Occupational hazards in a post-pandemic world

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Warning

This article was written by prospectivists. Strategic foresight is not about making forecasts. Its goal is to imagine possible futures in order to identify drivers of expected changes to help decision-makers to adopt suitable measures. In addition, strategic foresight can also fuel public debate. The authors of this article operate in the field of occupational safety and health. They are not health crisis experts. At the request of the Travailler au futur (TAF) journal, they have chosen to present the main results of their recent work devoted to possible developments in work organisation[1] adapting it to a context of epidemic or post-epidemic crisis. To facilitate understanding, a scenario-based format has been adopted. As previously indicated, this article aims above all to spark public debate on the main topics addressed independently of the health crisis, since, by definition, none of what is written here will come to pass as such…

[1] Three studies: *Utilisation des robots d'assistance physique à l'horizon 2030 en France*, Travailler en bonne santé en 2040 et Plateformisation 2027. Available at http://www.inrs.fr/inrs/prospective-quel-travail-demain.html

A permanent health crisis atmosphere

At the start of this year 2029, prognoses abound: return of H1N1 or of SARS-CoV? A re-emergence in a form already seen or a mutation? Where? Emergence of a new virus? Or maybe a year with a bit of relief marked in addition by the discovery of a new drug? These questions are still important, but are no longer crucial. Since the year 2020, a lot of ground has been covered: screening, vaccines, prevention measures are part of everyday life.

For what has not changed is the high contagiousness of these viruses and their significant fatality rate. Confronted with several epidemic crises in its territory and disruptions in the supply of drugs, consumer goods, etc. from suppliers across the globe, France, like most developed countries, has become accustomed to living under a permanent state of health emergency. It has had to adapt the lives of its citizens and the functioning of its economy to the related contingencies and uncertainties.

Adaptation of production organisation

The most obvious decision was to reshore strategic activities essential for at least the minimal functioning of society. Evidently, health-related activities, whose share in the gross domestic product (GDP) increased heavily, were the first in line. A significant part of medical instruments, drugs, personal and collective protective equipment is now manufactured in France or in its neighbouring European countries. Cooperation agreements were also signed with neighbouring countries, in order to rationally develop complementary production tools. But apart from the field of health, each activity sector - industry, construction, agriculture, services, etc. - were required to organise and develop production and storage logistics enabling it to guarantee at least six months of minimal operation during a major health crisis.

To do so, one of the priorities was to shorten production circuits so that manufacturing could not be stopped due to a missing component. All producers must therefore guarantee a sufficient six-month stock of intermediary products or the existence of an alternative supplier in the country. Logistics value chains, internationalised since the massive offshoring which started in the 1970s, were revised to take these new considerations into account. In practical terms, productions are reshored, old logistics practices (just-in-time, zero stocks) are disputed where the production of goods deemed essential for the life of the country is concerned. Border controls are reinforced, circulation of goods and people (including workers) is more heavily monitored particularly because of greater health controls. Temporary travel restrictions have become common.

Consequences on employment and work

Between 1970 and 2020, offshoring of production to low-wage countries and the boom in automation (in industry but also in certain services) significantly lowered the share of intermediate medium-skilled jobs characterised by routine work involving cognitive and manual tasks, performed following an explicit set of rules. Many industrial production jobs fell under this category, but also service workers, such as counter clerks, who were gradually replaced by automatic vending machines and invited to redeploy to other jobs geared more to consultancy. The two categories seeing an increase in jobs were:

- those corresponding to skilled activities requiring non-routine cognitive skills (often the best paid),
- those characterised by non-routine unskilled manual tasks, often involving human interaction (often low-paid), for example jobs concerning services to individuals which developed quickly between 1990 and 2020.

Figure 1 presents a simplified diagram retracing the mechanisms that led to this automation contributing partly to this polarisation of the job market [2] between 1970 and 2020. This timeline shows the introduction, followed by the growing importance of information and communication technologies (ICTs) across all business functions, from design to marketing, then the interweaving of these industrial processes with the realm of consumption. With all functions fully connected, the company (industry or services) was supposed to respond within a very short timeframe to consumers' choices as diverse as they may be; adaptability and agility had become requirements. What was valid for manufacturing was also valid for distribution: the client had to able to receive their order (preferably at their home) within an increasingly short timeframe since that criterion had become a sales pitch.

