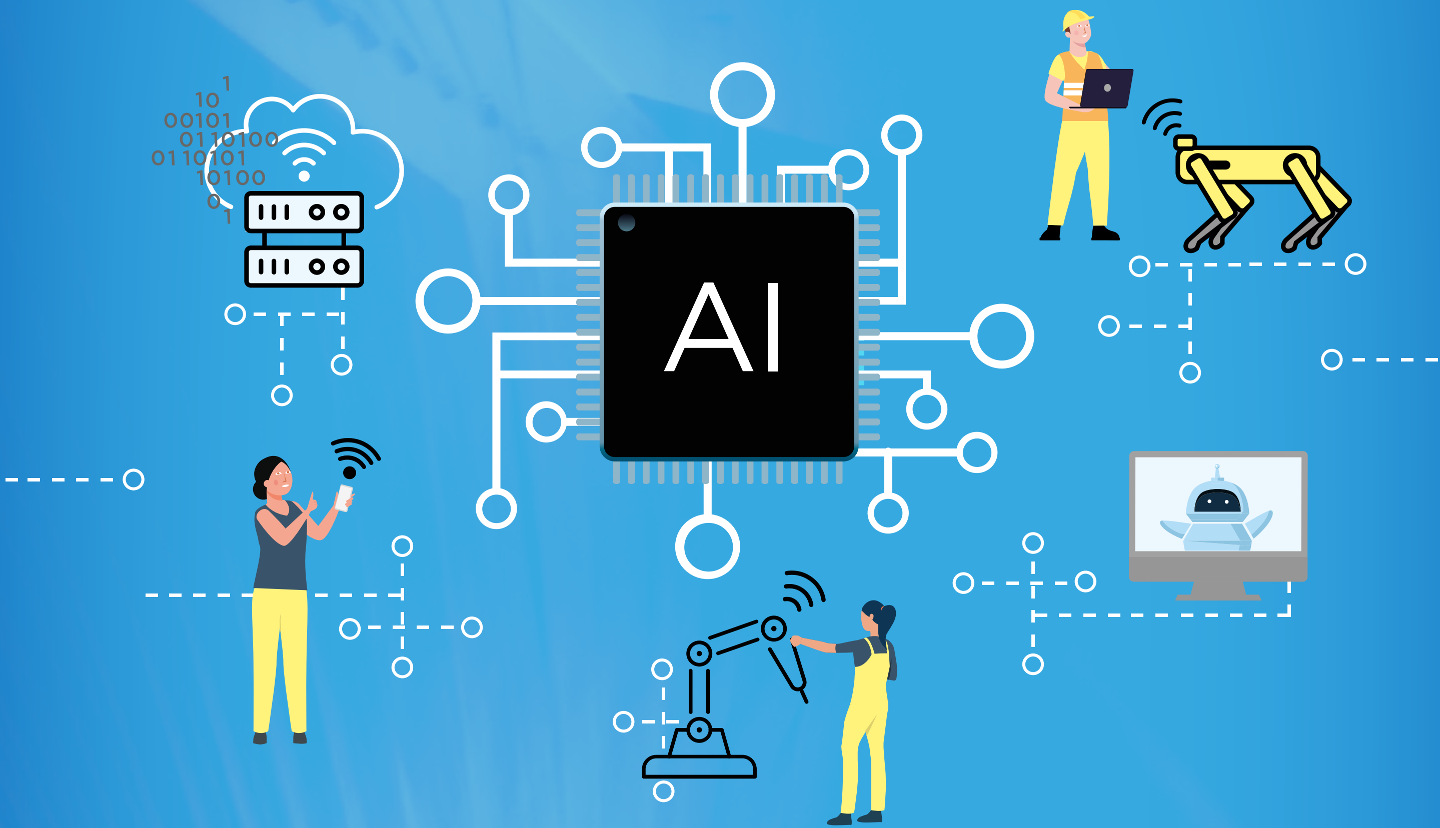
l'Assurance Maladie
RISQUES PROFESSIONNELS

inrs
Institut National de Recherche et de Sécurité



Artificial intelligence in the service of occupational safety and health

Challenges and prospects for 2035

Members of the working group:

Anani Olympio (CNP Assurances); Bertrand Braunschweig (Bilab, Confiance.ai); François de Jouvenel, Jean-François Soupizet (Futuribles); Jorge Munoz (Université de Brest); Martin Bieri, Régis Chatellier (Cnil/Linc); Nazim Fatès (Inria/Loria); Nicolas Bouby (Bouygues construction); Sylvain Halluin (Cramif); Timothée Silvestre (CEA); Vincent Mandinaud (Anact); Jennifer Clerté, Marc Malenfer, Michaël Sarrey, Michel Héry (INRS).

