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# 1 - Work done by INRS counterparts in the field of horizon scanning and strategic foresight

In the year 2019, the Horizon Scanning and Strategic Foresight Mission compared its work with that of a certain number of its counterparts, particularly within the framework of the Working on Safety 2019 conference where a workshop on the future of work and occupational safety and health was held<sup>1</sup>.

Clearly, current changes in the world of work are a topic of major concern for prevention organisations worldwide. Many of them are conducting work aimed at following these transformations and addressing them as best as possible.

Four major categories of forces driving change are systematically taken into account:

- technological developments: particularly robotisation and cobotisation, artificial intelligence, connected objects, collection and massive processing of data (big data), self-driving cars, 3D manufacturing techniques, etc.
- social and demographic changes: ageing of the working population, migratory phenomena, consideration of vulnerable groups, etc.
- globalisation of exchanges: globalised value chains, platformisation, etc.
- environmental challenges: alternative energies, change in production systems, waste recovery, etc.

These changes, which affect work, the work environment and workers, raise a number of health and safety issues. Some of these issues are of concern particularly to OSH practitioners because they profoundly change the framework and modalities of their practice. For example:

- the fact that the perimeters delineated by the work place and working hours are fading, with work increasingly being performed “anywhere” and “anytime”, contributing, in certain cases to work becoming “invisible”.
- “blurring” of occupational safety and health responsibilities in a context of increasingly fragmented work (outsourcing, interim, platformisation, crowdworking) in economies where a growing number of workers are in micro-enterprises or are self-employed.

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<sup>1</sup> The presentations made at this workshop are available at:

[https://www.researchgate.net/publication/336411694\\_Summary\\_report\\_Workshop\\_on\\_Digitalization\\_Future\\_of\\_work\\_and\\_occupational\\_safety\\_and\\_health\\_From\\_a\\_nordic\\_approach\\_towards\\_a\\_global\\_coalition\\_Working\\_on\\_Safety\\_meeting\\_Vienna](https://www.researchgate.net/publication/336411694_Summary_report_Workshop_on_Digitalization_Future_of_work_and_occupational_safety_and_health_From_a_nordic_approach_towards_a_global_coalition_Working_on_Safety_meeting_Vienna)

- the magnitude and pace of change both in terms of new technology and organisational changes in businesses which require constant adaptation without necessarily allowing time for satisfactory risk assessments.

Positive effects of new technology can also be expected, in particular, improved access to the job market and better working conditions for vulnerable groups: older people, people with disabilities or chronic diseases, migrant workers, pregnant women, etc. For those populations, digitalisation can provide solutions facilitating access to jobs - teleworking, or tools to overcome certain disabilities, provided that sufficient time is given for them to learn and adopt these technologies.

Lastly, while digitalisation and “servicialisation” of economies do not necessarily eliminate “classical” physical risks, they do cause a significant increase in psychosocial risks.

These different reflexions highlight a major need for training. All throughout their active life, workers must acquire skills enabling them to manage the transition between jobs threatened by automation and new jobs created by economic changes. For OSH practitioners, the goal will be to continue to be professionally relevant with these new work contexts.

The scope of the active population that will actually benefit from OSH actions is also an issue, since a growing number of workers do not fall within the traditional scope of intervention of OSH practitioners because of their job conditions (temporary work, teleworking, including for payers located in another country) or their status (self-employed).

Comparison with the work of counterpart organisations provides the opportunity to investigate the relevance of strategic foresight work recently conducted by INRS. Much of the analysis of the changes in the world of work is widely shared. The influence of technology on jobs and the OSH issues raised by such technology were addressed extensively within the framework of the foresight exercise “Modes and Methods of Production in France in 2040”. The Platformisation 2027 foresight exercise which built on that exercise, explored certain aspects such as the algorithmic organisation of a service and its effects on prevention, and the rise of a new category of workers – “economically dependent independent contractors”. The environmental challenges and the consequences of their consideration in the production and consumption system were central in the Circular Economy 2040 foresight exercise.

