this context, it would be valuable for suppliers to take an interest in maintenance and repair which is a major factor of profitability for their business.

The model based on the selling (and reselling) of repairable goods can generate more remote and more dispersed dependency relationships. Networks comprising micro-enterprises, freelancers, or SSEs perform services out in the field. With such dispersion, some might not pay as much attention to the constraints of others. Particular vigilance must therefore be exercised when building economic loops to prevent these types of enterprises from taking on high-risk activities without the means to handle them under the right conditions. The dialogue between equipment producers and those in charge of repairs, recovery, dismantling, etc. requires organisational efforts in order for it to be effective in both directions. On the one hand, to ensure that players spread across the field have all the information they need to be able to operate under good conditions (information about product composition, manuals, availability of spare parts, etc.), and on the other hand, to be able to collect and take into account these players' feedback concerning the difficulties encountered during their interventions.

By developing player inter-dependency, the circular economy raises the issue of people's responsibility towards each other and circulation of information among them. The dialogue between players in the loop shall therefore have to be reinforced and matters concerning workers' health and safety cannot be evaded in these discussions which could give rise to the implementation of shared prevention actions.

Materials known when new; **to be reconsidered/re-evaluated** after several use cycles

Materials have special importance in a circular economy. It is in fact probable that a large range of new materials will have to be developed to better respond to requirements regarding longevity, reuse and recycling. If the physical properties of these materials are not maintained, workers could be exposed to mechanical risks during different deconstruction operations or assembly of goods.

Change in the composition of materials, which may become loaded with impurities during successive recycling must also be taken into account. Consideration must also be given to the fact that components can deteriorate when they are used under the effect of different factors (light, heat, natural aging of components) and give rise to compounds that were not included in the original formula. Successive reuse can possibly lead to non-negligible concentrations of these impurities during different operations of reuse, re-machining or recycling. In that regard, as in a linear economy pattern moreover, jobs such as those of maintenance and cleaning may be particularly concerned.

Implementation of a circular economy involves developments in techniques, from the design phase to the recycling phase. Production facilities must be able to handle a certain variability in raw material, emerging from recycling, which will not necessarily have all the qualities of primary raw material. Products could be withdrawn temporarily from the production loop. They could be stored and reused later in other production loops in which the risks of exposure are lesser, because of the nature of the process or because suitable techniques will have been developed. It will be necessary in all these cases to develop specific occupational risk prevention which takes into account the real characteristics of products.

For example, the use of micro-organisms to decontaminate soils, break down biowaste, or purify materials in between two use cycles can expose workers to bioaerosols. Specific provisions will have to be made to protect workers involved in these operations, pending acquisition of knowledge about any potential effects.

What are the occupational health and safety impacts in circular logistics?

Engaging in a circular economy implies having "reverse" logistics so as to recover products from the user or at pick-up locations to be dismantled, sorted, repaired, to recover certain parts, restore them, recycle them or downgrade them to waste (all or in part). This causes a certain number of occupational risks:

- unless the risks are passed on to the customer by encouraging them, either positively or negatively, to return the used product to a suitable collection centre, the first mile is a high-risk mile for the shipper; packaging, dismantling or dismounting operations can lead to physical risks (low back pain, musculoskeletal disorders), but also chemical, biological and mechanical risks;
- regardless of the how collection is organised, the history and transformations of the spare parts or products recovered will not always be known; the different risks already mentioned may be increased; traceability at each step, all interventions performed on products and the successive operators, are all parameters to be controlled; cleaning of the packaging used for returns can also be a major prevention challenge.

These new logistics needs give rise to the "physical internet", the name given to the new organisation of transport and logistics, characterised the circulation of physical objects in standardised "packages" routed through automated hubs (such as for data in the "digital internet").

This physical internet can present opportunities for improving health at work. Standardisation of packaging, automation of loading, offloading, and container flows in hubs will reduce risks related to handling, picking and carrying heavy loads. Similarly, the creation of these hubs, geographically well distributed, should enable all drivers to "return home every evening". The reduced distances should improve their quality of life. But players in the last stage ("the last mile") shall have to face potential risks related in particular to handling: loading/offloading, unbundling, checks and relations with the end-user.

Ensuring traceability so as to control risks

The circular economy must evidently respond to environmental constraints within the framework of regulations but it will also profoundly change the way of doing things (new interfaced and adaptive processes, relocation of abandoned activities, acceleration of data exchanges, traceability tools). We can therefore witness a major remodelling of production conditions. It is therefore logical to enquire about the respective weight of regulation (action by governments) and standardisation in the regulation of these activities: the degree of involvement of the State and of the European Union will have an impact on the way OSH is taken into account.

The development of standards has drawn the attention of government bodies in France and abroad and projects are underway concerning the circular economy. Will the tempo imposed on ISO concerning the development of standards be compatible with the reflection required upstream to ensure optimised prevention? This upstream reflection would be an opportunity for prevention of occupational risks.

The circular economy implies that sometimes one business's inputs may come from another business's outputs (certain parts of disassembled products, excess or waste). In order for effective occupational risk prevention to be put in place, organisation of the circular economy must enable perfect traceability of products and their history (nature of the object and its components, origin, uses, reuses, transformations, circuits, users, etc.), as well as a design facilitating disassembly, and the description of the means used (chemical, thermal, mechanical).

The sufficient and necessary information allowing a product at the end of its lifecycle to be processed and used by players in the industry downstream shall have to be embedded in the product itself (through an electronic chip or some other technology). Data flows and traceability are necessary to ensure prevention of risks related to the handling of composite and used products, and of products having undergone physical, biological or chemical processes to ensure their decontamination or transformation.

This traceability, well- designed and well- implemented, also becomes a tool for prevention of occupational risks: it enables prevention measures to be adapted to the nature and state of the product. It is also a means of protection against risks related to counterfeit or against non-compliant products that expose workers and customers to risks.

Notice to readers

Prospective exercises are not aimed at describing the future. Neither are they aimed at predicting the future which would be an extension of past patterns. They take into account trends and discontinuities to identify possible futures and assist with decision-making. The work presented in this document is the result of collective productions. It does not in any way prejudge the opinions and wishes of the participants that have contributed thereto and does not commit those participants' organisations or INRS.

Institut national de recherche et de sécurité
pour la prévention des accidents du travail et des maladies professionnelles
65, boulevard Richard-Lenoir 75011 Paris • Tél. 01 40 44 30 00 • info@inrs.fr

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