Workshop participants:

Guillaume Boulanger (Santé publique France); Sabri Bayoudh (Blaxtair); Cegarra Julien [INU Champollion (Laboratoire SCoTE)]; Joséphine Hurstel (CNNum); Sebastien Lissare (Cognitive Engine); Claire Tissot, Frédéric Clerc, Guy Hedelin, Lisa Chedik, Adriana Savescu, Lien Wioland, Louis Laurent, Patrice Marchal, Adel Sghaier, David Tihay (INRS).

Other contributors:

Loïck Briot (Mines Nancy); Yann Ferguson (Icam); Ariane Leroyer (Université de Lille); Agnès Aublet-Cuvelier, Benjamin Paty, Jean Theurel, Jean-Christophe Blaise, Cordelia Genzel, Nadiège Félicie, Virginie Govaere (INRS).

The authors also acknowledge Céline Raynal from the Safety Data company and Florian Ruen from the Eyes'R company.

This document is a summary. A complete report (in French) is available on INRS's website:
www.inrs.fr/prospective

Introduction

Fifth among the nine general principles of prevention governing business players' actions in terms of the preservation of workers' safety and health, is: adapting to technical progress[1]. The pace and proliferation of innovations make this task particularly challenging, especially since there must also be compliance with the other general principles, particularly the second on the list: evaluating the risks which cannot be avoided. A rigorous risk assessment often requires time and puts decision-makers in a delicate position with regard to technological innovations. They must be able to use these technologies to improve productivity and working conditions while ensuring that they do not generate new risks.

With regard to information and communication technologies (ICTs), artificial intelligence (AI) has drawn in a lot of resources and attention these past few years. Whether to improve productivity, lower the vulnerability of supply chains or for geopolitical reasons for relocating activities in strategic sectors, AI systems are seen as an asset to be developed, including for occupational risk management.

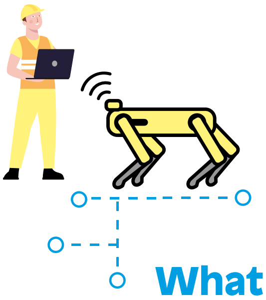
Occupational safety and health players are naturally concerned by the possible consequences of the introduction of AI systems in the professional environment. In general, they must attempt to assess the risks that these systems can pose to workers' physical and mental health and make prevention recommendations. INRS logically has a role to play in this work which completely falls within the scope of its mandate.

The approach adopted for this foresight exercise, the results of which are presented in this document, was to focus on the possible uses of AI systems for the purpose of protecting occupational safety and health about a dozen years from now. In practice, we will see that certain conclusions extend beyond this initial framework, but it was deemed relevant to keep them. These technologies are already being used at certain workplaces, still at a marginal level, but are already raising questions.

The approach followed uses the following elements:

- the fundamentals of the foresight practice at INRS, i.e. collaborative and multidisciplinary, involving many experts within and outside of the institute;
- the application of a methodological framework making it possible to imagine different possible futures, all coherent, not always desirable;
- in-depth investigation of certain challenges and the extraction of key messages aimed at prevention players, most importantly social partners sitting on INRS's board of directors.

1. Article L. 4121-2 of the French labour code: https://www.legifrance.gouv.fr/codes/article_lc/LEGIARTI000033019913/.



Definitions

What is artificial intelligence?

There are numerous definitions of artificial intelligence (AI), none of which totally settles the matter because the discipline's contours are vague. For the needs of this exercise, the working group used three definitions, which are inter-compatible.

Two of these are intensional definitions. The one proposed by the French language enrichment commission and published in the official journal of 9 December 2018:

"Theoretical and practical interdisciplinary field whose objective is the understanding of cognitive and thought mechanisms, and their imitation by hardware and software, for the purpose of supporting or substituting human activities."

The second is that published by the European Commission that same year:

"Even though there is no consensual definition, artificial intelligence (AI) refers to systems that display intelligent behaviour by analysing their environment and taking actions – with some degree of autonomy – to achieve specific goals. AI systems can be purely software-based, acting in the virtual world (e.g. voice assistants, image analysis software, search engines, speech and face recognition systems), or AI can be embedded in hardware devices (e.g. advanced robots, self-driving cars, drones or Internet of Things applications. In contrast with software-based AI systems, such systems perceive their environment using sensors, and act on it or move around in it, therefore requiring robust safety measures."

The third definition comes from another approach which consists in defining AI extensionally, by the sum of the different sub-disciplines of which it is comprised: automatic learning, automatic reasoning, natural language processing, artificial vision, knowledge representation, etc. This is the choice made by the French Academy of technologies in its report "renewal of artificial intelligence and automatic learning" also published in 2018[2]:

"– perception, a very vast domain containing recognition of images, shapes, and sounds (and all forms of signals produced by sensors). Image recognition is the most important domain (machine vision) because of its applications and the spectacular progress made these past few years, mentioned in the introduction, and related to deep learning;

– processing of natural language, in its written or oral form (which involves combining it with speech perception);

– planning and navigation, which could be extended to the field of problem solving, formalised in the area of operational research;

– knowledge representation, whether it is about knowledge handling, researching knowledge, or both. This field has evolved considerably with the development of big data;

– logical reasoning, related to the symbolic form of artificial intelligence, made famous in the 1980s by 'system experts'".