Our counterparts appear to be less focused on this topic. HSE (United Kingdom) conducted major work on new energy sources<sup>2</sup> and ILO on the effects of global warming<sup>3</sup>, but the production transformations caused by the growing shortage of raw materials and the need for greater sobriety are addressed much less. Conversely, while demographic trends such as ageing and migration are systematically taken into account in the construction of INRS's foresight scenarios, the specificities of vulnerable groups are less addressed than in certain Nordic countries for example.

An initiative to exchange and pool horizon scanning work within the PEROSH network was launched by HSE. The Horizon Scanning and Strategic Foresight Mission will take part in these exchanges which are expected to start as of the first half of 2020.

## 2 - Robotisation: “two steps forward, one step back”

### Digitalisation of the economy: automation of production

Digitalisation of the economy continues to be a major topic of debate. It concerns both industry and services. It involves topics as diverse as automation, particularly in the form of robotisation and cobotisation in industry, artificial intelligence (AI), the use of algorithms and platformisation of certain activities, etc., all of them often having significant consequences on occupational risks and their prevention.

The qualitative and quantitative trends identified for the development of several fields in the sector in the upcoming years currently appear to be contradictory.

**This is particularly the case for robotisation.** While it seems that the tendency towards rapid expansion, highlighted over the last few years, is being confirmed and amplified affecting smaller structures, certain businesses are backpedalling.

In the first instance, more and more small and medium-sized enterprises can benefit from automation or cobotisation (close association between humans and robots in production, with humans providing their skills and intelligence, while heavy, arduous and/or repetitive work is devoted to the collaborative robot).

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<sup>2</sup> HSE Foresight annual report 2017/18, Energy : <https://www.hse.gov.uk/horizons/assets/documents/foresight-report-2017.pdf>

<sup>3</sup> *Working on a Warmer Planet: The Effect of Heat Stress on Productivity and Decent Work*, note for the reader. Available at: <https://www.futuribles.com/fr/bibliographie/notice/working-on-a-warmer-planet-the-effect-of-heat-stre/>

This is the case, for example, of the Indra company<sup>4</sup>, specialised in the dismantling of moto vehicles, identified during the Circular Economy 2040 foresight exercise.

The great diversity of end-of-life vehicles to be processed does not allow for the automation of the line when the objectives to be met (95% of the weight of each vehicle must be salvaged to be used as parts or recycled materials) require a high level of performance from operators in the identification of parts and the implementation of dismantling techniques. In addition, accessibility and the weight of parts could result in very awkward postures which cause musculoskeletal disorders (MSDs). This is why a computer tool was developed to provide operators at their workstations with the information they need to optimise their implementation of the techniques to reach their recovery goals, thereby lightening their cognitive load. With regard to awkward positions, the decision was taken to have a robotic arm lift and pivot the car so that the worker can operate while standing. Similarly, the pliers used to cut the fasteners of the different elements are assisted, both in terms of their weight and the strength to be applied to make them work. Other examples of these types of achievements have been identified, including in small enterprises like the Indra company (a few dozen employees in the workshops).

In the second instance, among the companies that backpedalled and abandoned automated technology, Boeing, after six years of using such technology, has just reintroduced human operators to assemble the 777 fuselage, a phase which had been completely robotised. Now, the riveting of the forward and aft fuselage panels is entrusted to operators (drilling is still robotic), the line never having functioned perfectly and automated work causing numerous defects to the point where the entire process took more time than with the previous use of manual operations. It is therefore a cobotisation-type approach that has been adopted, with arduous tasks such as drilling the fuselage being entrusted to automated systems, while operations requiring more precision are now assigned to workers<sup>5</sup>.

The most grotesque backpedalling is probably that of the near disappearance of automatic car wash stations in the United Kingdom<sup>6</sup>. The remaining 4,000 stations are far outnumbered by the 10,000 to 20,000 stations where washing is done manually, at a cheaper cost.

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<sup>4</sup> Katia Delaval – La déconstruction, une mécanique bien huilée. Travail et sécurité, pp. 22-23, April 2019.