To meet these requirements, the job market had become flexible. Flexibility was even more necessary with the raging competition, since all businesses (including foreign competitors) had the same tools.

[2] M. Héry – La polarisation des marchés du travail. *Futuribles*, 435, pp.117-120, March-April 2020.

Therefore, throughout the 1970-2020 period, there was a weakening of the protection offered by permanent contracts, for the benefit of fixed-term contracts, contracts running for the duration of projects and temporary contracts. Platforms for exchanges between providers and consumers (passenger cars with drivers such as Uber, home food delivery services such as Deliveroo, etc.) had given new life to self-employment, as a main activity or for supplementing income.

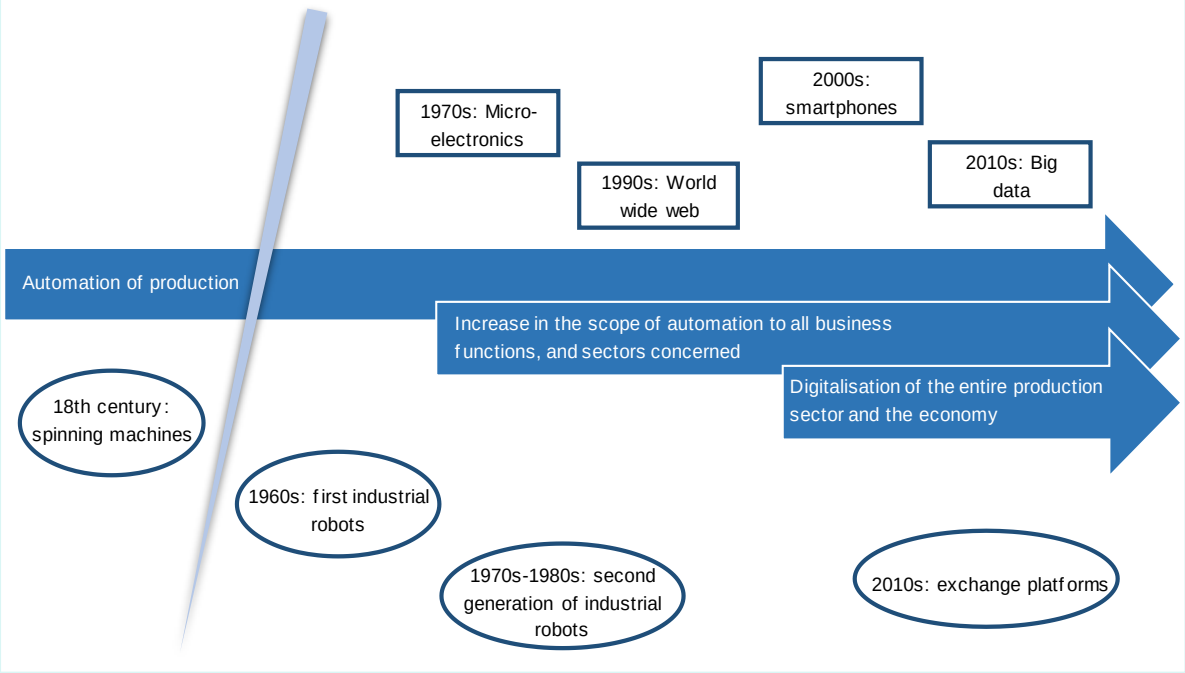

Figure 1 – From automation of production to digitalisation of the economy [3]

The reshoring of industrial activities to developed countries as from the 2020s could have gone hand in hand with an increase in manufacturing jobs. Paradoxically however, this effect was quite limited. While offshoring had destroyed numerous jobs, the return of production came with massive robotisation. Initiated in developed countries, this trend had continued in subcontractor countries in the 2000s and 2010s and new facilities built in developed countries only heightened this strong trend, facilitated by progress in ICTs and their deployment in all production sectors. When processes are not fully automated, workers are required to collaborate with the machine.