2. https://academie-technologies-prod.s3.amazonaws.com/2018/04/06/13/49/30/183/Rapport_IA_DEF.pdf.

These three complementary definitions all make reference, in particular, to the ability given to machines (software and hardware) to perform tasks requiring intelligence when they are conducted by humans, and all contain examples of applications using these abilities (self-driving cars, chatbots, image recognition, etc.) and technologies in the service of these functions (knowledge representation, reasoning, learning, planning, etc.).

Uses of AI in safety and health, what scope?

As stated in the introduction, the goal of this exercise is not to exhaustively cover all of the connections between AI and OSH. Rather, it is to explore the uses of AI systems specifically devoted to occupational risk prevention. This is not an easy scope to define.

The first challenge is to define which technological innovations use or do not use AI. In that regard, as stated above, the working group adopted quite a comprehensive definition.

The second challenge is to agree on the uses to be considered, since certain developments can be driven by objectives other than the preservation of occupational health (quality improvement, reduction in raw material and energy consumption) but can have favourable consequences on OSH. The group therefore attempted to focus on AI developments driven first and foremost by goals to improve occupational safety and health. This could be upstream uses, for the purpose of researching and studying occupational risks, for example in accidentology, or systems aimed at eliminating workers' exposure to hazards, for example with the use of autonomous robots, or mechanisms to detect risk situations before the occurrence of an injury, for example, real-time processing of data collected by connected objects.

Certain "indirect" uses are therefore not covered here. This is the case, for example, with mechanisms aimed mainly at substituting man for machine primarily for production gains such as the automation of repetitive tasks. The potential consequences (positive and negative) on OSH are significant but fall under the more global topic of the impact of technology on work, which has already been addressed in other foresight work conducted by INRS[3]. The development of virtual reality mechanisms for prevention training purposes are also not addressed here, since that is mainly about applying technologies that were initially developed for other purposes to the field of OSH; moreover, that topic was also addressed within the framework of a previous foresight exercise[4].

Throughout the work process, group members identified circumstances in which the introduction of AI can significantly modify work situations and the global approach to occupational risk prevention. Without challenging, a priori, the use of these technologies, these possible consequences require particular vigilance and consideration by social partners and more generally bodies in charge of occupational risk prevention. Some of the key messages arising from the exercise pinpoint these problem areas.

3. "Modes and methods of production in France in 2040: what consequences will they have on occupational safety and health?", PV 4, INRS.

4. "What training in occupational health and safety in 2030?", PV 15, INRS (in French only).

Key messages

The main lessons drawn from this foresight exercise are presented here in the form of 22 key messages.

A growing market

1 The various advances underway in the field of AI, made possible by massive investments by private and public players, foreshadow the development of a significant market in the coming years. The safety of working environments is one of the areas of professional use of these innovations.

2 The more intelligent the automation, the more the machine (or algorithm) will perform the tasks previously done by workers. This automation may remove some workers from risk. It will also lead to an evolution in the tasks of other workers towards training, coaching and control functions.

3 There is a challenge for stakeholders to promote the development of AI systems that are compatible with the core values of the European and French approach to OSH (collective approach, data protection, social dialogue). The current hegemonic position of the American and Chinese digital giants therefore raises questions.

4 Faced with the ethical issues raised by these new technologies, many organisations have formulated principles to be complied with so that the development of AI can be done for the benefit of all stakeholders in society. It is necessary to identify and promote to companies the relevant recommendations for the ethical use of AI technologies in OSH.

5 The scenario of a new "AI winter", (due to technological blockages ("walls"), energy crises, societal rejections, or cybercrime, etc.) is not excluded. It is therefore important not to rely on these technological solutions for all OSH advances. The search for effective prevention solutions that do not rely on these systems should therefore not be abandoned.

6 The use of AI systems in OSH may come up against the "wall of explicability" (especially for devices using deep learning) and therefore of the understanding of messages and decisions generated by AI. The development of AI uses for occupational risk prevention purposes will require both fostering a good understanding of these tools (virtues and limits) by employees and employers, and promoting the emergence of transparent solutions (e.g., hybrid AI systems: power of AI and transparency of logical reasoning systems) facilitating debates between stakeholders.

Promises in OSH

7 Advances in AI have the potential for a variety of uses in OSH. Advances are to be expected in the processing of large amounts of data for accidentology and epidemiology, in silico toxicology, in making work environments safer, and in the development of advanced robotics technologies.