<sup>5</sup> Dominic Gates - Boeing abandons its failed fuselage robots on the 777X, handing the job back to machinists. The Seattle Times, 13 November 2019. Available at: <https://www.seattletimes.com/business/boeing-aerospace/boeing-abandons-its-failed-fuselage-robots-on-the-777x-handing-the-job-back-to-machinists/>

<sup>6</sup> Eric Albert - Au Royaume-Uni, des laveurs de voiture symbole d'une certaine dérive de l'économie. Le Monde, 4 December 2019. Available at: [https://www.lemonde.fr/economie/article/2019/12/04/au-royaume-uni-pour-laver-les-voitures-les-hommes-coutent-moins-chers-que-les-machines\\_6021554\\_3234.html](https://www.lemonde.fr/economie/article/2019/12/04/au-royaume-uni-pour-laver-les-voitures-les-hommes-coutent-moins-chers-que-les-machines_6021554_3234.html)

The number of these manual stations is as imprecise as the situation of their employees: often undocumented, paid less than minimum wage, work 60 to 80 hours, six or seven days a week, with hardly any verifications from the labour inspectorate or environmental authorities.

More briefly, **the matter of employment related to the development of this automation**, largely addressed in previous years: the conclusions of the different studies have not changed much and range from a marginal effect on certain jobs, offset more or less by the creation of new jobs in new sectors, to a major impact in terms of job destruction. The past year did not really see the emergence of any new, or especially any decisive elements<sup>7</sup>. In two articles<sup>8,9</sup>, Paul Krugman, winner of the Nobel prize in economics, stressed the fact that this debate especially had the effect of creating a smokescreen and not addressing a certain number of essential questions for the US economy: the economic decision to outsource industrial activities to low-wage countries, wage inequalities and the ever-widening gap between the highest and lowest salaries, productivity (the growth of which drops paradoxically with the increase in robotisation), deterioration of the working conditions of certain categories of workers, etc.

Reshoring jobs through the use of robotisation of production was mentioned in previous foresight exercises, in particular through the creation of two speedfactories by Adidas. These two highly robotised factories, one in the USA, and the other in Germany, had been created to quickly meet a high-range and customised demand. Their shutdown, announced at the end of 2019 and the reshoring of their production to subcontractors located in low-wage countries came as a surprise<sup>10</sup>. The explanations provided by the company are mysterious, but it appears that the processes used met with technical difficulties, another example added to that of Boeing described above or that of Tesla presented in 2018. These difficulties prevented the production of a certain number of models. However, it seems that the experiment was not entirely in vain because it will be continued in countries where already low wages could be lowered even further by automation. However, the dream of a single series, that is extreme customisation of production enabled by robotisation appears to be elusive, at least for mass production, such as for sneakers<sup>11</sup>.

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<sup>7</sup> The senate delegation for strategic foresight devoted a report in 2019 on these matters in particular: « Demain les robots : vers une transformation des emplois de service ». Available at: <http://www.senat.fr/notice-rapport/2019/r19-162-notice.html>

<sup>8</sup> Paul Krugman - Don't blame robots for low wages. New York Times, 14 March 2019. Available at: <https://www.nytimes.com/2019/03/14/opinion/robots-jobs.html>

<sup>9</sup> Paul Krugman – Falling down the robot rabbit hole, New York Times, 17 octobre 2019. Available at: <https://www.nytimes.com/2019/10/17/opinion/democrats-automation.html>

<sup>10</sup> Devin Coldewey – Adidas backpedals on robotic shoe production with Speedfactory closures. The Crunch, 11 November 2019. Available at: <https://techcrunch.com/2019/11/11/adidas-backpedals-on-robotic-factories/>

<sup>11</sup> Florian Butollo, Philipp Staab – Fantasmies sur l'automatisation du travail. Le robot, coupable idéal. Le Monde diplomatique, December 2019.