[3] Conseil d'orientation pour l'emploi – Automatisation, numérisation et emploi. Tome 1 : Les impacts sur le volume, la structure et la localisation de l'emploi. January 2017.
Available at: https://www.vie-publique.fr/sites/default/files/rapport/pdf/174000088.pdf

Thanks to digital progress, operators who, in the 1980s controlled a machine, monitored 10 machines in 2029. When their skill was required, because it was superior to that of the machine, they performed the task with a collaborative robot (cobot) which multiplied their abilities in terms of strength, improving the efficiency of human movement. With the progress made with the emergence of active exoskeletons (much lighter and which automatically offset pressure on the worker's body), arduous movements, potentially hazardous to health, particularly because they require too much effort or are too repetitive, can be neutralised. They therefore limit physical load and/or musculoskeletal disorders (MSDs) by supporting or guiding the movement. However, when they are managed from a strictly economic perspective, subordinating humans to the machines, all of this equipment increases the work pace and therefore productivity and loses their effectiveness at protecting workers' health.

One of the specificities of this automation is that it also emanates from a desire for production tools to be adaptable. They must adapt easily, in particular during crises, to manufacturing of products for the general good. This search for production versatility led to increasingly flexible and configurable robotisation and training investments for numerous workers to develop double qualifications.

Although storage activities grew sharply in response to the rules for ensuring continuity during periods of crisis, they generate few jobs, except during the construction of buildings. Stock management, manual handling and the moving of standardised packages are easily automatable. Globally in logistics, digital technology progress had transferred work organisation to algorithms through different techniques (voice control system[4] or transmission of orders via tablet). The desire to eliminate epidemic constraints contributed to increasing the automation of these workshops without however eliminating human work, which remains essential for certain operations requiring greater dexterity than that afforded by the machine. Within these immense workshops, it is also quite easy to organise the work to avoid all inter-human contact. During epidemics, workers can moreover be easily equipped with protective gear.

[4] Voice control systems or voice picking involves audio transmission of orders to pickers and verification of the proper functioning of the order picking by voice recognition

This transformation in logistics came with a major development in 3D printing abilities enabling responsive and decentralised production of certain components meeting urgent short-term needs. The establishment of high-performance fab-labs has eliminated numerous constraints (management of a large number of stock references, transport difficulties, etc.)

In the retail business, where a choice had to be made between human work and automated work based on investment and operating costs and client acceptability, the Covid-19 crisis, followed by the following episodes accelerated decision making. Almost all stores (with the exception of a few high-end niches) completely automated cashing operations. Small, medium and large stores also generalised home delivery. For specialised items, remote selection is carried out through different video and audio transmission techniques in direct connection with chatbots or teleconsultants. The article is then delivered directly or made available at pickup locations (drive-throughs). Suitable mechanisms have been put in place for persons with disabilities or encountering difficulties using technology.

Jobs in services to individuals developed yet again. Previously considered low-skilled, they were revalued because of their fundamental role during crises. While a certain number of tasks in this field are now assisted by equipment that is more or less engine-driven (support for moving and handling people for example), they are mostly non-routine and adapted to each person. Given the sometimes close contact, the choice was made to systematically use personal protection, both respiratory and cutaneous. This situation, difficult to bear for certain individuals, is also hard for workers, both parties finding themselves limited by this distancing (indeed, for the purposes of safety) and see the relational dimension of their daily lives increasingly hampered by its technification (including the use of certain robots for example).

At the other extreme, the development of increasingly efficient ICTs at an affordable cost had given rise, well before the 2020 pandemic, to teleworking practices for certain employees who could work for more or less long periods at a sufficient level of autonomy not requiring face-to-face exchanges. This was evidently the case as well for independent service providers and mobile workers (working under different statuses, both self-employed and employed) who, during their travel, or from their homes, have the possibility of digital contact with their employee or payer.

The possibility of teleworking may concern high-level workers using non-routine cognitive skills, but also workers that perform repetitive tasks, aimed for example at updating social networks or low forms of artificial intelligence (with numerous intermediate categories)[5].

