THE DEVELOPMENT OF DYNAMIC RISK ASSESSMENT AND ITS IMPLICATIONS FOR OCCUPATIONAL SAFETY AND HEALTH

Introduction

Risk assessment is the cornerstone of the European approach to occupational safety and health (OSH) (EU-OSHA, 2020). Employers in Member States are obliged to conduct a workplace risk assessment that would allow the identification, assessment and management of risks for safety and health at work (Article 9.1.a in the Safety and Health Framework Directive 89/391/EEC). However, the third wave of the European Survey of Enterprises on New and Emerging Risks (ESENER) in 2019 has revealed that the actual ratio of workplaces that perform a risk assessment regularly varies from about 42 % up to 94 % for the different EU Member States (EU-OSHA, 2020). It is not so easy to explain these differences, but ESENER shows that, across Europe, there is a positive correlation between the size of the workplace and the level of compliance: the larger the workplace, the more likely it is to perform a risk assessment that is revised and validated regularly. SMEs are often more difficult to reach out to (EU-OSHA, 2020) and some never perform a risk assessment at all due lack of expertise, resources or understanding. This is troublesome, not just from a regulatory viewpoint but for workers as well.

One way to support companies to conduct risk assessments is to offer appropriate easy-to-use (e-) tools, which can facilitate the risk assessment process. The idea is that easily accessible tools yield results quickly with sufficient rigour. The European Agency for Safety and Health at Work (EU-OSHA), for example, has developed a series of online interactive risk assessment tools called OiRA (https://OiRAproject.eu/en). OiRA can be applied for a number of different establishments and activities, and it is currently used by thousands of enterprises across the EU (EU-OSHA, 2021a). A number of additional tools have been developed at a national level, such as:

- BeSmart.ie: https://www.besmart.ie/,
- Rie.nl: https://www.rie.nl/,
- Prevencion10.es: https://www.prevencion10.es/.

Moreover, a number of supporting digital tools have been developed focusing on specific risks that can be used to provide effective input when conducting a risk assessment, such as:

- noise: https://www.av.se/en/health-and-safety/noise/mata-ljud-och-buller/noise-exposure-app/,
- chemicals: https://www.seirich.fr/seirich-web/index.xhtml.

As such digital instruments proliferate, there is at least some confidence that they are successful in supporting workplaces in Europe. Together with the development of monitoring technology, sensors and artificial intelligence (AI) for the use of health and safety, this is a good time to consider the future of digital risk assessment technologies. This paper investigates how business and industry are taking the next step in risk assessment. In fact, their avances are to be so profound that they deserve their own term: dynamic risk assessment.

This paper provides insights into dynamic risk assessment by addressing the following questions:

1. What is dynamic risk assessment and how is it different from our current understanding of risk assessment?
2. What are the benefits of dynamic risk assessment for occupational safety and health (OSH) and what are sensible starting points for its development?
3. What are the unwanted effects of dynamic risk assessment for OSH and how could these effects be diminished?

4. What would be the effects of dynamic risk assessment on employers, employees, OSH experts and policy-makers?

To answer these questions, this paper approaches the issue from two perspectives to answer these questions. The first perspective is based on a business approach to risk management by McKinsey (Jain et al., 2020). This perspective provides a sense of urgency and explains why the word 'dynamic' is added to risk assessment.

The second perspective sees the process safety industries as front runners in dynamic risk assessment methods. These industries felt the need to change after landmark incidents in the early 2000s and considering risk as more dynamic was one way of trying to improve Risk assessment and prevention.

But before that, this paper will link key concepts on risk and risk assessment to understand the main aspects of dynamic risk assessment.

Linkage of key concepts

In order to take advantage of practices and considerations applied in other domains that deal with risk from a different perspective, a fairly broad framework of understanding is necessary; specifically, the relation between the concepts risk, management, assessment, barrier and OSH needs to be explained to facilitate the discussion about 'dynamic risk assessment'.

As the Framework Directive (Framework Directive 89/391/EEC) does not define risk, we turn to ISO standards and specifically to ISO 31000 and ISO 45001 for a broad definition that is suitable for the OSH domain: OSH risks are the combination of the likelihood of occurrence of a work-related hazardous event or exposure, and the severity of injury or ill health that can be caused by the event or exposure.