8 The progress of AI using learning techniques opens up interesting prospects, for example in epidemiology and accidentology, provided that reliable data are available and that certain dimensions of OSH for which usable data are not necessarily available (in particular the organisational dimension) are not overlooked.

9 AI also opens up possibilities for the supervision of a working environment, such as a building site or an industrial site. Beyond detection and warning, these devices should be expected to provide useful information for the development of sustainable (organisational) prevention measures; this implies exploitation by people able to analyse them.

10 Some advanced robotics technologies (including AI) offer potentially beneficial solutions for OSH. This is the case for tele-operations and collaborative robotics, which can mitigate or even eliminate exposure to risk factors. However, the implementation of these devices must be systematically assessed to ensure that they do not generate new risks (work intensification, loss of meaning, etc.).

Limitations and points of vigilance on the use of AI in OSH

11 The logic of making investments in these sometimes costly technologies profitable can lead to these systems being positioned at the centre of the organisation of work, at the risk of relegating human work to the background.

12 Generally speaking, inappropriate or misguided use or the absence of prior reflection on the organisation of the integration of these new technologies could lead to deleterious effects in terms of health and safety at work. The apparent ease of use and implementation of these "intelligent" solutions may lead to a complacency effect on the part of the players, encouraging them to take into consideration only the risks identified by the AI system, without regularly assessing the more organisational risks that are not subject to technological monitoring.

13 The use of AI in OSH can lead to the development of tools for monitoring workers and alerting them when the conditions for safe work are not met (instructions not respected, worker's state of health outside the norm, etc.). This permanent surveillance may generate RPS and also lead to an individualisation of OSH and to the sole responsibility of the worker, to the detriment of the employer's implementation of collective prevention measures.

14 Attention should be paid to the possible risks associated with the use in OSH devices of AI algorithms that have not been developed specifically for this purpose (open source libraries, off-the-shelf products).

15 Deep learning technologies are based on training a model on a data set. The use of AI in companies will therefore involve the collection and storage of a lot of data. As soon as a preventive use is envisaged, the question arises of the constitution, qualification and labelling of the data set used during the learning phases in supervised systems. Particular attention must be paid to the data sets so that they correspond to the areas of applicability, which may vary according to the activities and work situations, and so that they are not biased (see also key message 19).

16 Occupational accidents frequently occur in situations that are atypical of the classical course of a production process: degraded situations, breakdowns, maintenance operations, etc. These situations are often unforeseen and therefore not anticipated in the procedures, which makes them particularly dangerous. They thus constitute a possible limit to the training of AI systems, as the necessary data sets are not able to exhaustively integrate the range of hazards that can occur in many work contexts (construction sites, large industrial sites, work on the public highway, etc.).

Courses of action

17 Because of the opportunities offered by these new technologies, as well as the potential risks they entail, the training of prevention stakeholders (employers, staff representatives, actors in prevention) is a key issue in the future integration of AI in work equipment and prevention solutions. These training courses should provide a good understanding of the way these tools work, the ethical issues, the regulatory framework governing them, the possibilities of piloting them, the risks they may represent, as well as the acquisition of methods used to define needs, the drafting of specifications and the integration of devices in the company. It is essential to educate the players in social dialogue, both at the level of the professional branches and at the level of companies (particularly in MSEs and SMEs), so that they are in a position to understand and discuss upstream the changes in working methods and procedures that these new systems entail.

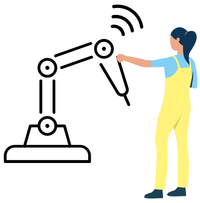
18 The development and marketing of devices using AI techniques presented as prevention tools must be carried out by people with solid OSH skills. In addition to the training to be provided within the company, modules should also be implemented in the curricula of management and engineering schools, in order to make future sponsors and developers of AI systems aware of the opportunities and risks that these new technologies bring with them in terms of OSH.

19 Companies should be encouraged to adopt approaches based on experimentation and assessment, which make it possible to measure in real conditions the consequences of new systems on the organisation of the company and on the work of operators, and to retain the possibility of going backwards.

20 The standards and regulations governing AI are developing (AI act of the European Union). It is therefore essential that the principles of OSH are taken into account in the development bodies. This is particularly true at the level of European regulations, but also in standardisation committees.

21 Collective reflection (such as a consensus conference) must be conducted on the issue of data used in AI devices relating to OSH. In particular, it will be necessary to define rules for the constitution of data sets and the framework for their use according to the fields of application. In addition to the users, the social partners and qualified personalities (experts, philosophers, ethics specialists, lawyers, etc.) will be involved.

22 In general, advances in AI offer prospects for progress in the prevention of occupational risks. Like any change, they also entail certain risks. The development and dissemination of methodological tools to guide the players in the face of these innovations are a major challenge for prevention organisations.