Originally intended for example, for limiting home-work travel (and facilitating the lives of workers) or for saving on office rentals, these teleworking possibilities were used extensively during the 2020 pandemic, then became necessary throughout the following years, when a significant number of warnings and crises derailed the operation of businesses: these quickly adapted their operating modes to the new configuration. Some went even further, exclusively resorting to independent contractors for functions not having an impact on the daily running of the business.

Circular economy

The slump in global commerce due in particular to increased border controls resulted in a relative shortage of certain raw materials and products. These restrictions, combined with the already growing awareness of environmental issues, promoted the development of initiatives in favour of a circular economy, more resource- and energy- efficient. While a linear economy is based on extracting-manufacturing-consuming-disposing, using natural resources and energy to make products that will ultimately become waste[6], a circular economy promotes, beyond recycling, manufacturing designed to last, collaborative consumption, repairs, industrial and territorial ecology, etc.

Figure 2 summarises the most important principles identified by the Environment and Energy Management Agency (Ademe).

[5] A. Casilli – En attendant les robots. Enquête sur le travail du clic. *Le Seuil*. 2019
[6] Rémy Le Moigne – L'économie circulaire : stratégie pour un monde durable. *Dunod*. 2018

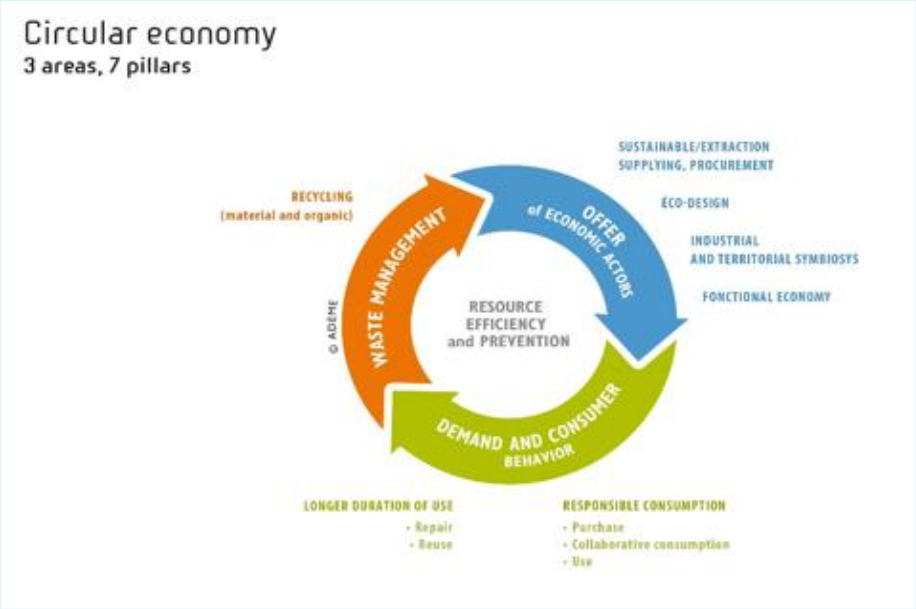

Figure 2 – The main elements in a circular economy according to Ademe[7]

Switching from one model to another is more about changing than about adapting. Since the life cycle of the product is completely transformed, all production phases had to be revised. For example, the product has to be designed in such a way that it can be used by several people who could adapt it to suit their needs; it has to be easily (and several times) repairable; at its end of life, a certain number of its components that are still in good condition must be able to be recovered and reused, and the material of components not repairable must be able to be recycled without too much loss.

It was therefore necessary to adapt the production mode to this new model. Manufacturing a component that could be used five times over the course of 30 years requires a different approach to that used to produce an element with a lifetime estimated between five and ten years. These adaptations may have been of a high technological level, such as techniques for tracing components and raw materials, necessary so that a "secondary" component or raw material is not used under conditions potentially hazardous to the health of the worker or consumer.