The ISO standards offer an international perspective on the definition of risk that is useful in this discussion. But, significantly, the standards introduce the wider organisational conditions, tasks, methods and responsibilities that organisations may choose to perform to ensure that the risks are controlled. That helps define **'risk management'** as a broad collection of organisational characteristics and instruments, most of which are not exclusive to the risk vocabulary. Elements such as communication, leadership, stakeholder engagement, design and competence are important for risk management but also relevant in other domains (such as financial management and productivity). **'Risk assessment'** is a process unique to risk management. Its role in the system is to clarify exactly what risks are prevalent in a specific workspace, how serious those risks are in relation to other risks and how they change over time. The assessment can also include the expected effect of protective measures. The objective of the assessment is to provide evidence to support decisions about whether and how the risk has to be dealt with. This relates to employers' responsibilities to decide on protective measures for their staff and for providing the necessary equipment and training.

As a matter of principle, the ISO standards envisage that risk management and assessment are **'dynamic'** concepts. ISO 45001 proposes the Plan-Do-Check-Act cycle to address the dynamics. The Framework Directive (89/391/EEC) also recognises dynamic processes: Article 6, point 1 shows that employers need to adjust health and safety measures when faced with changing circumstances and aim to improve health and safety. Of course, the frequency of adjustment is not strictly defined.

Summarising, risk management is the broadest concept addressing many aspects of organisations' efforts to eliminate or reduce risks of any kind. OSH (risk) management focuses on the control of occupational risks. Risk assessment is a specific process within risk management to investigate risk and facilitate systematic decisions about preventive measures. It is within this framework that the concept of dynamic risk assessment, needs to be understood; the real differentiator being the addition of the word 'dynamic'. So why do various actors call for 'dynamic' risk at all?

Perspectives on dynamic risk

The first perspective originates from the business environment dealing with the need for change. Despite obvious differences to the OSH field, the implications are relevant for OSH. A recent report from a business consultancy perspective explains why risk methods need to change and why they have to become much more dynamic (Jain et al., 2020). The argument starts with the fact that the world of business has changed substantially: the digital revolution, climate change, shifting geopolitical forces and changing stakeholder expectations demand that organisations **become more flexible, respond quicker and become more efficient**. The report suggests that dealing with risks needs to change in the following areas:

- hyperdynamic risk identification to keep pace with the rapidly changing business environment;
- dynamic risk assessment and decision-making to deal with rapid changes in market demands, social responsibility and work; and
- dynamically deciding on the appropriate risk controls and preventive measures.

Starting with the latter point, the dynamic decision-making on risk controls, this can be associated with the concept of **resilience**: organisations have to be resilient to rapid (technological) business change and install or remove controls quickly and efficiently. A poignant example related to OSH is the urgent distribution of face masks or adaptation to remote working (from-home) practices as part of the COVID-19 pandemic countermeasures. Almost overnight, OSH experts have had to deal with safety concerns of face masks and safe working places at home. The speed with which these changes occur do not just call for rapid risk assessments but also for new or better management structures; one of the more common ones being more interactions with stakeholders, decision-makers and legislators and, let's not forget, learning about the risks of COVID-19. The introduction of these OSH safety measures took place at a very high speed, often overruling or bypassing standard OSH processes. Committee-based governance processes may take a long time to result in a decision and more effective ways of making decisions are needed in order to mitigate risks quickly and efficiently (Jain et al., 2020).

The second point on dynamic risk assessment refers to the rapid and fundamental changes in their business that organisations are faced with. And there are many changes that organisations face today. Going back to our example for OSH experts in the COVID-19 crisis, organisations had to assess and decide very quickly which staff are critical for business (and would have to come in to work) and which could work at home.

This brings us to the first point: hyperdynamic identification of risks to keep pace with a rapidly changing environment. A key component is that organisations, but specifically those that operate in volatile markets, have to anticipate, assess and observe threats based on uncertain internal and external information. Returning once again to OSH in the COVID-19 crisis, safety risks were not limited to exposure to the virus, but also related to musculoskeletal complaints for people working at home, mental health issues with self-isolation and risks associated with face masks. With that, there is also a need to predict the future of risk: how will risk play out over time and what can we do now to mitigate the effects?

In general, risk identification, risk assessment and the management of preventive measures need to become more responsive and flexible (Jain et al., 2020). Moreover, according to the same report, there are five solutions to facilitate the change.