AI in work situations in 2035: foresight scenarios and uses

Scenarios

The four scenarios, the summaries of which are presented here, provide a view of possible and contrasting changes in the development of AI uses in the work environment in 2035. They are, above all, a tool for planning and supporting reflection.

1 – Digital giants impose their solutions and vision

In this scenario, technological exuberance continues amidst competition to control artificial intelligence, but the main players are the digital giants, essentially AMAMA[5] in the West and BATX[6] in China. Their power largely exceeds the digital field and in fact they control most innovations and dominate entire areas of the global economy. Against systemic international rivalry, States must deal with players and use them to maintain their power and ensure key functions of their sovereignty. Regulations are all very ad hoc in between States and heavily influenced by these giants. Users accept these standards out of convenience and because they have become essential. Automation progresses and surveillance becomes the preferred tool for safety at work. This justifies the supervision of all workers' activities in a context of close collaboration between man and machine.

2 – States guarantee a framework for AI integration

The uncontrolled development of AI has driven European States to work on a common regulation in order to govern the ecosystem and ethical principles. Over the period, the multiplication of issues causing harm to citizens, businesses and workers pushed them to toughen this framework amidst increasing environmental concerns. States, in order to direct resource allocation, decided to develop only sober AI systems, meeting strict criteria (particularly surrounding the concept of general interest), in non-critical sectors and under human supervision. This means better control of manufacturers, the development of European and national poles of expertise, but also experiments that demonstrate the harmlessness of AI, and control and audit measures. AI at work therefore develops in a rather regulated environment, where AI is implemented once the value and harmlessness of systems have been approved.

5. Alphabet, Meta, Amazon, Microsoft, Apple.

6. Baidu, Alibaba, Tencent, Xiaomi.

3 – Democratic development

In this scenario, the 2020s see the establishment of democratic control processes by workers and citizens, necessary for the proper development of AI and their regulated expansion in civil and professional life. Against global economic growth generating employment in industry and services and investments in training, the conditions are prime for AI systems to be rolled out widely in the world of work, and for there to be gradual shaping of the collective control of these technological projects. The use of AI devices is facilitated by the boom in open source tools and the development of very accessible solutions (low code, no code). Moreover, AI research launched since the 2010s leads to, in the 2030s, the design of hybrid AI systems combining the power of automatic learning with the transparency of logical reasoning systems. In restoring the ethical principle of explainability as the key to appropriation, these results contribute to building collective trust in AI and using it for performance, health and safety in work organisations.

4 – Decline in AI

At the start of the period, uses of artificial intelligence develops in all professional fields. Driven by technological progress, generalised digitisation of society and new work organisations, AI is mostly well accepted in the world of work. Since 2022, it is considered an asset for employers (automation, productivity, quality, etc.), and for workers (arduousness, safety, etc.). This perception is mainly based on the improvements promised by AI systems. Progressively, disappointment in the field applications and faults in these systems which cause incidents, accidents and crises, generate a rejection of AI systems in the world of work. As from 2030, this rejection leads to a decline in this technology and its professional uses.

Uses

The second phase of this exercise consisted in selecting three possible types of AI applications for OSH and playing them out in the possible futures described in the scenarios.

1. Possible uses of AI tools in epidemiology and accidentology

Because of its potential for intelligent processing of massive data, AI opens up promising possibilities for OSH players. Here, we think of uses in certain fields:

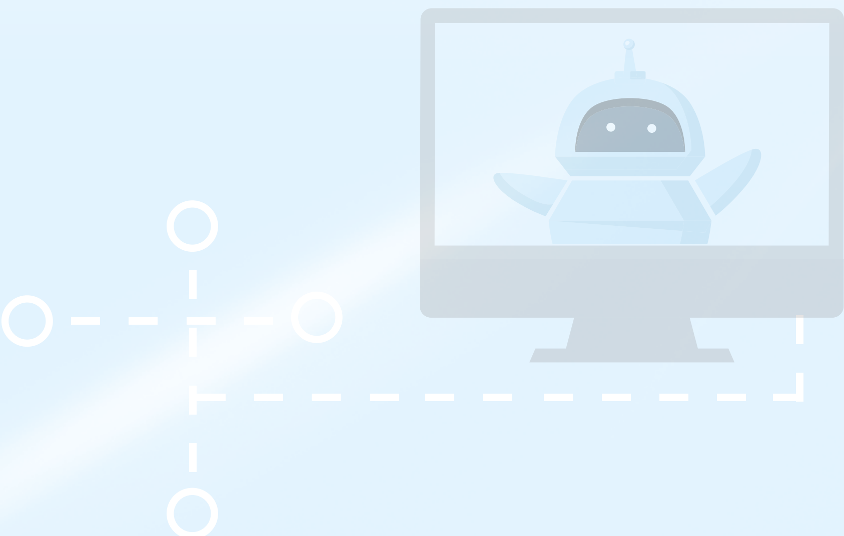
- In epidemiology, AI can offer new possibilities for sophisticated and rapid processing of data collected for populations of interest in terms of vulnerability, exposure, etc. But also perhaps better crossed mining of different databases (health indicators, professional trajectories, personal and air measurements, etc.).
- In accidentology, automatic language processing systems also promise better use of poorly structured data, textual data (e.g. death certificates, but why not occupational accident declarations in the future, data from occupational health departments relating to medical fitness, feedback databases such as Épicéa, intra-company data: machine dysfunction registers, occupational accident and disease data stored in specific software, QSE surveys, etc.).