### 3 - A two-tier development of artificial intelligence?

Early 2019, the publishing of *En attendant les robots*, a book by Antonio Casilli<sup>12</sup>, provided fodder for the supporters of a limited development of AI. In response to enthusiasts that predict a radical and positive change in professional and private life or those concerned about marginalisation of humans, the author highlights that the learning processes for current AI are long and cumbersome and require repetitive work by humans. Smart AI would only be an illusion hiding the reality of millions of regular and casual clickworkers, whose lives would be continuously governed by algorithms that reconfigure and make human work precarious.

This difficulty in bringing AI to a level of intelligence as efficient and general as humans is confirmed by Yann Le Cun, winner of the Turing award 2019<sup>13</sup>. However, in his opinion, it is above all a matter of time and means. This creator, among others, of deep learning, believes that this goal will require conceptual progress (responsibility of science) rather than a more intelligent or more effective use of current techniques. What is needed in particular, is the construction of machines capable of learning on their own, similar to a child learning about the world. No-one can predict the consequences of the development of these forms of AI on OSH, but they could significantly change the working conditions of clickworkers, or even cause the elimination of some of those jobs.

Others highlight the colossal investments that the development of these new techniques will require. At the risk of creating two-tier AI, the more powerful forms being reserved to a few technology companies: the cost of admission into this club could be several billion, or several tens of billions of dollars<sup>14</sup>. For example, the computations necessary for making a leading product on the AI market have been multiplied by 300,000 in the space of six years<sup>15</sup>. This could permanently exclude, in particular, university laboratories which, for many decades, have however produced numerous innovations currently at our disposal. It is reasonable to assume that such investments will have consequences on modes and methods of organisation of production, with inevitable effects on working conditions (good or bad) and on occupational risk prevention.

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<sup>12</sup> Antonio Casilli – *En attendant les robots*. Editions du Seuil, January 2019.

<sup>13</sup> Benoit Georges, Yann Le Cun - Les machines vont arriver à une intelligence de niveau humain. Les Echos, 22 October 2019. Available at: <https://www.lesechos.fr/idees-debats/sciences-prospective/yann-le-cun-les-machines-vont-arriver-a-une-intelligence-de-niveau-humain-1141731>

<sup>14</sup> Steve Lohr - At tech's leading edge, worry about a concentration of power. New York Times, 26 September 2019. Available at: <https://www.nytimes.com/2019/09/26/technology/ai-computer-expense.html?searchResultPosition=7>

<sup>15</sup> Roy Schwartz, Jesse Dodge, Noah A. Smith, Oren Etzioni – Green AI. Available at: <https://arxiv.org/pdf/1907.10597.pdf>

It seems that this risk has not eluded certain major companies. Open AI (a capped-profit company), which receives financing from several large operators (Tesla, Amazon, Microsoft, Infosys), and whose goal is to promote AI for the good of humanity, has started to widely share the results of the initial studies it financed (for example the articulated robot arm capable of manipulating a Rubik's Cube and solving it)<sup>16</sup>. They hope to identify new future partners.

**Hacking of data and IoT devices continues to be an issue.** The hacking of voice-controlled digital assistants such as Alexa, Siri and Google Home equipment at distances over 100 metres made headlines<sup>17</sup>. The effect was heightened by the fact that the tools used for the hacking were as unsophisticated as lasers and flashlights. Increasingly complex protection systems are used to combat the risk of hacking, however, it seems that gateways still remain open. In particular, it appears that the development of connected buildings within the framework of smart building, facilitates exposure to cyber-risks, creating the possibility of incidents or even catastrophes in the upcoming years if measures are not taken urgently<sup>18</sup>. The author of the article draws attention, in particular, to the absurdity of existing safety and security standards. They hinder the development of connected buildings because of the numerous technical obstacles they pose. However, they do not guarantee a minimum level of security because their recommendations do not provide for the basic mechanisms that would ensure the cyber-security of premises. They are generally “off-topic”.

Lastly, cyber-security specialists highlight that negligence in the management of access authorisations for IT systems, in particular those of workers that have left companies, provides very convenient gateways to hackers<sup>19</sup>.