The first is to **elevate risk management in businesses** to a more central instrument to support strategic decision-making. Together with the second solution, to establish **agile practices** to understand the nature of risk quickly, this means that risk assessments have to be done quicker, on a wider range of risks and to a higher degree of quality. For OSH experts, that means that key information about the occupational risks has to be readily available for risk assessments, it has to be aligned with key information from other risk domains, and OSH experts have to come up with creative OSH solutions quickly and deploy them promptly.

The third solution is to **digitalise risk assessment and management**. Data on OSH risks have to be much more accessible and have to be analysed faster, and the data should readily flow into a consolidated risk profile with other risks (like financial risks and process risks), supported by technology. That data can be from OSH data systems such as the e-tools described in the Introduction; but, equally,

incident reporting systems and external OSH data sources could be useful: industry databases, data from statistics bureaus, public health data and other monitoring data.

Solution four is that **OSH professionals and risk managers need to be better prepared for the new realities of digitalisation** and **the dynamics of business** today, regarding the urgent need as well as the growing possibilities in monitoring technologies and data collection via the Internet of Things and so on. To keep up with the realities of a digitalised world, their training has to be modernised to include data analytics as well as broadening their horizon to understand risk in more diverse domains. At the same time, stronger leadership skills need to be developed along with other non-technical skills to lead multidisciplinary teams and extract relevant knowledge from colleagues and stakeholders.

Readily understood by OSH experts, solution five is to build **a strong risk culture where safety and risk experts are at the front line**, where executives are held to account for achieving a healthy risk culture and employees are fully engaged. This business perspective seems to overlook that this solution has long been of interest to OSH experts.

It is easy to see how this approach is attractive for large organisations, especially those in high-risk industries; it isn't surprising that the large chemical companies were among the first to work on dynamic risk management. For smaller organisations, which often seem to lag behind regarding the implementation of risk assessment tools (see also in our Introduction), such solutions could be very useful, yet they tend to be too costly. In this regard, sectoral associations or industry associations may provide sufficient size to develop digital OSH solutions for their sectors. For SMEs, more advanced national digitalised OSH solutions should be developed, also as a next step or at EU level OiRAproject.eu.

This paper chooses a single perspective from a business perspective to explain that ideas about risk are changing. This view is shared by other business leaders (Kaul et al., 2018; Terblanche & O'Donnell, 2018) even though they have developed their own perspectives. What binds them is that risk analyses have to be done much quicker, based on data, and respond to sudden and large changes in the organisation.

In OSH, as a relatively self-contained working domain, digital tools are entering the market (see the e-tools examples in the Introduction), but the need for speed seems to be less pressing. At the same time, suggestions about culture building, establishing risk assessment methods and stressing the importance of risk analyses fall well within the expertise of OSH experts. From that perspective, it can be assumed that the processes need to speed up with digital tools.

Process safety pushing 'dynamic' forward

The origins of the terminology 'dynamic risk management' in relation to safety stems from process safety. Process safety focuses on preventing leaks, fires and explosions in chemical process plants to prevent people from being hurt at work (through the Framework Directive 89/391/EEC) and the environment (Seveso Directive 2012/18/EU, European Commission, 2012). As the industry mostly comprises large, financially strong companies in a high-risk environment, it comes as no surprise that they are paving the way for making the risk domain more 'dynamic'. An early paper relates directly to the Texas City Refinery explosion in 2005. Five years after the incident, Kalantarnia et al. (2010) published a paper that combined mathematical risk models with incident records stretching over an 11-year period to find that the risk of an accident was continuously increased to 37 times the original risk. The author fused the mathematical model with data to create a 'learning model' to demonstrate that deterioration of equipment and neglect in maintaining the systems led to a dynamically increasing risk.

Pasman and Rogers (2014) used the same accident, the Texas City Refinery explosion in 2005, to argue that controlling safety benefits from continuous monitoring of process safety indicators (preferably leading indicators). These authors also proposed to update mathematical models with data, albeit this time being mathematical models of the chemical process plant.

The Deepwater Horizon disaster in 2010 seems to have accelerated the interest in data-driven risk management methods as more papers were written in the years following that accident (e.g. Khakzad et al. 2012, 2013; Vinnem et al., 2012). These papers actually set off a new tradition of analysing and

optimising mathematical approaches to risk assessment. The Norwegian school with Vinnem worked towards management support systems (in the 2012 case, to understand risk-inducing factors to plan safer maintenance tasks and the Canadian school with Khakzad and Kahn worked on improving mathematical assessment tools.