The use of these tools to optimise the use of data contained in scientific literature is also to be considered; it goes beyond the field of accidentology.

Development potential

The main factors likely to accelerate the development of these types of uses are:
– the availability of large volumes of quality data,
– stakeholders' desire to share and use their data, and the implementation of a framework to do so under the right conditions (data protection, database compatibility, etc.),
– the increase in data storage and processing capacity,
– the improvement in the performance of AI tools to reach a significant reliability level.

The benefits expected are progress in risk assessment and analysis, which should bring improvements in prevention.



Assets and problem areas for OSH

The development of these tools offers interesting prospects in terms of risk prevention and the medical follow-up of workers. In particular, they can make it possible to detect new risk factors (or combinations of factors) both for accidents and diseases. It is also possible to imagine improvements in the follow-up of workers' health all throughout their career and particularly populations whose follow-up poses difficulties to institutional players such as seasonal and temporary workers.

The main concerns are related to the data necessary for the functioning of these systems. Protection of these data is a major challenge, since it is a matter of guaranteeing that personal data, particularly health data, are secure, of being transparent regarding the purpose of this data processing, and preventing misuse of the data. In addition, the quality of datasets, particularly those that will be used to train the AI systems, is decisive. The nature of training data will have to be representative of the situations handled and inversely, the uses will have to be limited to the projected areas of applicability, corresponding to the training data used.

In the long term, these systems can change occupational health approaches. In particular, they can promote greater individualisation of worker follow-up by integrating personal risk factors (genetics, lifestyle) along with professional risk factors and therefore lead to increasingly individualised prevention measures, which raises ethical questions. There is therefore a major issue surrounding the skills, objectives and control of players that develop and use these tools.

Implications for OSH players

Health monitoring and prevention players are confronted with the matter of upgrading their skills regarding the understanding of these solutions. They will not only have to be able to conduct studies on these systems, but they must also develop the ability to advise and support stakeholders: administrations, OSH practitioners and social partners, etc.

The involvement of occupational safety and health bodies in standardisation institutions, and dialogue with regulators will also be important to ensure that the solutions developed improve prevention and do not drift from the occupational health approach.

They will also have to be able to manage a few possible pitfalls. On the one hand, the risk of focusing on the tools themselves, to the detriment of other missions and approaches. Since these tools are dependent on the data available, they can steer the attention of players towards fields or populations for which they have data to the detriment of others, made "invisible" because of the lack of usable data available (this could be the case with organisational factors for example). On the other hand, if the developments of these devices require specific skills and major data storage, protection and processing capacity, they will only be able to be managed by players having considerable resources (public or private). This could contribute to the centralisation of occupational safety and health management and possibly to the widening of a gap between the centralised management data coming from these tools and actual work contexts in companies.

2. AI security technologies for work environments

Artificial intelligence makes it possible to extract meaning from considerable volumes of data. This is particularly the case for the analysis of real-time video and audio flows, speech and biometric data. Combined with connected collection devices, AI algorithms can perform instantaneous or consolidated surveillance of situations observed. For OSH, numerous initiatives promise to warn about imminent hazards or prevent chronic disorders by informing operators about bad practices. These applications fall under two categories: scene surveillance objects (e.g. intelligent cameras for detecting hazardous situations in warehouses) and wearable technology which measures and transmits biometric data on the worker (e.g. measurement of heart rate for the prevention of cardiovascular diseases) or the position of joints (for the prevention of back pain).

These solutions aim to secure work environments by using devices for real-time analysis of data collected by connected objects. They function with the use of sensors that can measure different types of values, and switches. Here, we will distinguish between two types of uses of these surveillance systems:

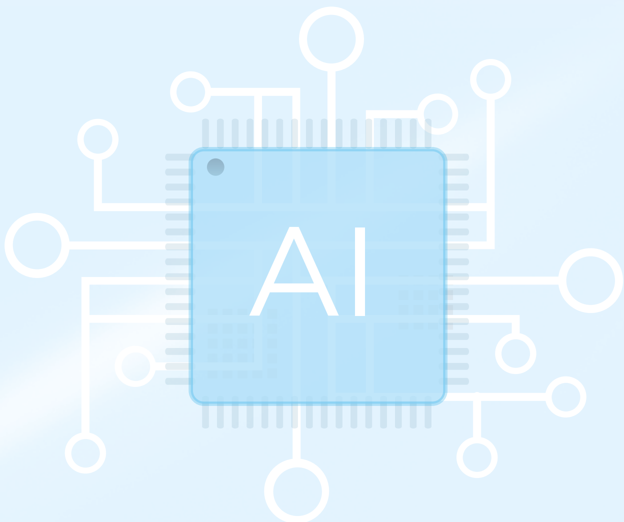
– systems aimed at monitoring the work environment and able to trigger a warning before the occurrence of a hazardous phenomenon: emission of a toxic product, proximity of moving equipment, etc. These systems are defined here as detection solutions;

– systems aimed at monitoring the workers themselves. This can be connected PPE carrying out regular measurements of biometric data, or work equipment fitted with biometric measurement sensors.

Development potential

Currently, progress is related to the change in calculation power which increases performance and precision. Energy consumption of embedded chips is also increasingly low. Developments in the quantum field could further increase this calculation capacity and thus increase relevance, compacity, and reduce energy consumption (vehicles). All of this can ultimately reduce the prices of these solutions, which heavily limit their deployment for the time being.

5G technology will also ensure a high level of security by reducing latency.



Assets and problem areas for OSH

The ease-of-use of these technologies allow for the development of new effective tools in the field of occupational risk prevention, which can contribute to significantly reducing accident rates. They provide the possibility of securing environments including for employees not trained or made aware of sites' safety rules (such as temporary staff, new hires and external workers). With the availability of these tools promising improvements in the safety of work environments, it could lead lawmakers and judges to strengthen their requirements concerning employers' resource and performance obligations. Lastly, because of the information they can provide on risk situations and behaviour, they can assist with targeting prevention actions based on the occurrence of near-misses and prioritising the training of certain audiences: temps, new hires, maintenance operators.

However, inappropriate use, misuse or the absence of prior consideration about how to integrate these new technologies could lead to negative occupational safety and health effects. The ease with which these solutions are used and implemented can encourage players to only take into account the risks identified by the machine without regularly assessing more organisational risks. The unawareness of the possible faults of these tools could lead to a drop in both employees' and employers' vigilance. This non-accountability, both collective and individual, in terms of prevention could be accompanied by the appearance of deviant behaviour (such as attempting to avoid being monitored by these technologies) which can possibly generate accidents. These tools can also promote the development of more coercive rather than preventive approaches, with the effect of transferring responsibility onto the employee in the case of accidents.

Misdirected from their initial prevention purpose, these technologies can also facilitate intrusive surveillance of employees both regarding their health status, through the collection of data (heart rate, medical follow-up without formal agreement) but also their work behaviour and pace. Such surveillance can intensify work for employees that know they are being watched and lead to psychosocial risks or an increase in accidents.

Implications for OSH players

The collection and exploitation of large volumes of data on workplaces offers an unprecedented analysis opportunity to objectify exposure and reveal certain risk factors.

Combining and pooling data from different companies in the same sector to build a base under the auspices of research bodies could propel research in the field of prevention and occupational safety and health.

At the same time, given the consequences of potentially harmful uses of these emerging technologies, an effort to inform and train prevention practitioners and companies is desirable to convey the points to watch and keep in mind, and the good practices to follow when they are being implemented.

Lastly, prevention practitioners will be responsible for warning and reminding companies that these tools are not safety systems and that they do not exonerate them from the risk assessment and prevention approach they must implement in their companies.

3. Advanced robotics using AI

Certain advanced robotics technologies (with embedded AI) offer potentially beneficial solutions for OSH. For this workshop, two types of uses were identified: tele-operation which distances the operator from hazardous situations, and man/robot collaboration which makes a robot capable of collaboration execute tasks that are physically arduous for operators.

- Teleoperation: Remotely piloted compactors and rock-breakers in the building and public works sector distance operators from these dangerous machines. But for more complex tasks or tasks to be performed in dangerous spaces, remote control is not always possible. In these situations, the machine must incorporate part of the expertise and abilities of the human operator (or even greater capacities). Examples are stereoscopic view, moving in an environment made for humans or picking up objects. In these cases, the remote operator only controls macro orders such as “go to such-and-such place”, “open this door”, “perform mission XDK74”, etc. This is known as teleoperation, which requires advanced robotics functions using AI.

- Collaboration: Collaborative robotics defines the conditions under which an operator can work in close proximity with a robot without the risk of bodily harm. There are three types of collaboration:
  – direct collaboration where the operator and the robot work simultaneously on the same part;
  – indirect collaboration where the operator and the robot work alternatively on the same part;
  – the sharing of the workspace where the operator and robot work independently in a common space.

In order to be safe, these collaborations require the robot to have very acute faculties to perceive the actions of its human co-worker. These faculties may use AI.