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<sup>16</sup> Cade Metz - If a robotic hand solves a Rubik's cube, does It prove something? New York Times, 15 October 2019. Available at: <https://www.nytimes.com/2019/10/15/technology/robot-hand-rubiks-cube.html?searchResultPosition=1>

<sup>17</sup> Nicole Perlroth - With a laser, researchers say they can hack Alexa, Google Home or Siri. New York Times, 4 November 2019. Available at: <https://www.nytimes.com/2019/11/04/technology/digital-assistant-laser-hack.html?searchResultPosition=5>

<sup>18</sup> Emmanuel François – Le jour où les bâtiments connectés seront hackés. Rendre notre monde + sûr, 26 novembre 2019. Available at: <https://rendre-notre-monde-plus-sur.goron.fr/le-jour-ou-les-batiments-connectes-seront-hackes/>

<sup>19</sup> [https://www.lemonde.fr/emploi/article/2019/12/11/le-turnover-des-salaries-penalise-la-securite-informatique\\_6022404\\_1698637.html](https://www.lemonde.fr/emploi/article/2019/12/11/le-turnover-des-salaries-penalise-la-securite-informatique_6022404_1698637.html)

## 4 - Platformisation

### With the AB5 bill, California wishes to restore social protection to platform workers

On 18 September 2019, Gavin Newsom, Democratic governor of the State of California, ratified the AB5 bill. This text, widely adopted by Parliament, will enter into force as at 1 January 2020, and will reclassify numerous independent contractors as employees. This text is of the utmost financial importance, both for the financing of the social protection system and for platforms whose economic model is greatly challenged.

This ratification took place following a process through which the California legislature integrated into law criteria for qualifying independent work which had been previously defined by a California Supreme Court case. On 30 April 2018, the court had issued a major ruling (Dynamex Operations West, Inc. V. Superior court of Los Angeles) which defined three criteria to distinguish “truly” independent workers from dependent workers who should have employee status. The three criteria give rise to the “ABC test”, a simplified framework for determining an independent job (whether the person works for a platform or some other hiring entity), which consists of examining the following questions:

- Is the worker free from the control and direction of the hiring entity in connection with the performance of the work, both under the contract for the performance of the work and in fact?
- Does the worker perform work that is outside the usual course of the hiring entity’s business?
- Is the worker customarily engaged in an independently established trade, occupation, or business of the same nature as that involved in the work performed?

Examination of the first criterion alone is enough to consider that ride-hailing drivers or bike delivery persons working through an application installed on their smartphone cannot be considered as independent contractors, since the application gives the platform continuous control over their activity.

This legal development resulted in the immediate fall in the shares of Uber and Lyft (the two main ride-hailing platforms concerned) on Wall Street. Indeed, financial analysts consider that the requalification of their ride-hailing drivers as employees presents a major risk for their business model. The Morgan Stanley bank estimates that this will result in a roughly 35% increase in their costs.

Barclays analysts forecast that these platforms will have to spend an additional \$3,600 per year and per driver, leading to additional operating losses of \$500 million for Uber and \$290 million for Lyft. Therefore, it is not surprising to see these operators mobilise major resources to attempt to impose an alternative solution based on social rights, such as minimum wage and paid sick leave, defined within a “new progressive framework”. The Californian authorities, who are set to receive billions of dollars in taxes as a result, have refused this compromise proposal. Both companies announced that they have set aside \$30 million each to fund a ballot initiative for their counter proposal as provided for by Californian law<sup>20</sup>.

### **In France, the LOM bill aims to regulate ride-hailing platforms and bike deliveries**

This revision of the job platform model within the very cradle of the gig economy leads us to explore legal developments in France regarding this topic. French lawmakers have not adopted the same approach as California. While the AB5 bill reproduces the criteria defined by the Supreme Court (legislature thus aligning with the judge), in France an article in the mobility bill (LOM) adopted on 19 November 2019, aims to protect platforms from the risk of legal requalification provided that a few rules are followed (transparency about the price of rides, right to refuse rides, etc.) and that platforms voluntarily adopt charters determining the conditions and modalities for exercising their social responsibility, defining their rights and duties and those of the workers with whom they have relations.