By 2016, sufficient papers had been produced to conduct a review on the subject (Khan et al., 2016). This work uses the term **dynamic risk assessment** to explain the updating of risk models as a continuous task, with automated data linkage as an ultimate goal. Again, mathematical models for risk assessment play a central role. In that same year, Pitblado et al. (2016) forged the connection between data systems and dynamic risk management, using data to update risk assessments with requests for work permits so they can be accepted or denied based on target risk levels, thus ensuring that the risk level never exceeds a certain threshold level. From that point on, 'dynamic' extends to digitised safety management systems and the methods have proliferated into other risk domains.

These papers show how major disasters have nudged chemical process safety experts to accelerate dynamic approaches in risk. The objective of these early works was to understand deteriorating safety standards, to introduce time as a relevant factor in mathematical risk assessment methods to assess risk levels, and to minimise risk in the workplace. Note that this shift may be strengthened with the increase of sensor networks measuring all kinds of risk parameters. The methods that are associated with dynamic risk management or dynamic risk assessment are well lodged in the field of technical risk analysis today and many are published on the subject, even if the terminology isn't necessarily repeated.

The important lesson for OSH is that the interests and incentives for dynamic risk analysis in the process industries are similar to those for OSH: controlling deteriorating systems, controlling risks for workers, and making reasonable judgements safety. The main differentiator is that chemical process safety requires detailed analyses of a vast number of technical systems while OSH management does not. For that reason, there may be fewer opportunities to perform complex mathematical assessments in OSH. On the other hand, OSH management deals with a complex interplay of technical, human and environmental factors; and with the development of monitoring technology, sensors and AI for the use of health and safety, more and more data are becoming available for OSH purposes. Boxes 1 and 2 illustrate what dynamic risk assessment could look like in OSH management.

Box 1. Dynamic risk Assessment with the Risk Matrix

The risk matrix originates from the United States Department of Defense (DoD) military standard 882, which had at least five iterations (, 2012). Especially in the field of safety, it is used by OSH experts, as well as employers and policy-makers to visualise risks in a tabular format. When it is not prescribed by policy-makers, employers may choose to use it in their organisation.

The risk matrix indicates severity on the horizontal axis (in four steps: catastrophic, critical, marginal, and negligible) and probability on the vertical axis (in 5 steps: frequent, probable, occasional, infrequent, rare). Each of the boxes in the matrix are assigned with risk severity levels (in five steps: high, severe, medium, low, and eliminated), where each level prompts different decisions as to how to act in that particular risk situation.

This example uses a possible configuration alongside hypothetical OSH hazards for a storage area. Three hazardous situations are enclosed here: fire, a collision of forklifts, and a wet floor causing pedestrian slip-trip-falls (STFs).