Development potential

These two types of uses are expected to be deployed if the following progress is made:
– democratisation of the technology (purchase, integration, operation and maintenance costs);
– extension of operational functioning to other fields;
– increase in acceptability and trust by human collaborators;
– improvement in the quality of integration of these technologies in work organisations (transparency in the goal sought by this integration (increase in productivity or reduction in arduousness), team preparation and consultation, pace at the workstation, support for change, training).

For these two fields of application and in the medium term, development potential depends on two issues:
– the increase in the flexibility of this equipment (variability in products and tasks);
– the increase in the capacity of this equipment to perform more complex tasks.

Assets and problem areas for OSH

The main advantage of these technologies lies in the reduction or elimination of the risks to which operators are exposed, thanks to the replacement of the employee by the robot at confined or polluted sites, or for repetitive tasks or the handling of heavy loads.

They could also favour the retention or return to work of operators relieved of the physical part of the job. In addition, they can provide an opportunity to requalify operators, who, once relieved of repetitive tasks henceforth performed by robots, can increase their skills, particularly in areas related to maintenance and supervision of these new tools.

However, these technologies can also cause the emergence of certain risks.

A work organisation that would not have involved experimenting beforehand and collective consideration of these new tools could lead to a harmful increase in work pace, because of the maintenance of production objectives to which is added maintenance and supervision activities. The replacement of the employee by the robot can also lead to a loss in practice, and therefore to the gradual deskilling of labour, devaluation of operators, a reduction in their autonomy and their job potentially no longer having any meaning for them. The resulting psychosocial risks can therefore be numerous.

Moreover, unexpected behaviour by the machine, caused by an unforeseen situation or cyberattack, could lead to reflexes on the part of workers to remedy situations or intervene in degraded situations which can cause accidents. The resulting loss of trust could lead to an abandonment of these technologies despite the advantages they represent.

Implications for OSH players

Prevention players, because of their multidisciplinary practice, their expertise in mechanical and organisational risks and in legal systems, can support the emergence of these technologies and intervene upstream, during development. However, these players are currently faced with a lack of skills concerning artificial intelligence and intelligence robotics and experimental fields.

In the future, an evaluation of the relevancy of using these tools – performed through social dialogue within companies – could be promoted by suitable methods. These could emerge from horizon scanning and research work concerning specific risks related to AI and collaboration among players. This research can also contribute to validating the robustness of systems, and updating regulations. Information and awareness-raising products can also emerge.

Efforts to train OSH practitioners, designers and employees are necessary to enable stakeholders to discuss these topics and build trust and acceptability.

Annex

The methodology in five phases

This exercise was led by a multidisciplinary working group made up of experts and backed, from the methodological point of view by Futuribles.

It was conducted in five phases.

1. Collective definition of the topic and its scope

Because of the technicity of the topic, the definition of concepts was an important stage when this exercise was undertaken. Guidelines were used as a base at the first meeting of the working group, aimed at clarifying concepts and delineating the topic. The time horizon of the exercise was also defined during this phase.

2. Analysis of the topic

The analysis of key factors enabled the establishment of a list of 12 variables distributed across three components: evolution in the AI offering, acceptability of possible AI uses, work and prevention. The drafting of each variable sheet was entrusted to a group member then discussed in meetings.

3. Development of scenarios

On the basis of the development hypotheses for the different variables, four scenarios were established. They had to be contrasting in order to explore a sufficiently broad range of possibilities.

4. Study of uses

Three workshops were then organised to pursue reflection on the possible uses of AI and its potential consequences in prevention both for OSH actors and for employees' working conditions. These workshops were conducted based on the different contexts envisaged in the scenarios, with an attempt to consider all consequences both favourable and unfavourable in three possible areas of use: epidemiology/accidentology, surveillance of workplaces and workers, advanced robotics.

5. Drafting of key messages

A last series of exchanges with the working group and experts outside of the group resulted in a list of 22 key messages, the main lessons drawn from this exercise.

Notice to readers

Foresight studies are not about predicting the future. They are also not a forecast of what would be the continuation of past trends.

Foresight studies take into account trends and discontinuities to describe possible futures and propose decision-making support.

The work presented in this document is the outcome of a collaboration. It does not necessarily reflect the opinions and desires of the participants that contributed nor those of the institutions to which the participants, nor INRS.

Within the framework of its foresight activity, INRS directed a collective investigation into how systems incorporating artificial intelligence could be used to improve occupational safety and health by the year 2035. What are the opportunities and threats for occupational risk prevention? In what fields can progress be made? Under what conditions? How can players become prepared?

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

Édition INRS PV 23

1re édition | mars 2023 | ISBN 978-2-7389-2823-8 | uniquement pour le web
Mise en pages : Valérie Causse

L'INRS est financé par la Sécurité sociale
Assurance maladie - Risques professionnels