They must specify the measures aimed at preventing the occupational risks to which workers may be exposed in performing their activity and any damage that may be caused to third parties. The text specifies that the adoption of such a charter (once it is approved by administration) cannot characterise the relationship as a “legal subordination between the platform and workers”<sup>21</sup>.

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<sup>20</sup> The following article speaks about the fall of Uber and Lyft on Wall Street: « Sous la menace d'une réforme du statut des chauffeurs, Uber et Lyft dégringolent à Wall Street », Les Echos, du 4/09/2019  
<https://www.lesechos.fr/industrie-services/tourisme-transport/sous-la-menace-dune-reforme-du-statut-des-chauffeurs-uber-et-lyft-degringolent-a-wall-street-1128840>

<sup>21</sup> Legislative documents on LOM are available on the *Assemblée Nationale* website: [http://www.assemblee-nationale.fr/dyn/15/dossiers/loi\\_orientation\\_mobilites](http://www.assemblee-nationale.fr/dyn/15/dossiers/loi_orientation_mobilites)

## Understanding algorithms

This article of the LOM bill specifies that workers can refuse a proposal for a transport service without being penalised in any way. This raises the question about how compliance with this principle can be controlled, because while unfair disconnection could easily be characterised, the lack of penalties will be more difficult to verify. It would require monitoring of the ride-management algorithms to check whether a worker that has refused deliveries for example, is penalised in the allocation of subsequent deliveries.

In the future, OSH practitioners will continue to be confronted with this matter of accessing and understanding algorithms for digital platforms, but also for traditional companies that also use them. It will not really be about understanding the computer code but being able to establish the link between parameters, rules and data on which the algorithm is based and the impact on operators' work conditions. The purpose of this will be to formulate recommendations for the leaders and IT project managers of these algorithmic work organisations. But, recent attempts aimed at understanding algorithms in order to better regulate them were made in several American cities and showed the limits of existing administrative procedures in challenging automated decisions<sup>22</sup>.

## Increasingly sophisticated worker monitoring tools

The LOM bill focuses on the specific case of ride-hailing drivers and bike delivery persons working through platforms; it does not address other jobs affected by these new forms of work organisation. However, as mentioned above, a growing portion of work is done remotely, in homes or a third location, within the framework of classic teleworking or in the form of crowdworking via platforms. In these new organisations, tasks generally assigned to call centres (sales prospecting, assistance services, etc.) are increasingly done remotely from workers' homes. The tools for controls used in call centres and their effects on the health of workers are well-documented. They have now been perfected with "emotional intelligence and analysis tools" such as Cogito<sup>23</sup> which listens to the operator and customer, evaluates the emotional situation of both speakers in real time and directly recommends the worker to adapt strategy, tone, etc. Tools have also been adapted to monitor teleworkers remotely.

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<sup>22</sup> De la difficulté à imposer la transparence des décisions automatisées, Internet Actu, 13/12/2019 <http://www.internetactu.net/a-lire-ailleurs/de-la-difficulte-a-imposer-la-transparence-des-decisions-automatisees/?fbclid=IwAR0h38n1JPq-dKmo6gB98V77IOGKX1ilHWvxh8LiHLXtzgBfOthpIC8JOHU>

<sup>23</sup> See: <https://www.cogitocorp.com/product/>

Some of such workers are subject to permanent controls to make sure that they are active in front of their computer screen through the recording of their keystrokes, movements of the mouse or regular screenshots. Remote listening tools are more sophisticated in order to detect peripheral noises (dogs barking, children crying), indicators of possible distractors<sup>24</sup>. In the case of self-employed workers, the consequences may be substantial if the interpretation of the data collected leads to them being refused missions. Regulation of this type of use of information technology will be a challenge in the future.

## 5- Health effects of nomadic and connected work

Eurofound, the European Foundation for the Improvement of Living and Working Conditions, regularly conducts surveys on the working conditions of European citizens. The last survey, dating back to 2015, was done on 43,850 people in 35 countries. One of the topics covered was mobile work (outside of a traditional space), the use of ICTs and the consequences on health (declaratory). All of the results will be published in February 2020<sup>25</sup>; some of the results were presented at the “A gaze into the future” conference on occupational health organised by INRS’s Greek counterpart<sup>26</sup>.