Figure 1: Hypothetical risk matrix for a warehouse

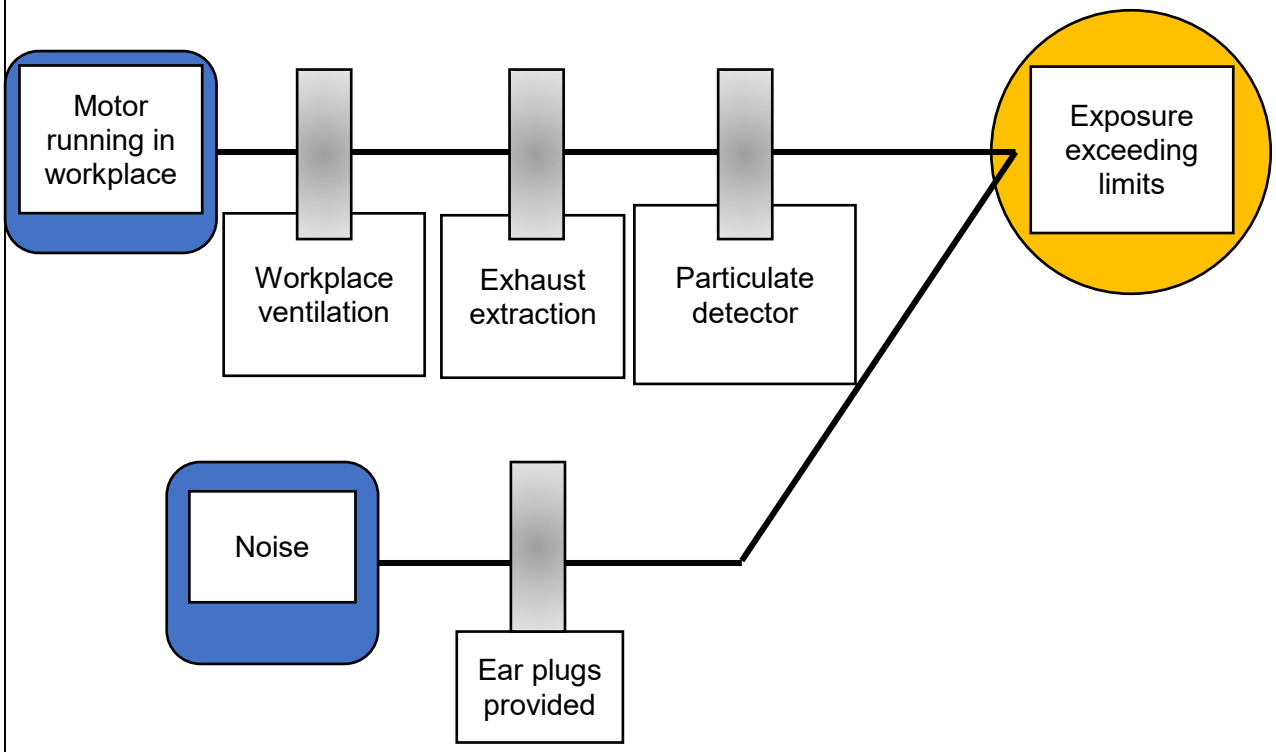
	Catastrophic	Critical	Marginal		Negligible
Frequent					
Probable					
Occasional		forklift collision			
Infrequent			wet floor-STF		
Rare	fire				

OSH experts tabulate all situations in which the OSH hazards can occur and use reference lists to decide in which box of the risk matrix the situation belongs; this process can be digitalised using digital evidence to support the actual risk assessment. This hinges on the idea that the evidence for selecting a specific box in the risk matrix is often stored digitally; for instance, in records for incidents causing prolonged sick leave (which the Framework Directive mandates), but for dynamic risk assessment it is more interesting to collate near misses, maintenance reports and complaints. The linkage of such databases should provide better insight into frequencies of incidents involving named hazards and as such provide evidence for placing them in the right box in the risk matrix. That same method can be used to monitor and highlight that a particular risk (e.g. forklift collision) is changing over time, perhaps because the number of incident reports increases or perhaps because there are many inexperienced staff working on site on a particular day. With sufficient data (from a single organisation, an industry or on national level), algorithms could allow for dynamic indicators to monitor all hazardous situations.

Box 2. Monitoring preventive measures

Much of the work of OSH professionals is related to maintaining safety levels, or the maintenance of preventive measures (referred to as barriers in the process safety domain). BowTies offer one way of monitoring preventive measures in a consistent manner. This example features exposure to diesel soot in garages; Figure 2 shows a part of a hypothetical BowTie.

Figure 2: Part of a BowTie for exposure to hazardous materials



The grey bars are the preventive measures (barriers) that may result from the risk assessment process indicating that controls are necessary to keep risks at acceptable levels. The risk assessment itself may have been done with data-driven methods such as those described in Box 1, but here we focus on the integration with data from preventive measures. In this case, the particulate detector is a constant monitoring system that counts particulate mass per cubic centimetre every minute. It is connected to a digital system to read the measurements out. In this example, that data for calculating accumulated exposure is a proxy for air quality; with adequate thresholds set, the quality can be visualised as a traffic light (red, amber, green). Equally, the flow rate of the ventilation is monitored and so is the number of exhaust activations, each gathering information about the state of that particular preventive measure. But what makes the use of any of these data streams really 'dynamic' is that they can be used to monitor the conditions and performance preventive measures in almost real time, which allows real-time interventions that go beyond alarms.

If sufficient data can be collected from this and other detectors, the level of exposure (and risk) may be predicted based on weather, workload or type of car tested. Equally, it can be used to calculate the level of exposure to workers and for predicting long-term health effects. With personal detection monitors becoming cheaper, they also offer attractive data sources for dynamic risk assessment and risk management. at go beyond alarms.