[7] Ademe (Agence de l'environnement et de la maîtrise de l'énergie) – Nos expertises: Economie circulaire. Available at: https://www.ademe.fr/expertises/economie-circulaire

Adaptations were also basic: concretely, repair workshops had to be set up, an activity which, in many cases, had disappeared several decades ago. The development of collection, disassembly and sorting activities was also significant. As for selling activities previously mentioned, the decision was made depending on the technical possibilities for automation and the cost of labour. Since, in the case of recycling, there is no contact with clients, and the robot's efficiency can be hampered by the variety of elements to be sorted, a large portion of this type of work is still reserved for humans.

Possible occupational health and safety approaches

In the previous pages, an attempt was made to imagine work and production transformations over the 2020-2029 period marked by epidemic conditions that are sometimes latent, and at other times severe. Henceforth, work conditions and occupational risks will be addressed. For a few professional categories or professions, we will endeavour to show the different possible consequences based on the social and societal choices made upstream.

In that regard, two important background elements having a significant influence on work conditions in general and on occupational risks in particular must be highlighted:

- the scenario as proposed here assumes that production has been adapted to the situation incorporating new health data[8], but however still continues to be affected, subject in particular to epidemic outbreaks; it is therefore likely, given the many constraints, that the wealth produced by the country has declined considerably and that productivity itself has diminished;
- the new work organisation modes favour automation to the detriment of human work, even when it is less expensive; cost prices have increased, especially because cheap goods produced in low-wage countries are scarcer on the French market, replaced by products manufactured locally and therefore more expensive; it can therefore be considered globally that the portion of gains dedicated to capital (which includes production investments) grew to the detriment of work.

[8] L. . Boltanski, E. Chiapello – Le nouvel esprit du capitalisme. *Gallimard*, 1999

Teleworking and the upper socio-professional categories

Since they involve a large portion of autonomous work, jobs requiring non-routine cognitive skills are particularly well adapted to teleworking. As at the end of the 2010s, algorithms were used to organise efficient remote cooperation among dozens of workers for performing work in project mode. One such algorithm, *Foundry,* already allows this type of operation almost instantly and at global scale[9]. A classic multinational company, Publicis, set up its own tool (*Marcel*) aimed at promoting the interaction of its 80,000 employees in 130 countries, a tool which can be extended to external providers[10].

Such work configurations favour the switch from employee status to independent contractor status. This latter status was voluntarily adopted in particular by an entire portion of the population who prefer to live out isolation periods in (semi)rural environments: the classic professional activity is then combined with another activity often having nothing to do with the original job (tourism, agriculture or family assistance).

This development of teleworking also contributes to globalising work, putting workers from developed countries in direct competition with those of less advanced countries. Since work contracts (in this case, service contracts rather) are transnational, there is also a weakening of social protection systems related to the drop in the collection of social contributions. The sometimes fragmented nature of tasks performed does not enable workers to have an overall view of the product being manufactured and can lead to a loss in meaning, especially since there is no work community to ensure a minimum level of solidarity in the face of any kind of difficulty. The separation between professional life and private life is increasingly difficult, particularly in extreme cases such as with Foundry, when a request for a service, which must be performed immediately, can be made at any time of the day or night. Lastly, recent work shows that the productivity of teleworkers using ICTs is greater than the productivity of workers subject to more classic forms of work but also that they are more likely to develop pathologies such as stress, anxiety or depression, headaches and visual fatigue[11].

[9] M. Héry – Le travail à la tâche comme horizon pour tous? *Santé et travail*, 100, pp. 28-30, Octobre 2017.
[10] Video: Publicis Groupe introduces the platform Marcel. Available at: https://www.youtube.com/watch?v=L7iLdQ8WK5A
[11] *Eurofound* - Telework and ICT-based mobile work: Flexible working in the digital age, New forms of employment. Publications Office of the European Union, Luxembourg. 2019

Through these examples, we see that the work of professional categories having a good level of training and the capacity to be autonomous (sought by clients) can be exploited at the expense of their *professionalité*[12].