The people questioned were grouped into five categories based on the following criteria:

- fixed workplace, no use of ICT,
- fixed workplace, with use of ICT,
- teleworking from home, employee,
- major portion of work with travel, use of ICT, employee,
- work with occasional travel, use of ICT, employee.

The last three categories are the most likely to work outside of their official working hours, in particular teleworkers. Those who travel the most also find it most difficult to balance their private and professional life. These same three categories are those that most often work more than 48 hours per week and that indicate that they do not have enough time to perform their job (work intensification).

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<sup>24</sup> See the article in the WallStreet Journal: *Work at Home? Your Employer May Be Watching*, <https://www.wsj.com/articles/SB121737022605394845>

<sup>25</sup> Oscar Vargas-Llave, Irene Mandl, Tina Weber, Mathijn Wilkens – Telework and ICT-based mobile work: Flexible working in the digital age. Eurofound. <https://www.eurofound.europa.eu/publications/report/2020/telework-and-ict-based-mobile-work-flexible-working-in-the-digital-age>

<sup>26</sup> Oscar Vargas-Llave – ICT-enabled flexible work or Telework and mobile work: Remote, mobile, flexibility and autonomy. Second Hellenic Conference on Occupational Health and Safety: “A gaze into the future”. Athens, 18 and 19 November 2019

More globally, for all job categories (and no longer for employees alone), the health effects of the activity were assessed for mobile workers (possibly also working at home part of the time). This type of work is referred to as Telework and ICT-based mobile work (TICTM) in the results below:

- there is a clear link between the use of ICTs at work<sup>27</sup>, TICTM and the results on health. Some aspects of the TICTM environment have positive results, but others can jeopardise the health of the workers concerned;
- the results concerning health and well-being such as fatigue, anxiety and presenteeism are likely to be higher in teleworkers and mobile workers, which could be related to long trips, high levels of work intensity and constant connectivity;
- the TICTM work environment is heavily linked with stress, and the associated work autonomy is not an effective means of protection;
- regular TICTM work, marked by high mobility results in a greater number of negative health results, mainly because of the work intensity. However, certain results, such as an increase in headaches and eye fatigue, overall fatigue and virtual presenteeism, appear in all TICTM configurations;
- the reduction in the use of ICTs can limit the risk of headaches and eye fatigue. However, reducing stress related to TICTM requires tackling a number of problems, particularly heavy workloads, constant connectivity and availability and difficulties in being confronted with a high level of cognitive demand.

## 6- Circular economy in the building and construction industry

One of the objectives of the horizon scanning work performed by INRS's Horizon Scanning and Strategic Foresight mission is to follow the development, over a few years, of certain challenges identified during the different foresight exercises, in order to objectivise the relevance of certain assumptions made.

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<sup>27</sup> The concept of TICTM encompasses the following work situations:

- home-based: employees who frequently use ICT to work from home
- highly mobile: employees who frequently use ICT to work and have a high level of mobility
- occasional: employees who occasionally use ICT to work from locations other than their employer's premises
- self-employed: self-employed workers who occasionally or frequently use ICT to work from locations other than their own premises

<sup>28</sup> *Ministère de la transition écologique et solidaire – Déchets du bâtiment et des travaux publics*. 19 March 2019. Available at: <https://www.ecologique-solidaire.gouv.fr/dechets-du-batiment-et-des-travaux-publics>

For the “Circular Economy 2040” exercise, it was decided to follow the development of a sector – building and construction - which, with public work activities, generates a significant volume of waste: about 75% of waste produced in France, excluding the agricultural sector<sup>28</sup>. While a large portion of this waste is already reused for backfilling and road works, the current situation highlights two significant facts:

- a major portion of this waste (such as concrete, PVC and glass) could be used more nobly and efficiently in terms of raw material and energy savings,
- paradoxically, recycling or reuse of elements or materials of value often are not even planned, in particular for matters of responsibility (and insurance<sup>29</sup>).