Discussion

This paper aims to explain what is new about 'dynamic risk assessment', what it could mean for OSH, and whether and how experience can be transferred from the front runners. Clearly, dealing with risks is dynamic by nature; the Framework Directive (89/391/EEC) and ISO 45001 show this clearly. It cannot be a surprise to anyone working in the field of OSH that risk management, assessments and controls need to be updated when new insights are found, serious accidents have happened, laws change or new safety solutions are developed. Yet, the developments in other domains prompt us to think about the future of risk assessment in an OSH working environment. This section discusses the more pressing ones.

Dynamic risk assessment as a vision for the future

The perspective from business risks shows that we need to be more dynamic because the world is more dynamic. Business is becoming quicker and risk itself is more dynamic than it used to be. The trend is rooted in digitalisation that speeds up business operations and decision-making. The message for OSH experts is that their processes need to be quicker, more flexible and based on digital evidence systems.

The views from process safety support the views from business but take a more practical approach. These industry havs developed methods to support dynamic risk assessment and risk management.

This vision for the future is not without controversy for OSH experts. When complexity of systems increases, OSH experts can be confronted with automation and digitalisation while safety is at stake (EU-OSHA, 2018). But with e-tools in the market, it seems that the OSH domain has to follow suit, but nearly every aspect of digitalisation will have to be scrutinised before it can be applied.

Benefits

The viewpoints from business and process safety demonstrate the advantages of dynamic risk assessment, but they boil down to a few basic benefits. Aside from making risk assessment more accessible to employers (and SMEs) in Europe, they could assist companies to become (better) able to adapt to fast-changing dynamics in business or technology. This puts organisations in a better position to respond to changes in business processes and their associated OSH risks.

Another benefit is that the digital system offers rigidity to risk assessment and risk management. Once thresholds are set, tasks are programmed and inspections planned, the execution is rigid and deviations are easily detected. This helps to make risk controls (prevention measures) consistent and traceable. On top of that, digitalisation increases the speed of the process whilst minimising human effort.

Digitalised systems also force consistent methods for collecting data. When a lot of data options emerge for detection of weak signals, connections between risk factors that remained hidden in normal operation become visible. Also, when large amounts of data are collated, it may be possible to perform some risk forecasting, but that is very much dependent on the quality of the data. The analyses could be done by third parties (i.e. not the employers), taking advantage of technological advancements (such as highly sophisticated algorithms, Big Data, powerful processors and so on) so that high-quality assessments can be provided with a minimal effort.

With the introduction of digital systems, there are also options to link directly to other digital systems that may contain relevant information. Duty rosters, weather forecasts, maintenance reports, work permit software and auditing software could provide useful information to inform risk assessment with a much broader knowledge base than before.

Drawbacks

At the same time, there are significant drawbacks. Some processes that are key for OSH cannot be readily digitalised. Safety culture is one of those: notoriously difficult to measure and even harder to influence, improving safety culture remains fundamentally a human effort. The same rings true for leadership; an OSH manager's skill to lead their organisation to safety excellence is a fundamentally human effort. Communication and trust are similar, but there may be help from social media. Recognising these human skills, an OSH expert can use data systems to tailor their interventions more

precisely on specific OSH issues. If data systems show that the use of face masks is deteriorating, they can intervene on that specific issue rather than focusing on improving safety culture. The intervention itself, however, requires a human touch.

Another drawback (a drawback that front runners don't advertise) may be cost. Not all organisations, especially SMEs, may be willing or able to spend money on dedicated OSH software. Here lies a challenge for software developers: they have to develop systems that make OSH delivery effective and efficient for a group of users. At the same time, they have to demonstrate that they use data in a trustworthy manner and that data is protected well. Even if organisations upgrade risk management to take up a more central role, and fund data systems accordingly (as the earlier mention report (Jain et al. (2020)) suggests), it doesn't necessarily mean that OSH concerns become more central to the organisation. Another way to address cost limitations is for organisations to work together in trade associations or perhaps on a national level. That would introduce harmonisation concerns as well, but it could also offer opportunities to learn from each other's safety incidents.