Relearning to manage old risks

The relative closing of borders and the boom in the circular economy will result in the re-emergence of certain jobs that had disappeared, for example, jobs involving the repair of consumer goods. The conditions surrounding the creation of these new activities can be very diverse; this paper will be limited to two contradictory options, whose consequences in terms of occupational risks are very different:

- a first which is based on technology, where, as of the design of consumer goods, phases such as maintenance and repairs will be included in the reflection concerning their life cycles; these phases can then be organised in terms of occupational risk prevention, which could lead to the products being designed differently and specific protocols being set up for repairs which will be performed at maximum efficiency,
- a second where the designer considers that the subsequent phases are not within his purview; these phases therefore risk being improvised or eliminated from within the sphere of organised work, to end up within the scope of informal work, with workers attempting to "get by"; at first sight, the economic consequences can be the same and the products can be repaired with the same apparent efficiency; it remains to be seen the impact on occupational risks, or on public health, with the final service to the consumer possibly not having the same quality.

Above, we described a certain number of configurations in which mechanisms (real or virtual) such as cobots, exoskeletons or algorithms such as *Foundry,* can be used under conditions favourable to human development or under other conditions were the imbalance is blatant and where the use of the robot is a threat to human health. However, the same operations are conducted, just with different yields, and therefore different profitability constraints.

[12] D. Linhart - La comédie humaine du travail - De la déshumanisation taylorienne à la sur-humanisation managériale, 2015. Editions Erès (collection Sociologie clinique).
About *professionnalité*: the sum of knowledge, skills and experience (somewhat equivalent to the traditional concept of being able to do one's own job well), according to WEISS D. (1983). - « Du concept de professionnalité dans les relations industrielles italiennes », Relations industrielles, 38 (2), pp. 369-379.

We also raised the matter of the reshoring of certain strategic manufacturing activities to Europe, such as for drugs. Some such activities had been offshored, on the one hand, for economic reasons, but also for reasons relating to the standards governing workers' exposure to chemicals deemed too restrictive. One known example of this is the basic molecule, paracetamol, whose synthesis requires the use of benzene derivatives that may release low quantities (but potentially hazardous to the worker's health) of benzene which is a carcinogen: heavy robotisation (therefore costly) can solve the problem, but given its cost, it will require a choice to be made between the economic and social imperatives. In this case as well, the problem must be considered from all angles to take into account functions related to production, for example protection of personnel tasked with the maintenance and cleaning of installations.

Independent workers left to take care of their own risk prevention

When the production system is unsteady because society alternates between periods of crises and periods of calm, businesses are tempted to use independent contractors to simplify social management of staff and increase flexibility. It is this type of situation that was imagined as a background to the events described in this article.

This use of independent contractors initially introduced by platforms showed its inability to ensure satisfactory social protection and consequent occupational risk prevention[13]. We can therefore imagine that in the period in question in the article, the same will apply and will even transcend the transport and delivery sectors. However, this will deliberately introduce a weak link in a logistics chain during crisis periods, with the current situation cruelly highlighting the vulnerability of these precarious workers, a vulnerability that can spread to the entire society.

[13] M. Malenfer – Derrière les trottinettes, *les juicers*. Futuribles, 431, pp. 119-122. July-August 2019.

Conclusion

None of the hypotheses (except of course the central issue of a long pandemic/epidemic), none of the examples used in this article are original. All of these demonstrators are the result of different works conducted by INRS devoted to the possible developments in work and the prevention of occupational risks in the upcoming decades[14]. However, the implicit conclusion is similar to the conclusions made within the context of these different exercises, whether devoted to physical assistance robots (exoskeletons for example), the global change in production enabled by progress in ICTs and in particular platforms, or the circular economy, which is the most recent study. There is nothing inevitable about the use of these techniques which we can sincerely deem equally promising and disturbing. Intrinsically, they are neither good nor bad. Their acceptability, their "service rendered" to the society will result essentially from the choices that will be made concerning their use. Choices, one hopes, that will emerge out of an enlightened debate by society.

The matter of adapting social protection given these work transformations was not addressed here, evidently, it should be considered and discussed. Other authors undoubtedly can take the lead on these issues in these pages.

Regardless, the authors acknowledge the TAF journal for encouraging them to put their model of reflection to work against a scenario they can only wish remains hypothetical.

[14] See note 1.

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