Logically, the law on energy transition for green growth of August 2015 and the future circular economy law<sup>30</sup> focus heavily on the matter of waste in building and public work activities. The salient provisions in the future circular economy law, apart from the logical increase in volumes recycled, includes the extension of the waste diagnosis already in effect for the largest operations to include finishing works<sup>31</sup>. Major valuable resources can be found in these activities: doors, windows, sanitation equipment, knobs and handles, electrical material, etc. They also present major occupational safety and health challenges. This dismantling work requires more human interventions; in order to be performed safely, strict protocols must be developed, more particularly over the first few years, in a context in which neither the buildings nor the recoverable elements will have been designed to facilitate dismantling.

Furthermore, it is in the field of design that progress remains to be made: meetings between the Horizon Scanning and Strategic Foresight Mission and professionals in the sector show that while these professionals are becoming familiar with the notion of circular economy, they associate it most frequently with recycling alone<sup>32</sup>. They are yet to understand that they will have to design specifically. However, the upcoming years must not see greater circularity requirements imposed when design has not anticipated all the operations that may be performed on the different elements or materials: this situation would be particularly worrisome in terms of occupational risks.

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<sup>28</sup> *Ministère de la transition écologique et solidaire – Déchets du bâtiment et des travaux publics*. 19 March 2019. Available at: <https://www.ecologique-solidaire.gouv.fr/dechets-du-batiment-et-des-travaux-publics>

<sup>29</sup> See in particular pages 43-45 of the Orée report “Comment mieux déconstruire et valoriser les déchets du BTP”. November 2018. Available at: [https://www.union-habitat.org/sites/default/files/articles/pdf/2018-11/guide\\_comment\\_mieux\\_deconstruire\\_et\\_valoriser\\_les\\_dechets\\_du\\_ptp.pdf](https://www.union-habitat.org/sites/default/files/articles/pdf/2018-11/guide_comment_mieux_deconstruire_et_valoriser_les_dechets_du_ptp.pdf)

<sup>30</sup> Under discussion in the *Assemblée nationale* at the time of drafting of this passage

<sup>31</sup> Philippe Collet - Loi économie circulaire : vers un diagnostic déchets du bâtiment étendu au travaux de second œuvre. Actu Environnement, 12 September 2019. Available at: <https://www.actu-environnement.com/ae/news/diagnostic-dechets-batiment-second-oeuvre-34029.php4>

<sup>32</sup> See for example <http://wmp.mystrikingly.com/> ou <https://www.cycle-up.fr/>

However, with regard to design, major changes are underway: this is the case, for example, with modular construction. This technique was adopted for the construction of two high-rise buildings, of 38 and 44 floors respectively, recently completed in London<sup>33</sup>. The elements prefabricated in factories are made of steel, but the wood and concrete are also materials already used for this type of project. This technique should logically limit defects and transfers a major part of worksite jobs to workshops where occupational risk prevention is easier to implement. Ultimately however, simple deconstruction processes will have to be implemented to make this currently hazardous phase safer.

Another example: the reuse of parquet flooring is rapidly developing<sup>34</sup>. It requires a certain number of cutting and cleaning operations, insecticide and fungicide treatments before reuse. As operations that are often punctual done on specific parts, many times they will not be able to be performed in specific facilities where occupational risk prevention measures are incorporated into the work process. In this case as well, upstream preparation of the worksite will play a major role.

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<sup>33</sup> Myriam Chauvot - La construction modulaire va établir un record mondial de hauteur en Europe. Les Echos, 9 Novembre 2019. Available at: <https://www.lesechos.fr/industrie-services/immobilier-btp/la-construction-modulaire-va-etablir-un-record-mondial-de-hauteur-en-europe-1146751>

<sup>34</sup> Augustin Flepp - Le réemploi gagne du terrain chez les maîtres d'ouvrage. Le Moniteur, 12 October 2018. Available at: <https://www.lemoniteur.fr/article/le-reemploi-gagne-du-terrain-chez-les-maitres-d-ouvrage.1997289>



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