Another complication is that OSH legislation tends to change slowly: OSH regulations may survive years and sometimes even for decades. For example, the Framework Directive 89/391/EEC has been in place for more than 30 years. This not entirely surprising because basic legal attitudes to work-related injury and death do not change quickly. For employees, this may actually be acceptable; for them it doesn't matter much whether their health is affected by a 19th-century lathe or a futuristic cobot. But for software solutions that can change overnight, it might be helpful if there is some guidance (e.g. machine-readable definitions or machine-readable legal text).

And then there is a cultural issue. Not all OSH experts welcome the digitalisation of their work as it increases their distance to people and their (OSH) concerns. With digital systems, data are more readily available, which yields better and faster risk decisions, but more time is spent working with computers rather than with people. Remarkably, consulting companies actually suggest that risk management takes a more centre role in businesses, not just tucked away as a specialist department but at the heart of the decision-making processes in organisations. Even if they don't mean OSH risk management, it is surely an opportunity for OSH experts to rise to the occasion. But that invariably means the upskilling of OSH staff to deal with modern digitalised systems, agile projects and a lot more responsibility.

For policy-makers, especially those on a national level or an international level, it is hard to see what would change for them in the short term. From a perspective further away from the primary processes, digitalisation does not have such a significant effect on requirements for health and safety at work or the systems that monitor performance. From the perspective of policy-makers, it could be considered to digitalise their monitoring systems to keep up with accelerated dynamics in OSH. Also, they need to consider how OSH data infringes privacy, as in many policy areas across Europe.

A word on artificial intelligence

These days, any progress made in digitalisation automatically invokes discussions about AI. Once data are collected, it is invariably attractive to apply learning algorithms to forecast risks. But AI opens up a whole new discussion and EU-OSHA is not alone in addressing complications of AI in the workplace (EU-OSHA, 2018): the International Labour Organisation (ILO) addressed the issue in their report 'Negotiating the algorithm' (De Stefano, 2018); the International Electrotechnical Commission (IEC) published 'Safety in the future' (IEC, 2020); and a more generic approach to AI was published by the European Commission in their White Paper 'On artificial intelligence' (European Commission, 2020). It seems possible that the discussion about dynamic risk assessment or management and AI merge into one.

Conclusion and outlook

Dynamic risk assessment is a term that is used to indicate that risk assessment has digitalised and modernised to become more powerful and deal with digital data and fast-changing risks. A prominent driver for change comes from business leaders who offer their services for the widespread digitalisation that takes place throughout society. Scientific progress in the process industries has already developed

methods to implement dynamic risk assessments, albeit for their specific purposes. For the OSH domain, dynamic risk analysis functions as a reminder that there is a need to modernise.

Clear **benefits** for dynamic risk assessment are agility in a dynamic work environment, dealing with complex and complicated risk assessment problems, speed and consistency. **Drawbacks** are the same as they are for any ICT system: the skills gap, dependency on ICT expertise, cybersecurity and cost. Despite the drawbacks, several digital risk assessment tools have been developed, which suggests that OSH experts are embarking on the digital journey in various places in Europe.

Different OSH stakeholders are affected in different ways. **The OSH experts** are affected most because they will have to add some digital skills to their repertoire. They will have to understand what data go into the system and what they represent in terms of safety content, and understand when things go wrong. Also, they are most likely part of the architects of new systems and work with IT experts. **Employers** are most likely heavily involved as they decide on investments but don't need to know the precise details. **Also**, they are mostly affected because of their leading role in the transformation project and the skills gap and their control of costs. Employees are most likely to be users, so they don't need to know much about the systems but will have to work with them. However, employees as end users need to be involved to develop and address user requirements, privacy issues and other concerns that they may have.

Policy-makers may not have to do much in the near future, apart from emphasising that there are risks associated with using personal data. Also, they typically get involved when performance standards are raised or when specific solutions should be endorsed. Their role in the future may be to harmonise efforts, identify better practices and operate in a digital format.

In conclusion, from an OSH perspective, dynamic risk assessments represent a drift into digitalised risk assessments to deal with dynamic risk much quicker than we used to. The experience from other domains suggests that the approach is successful, which means that OSH risk assessment may have no choice but to follow their example. With several OSH risk assessment tools in Europe (like OiRA, BeSafe and RIE), we are already drifting into a digital future, but the driver is different; where OSH platforms focus on achieving higher percentages of workplaces performing mandatory risk assessments, dynamic risk assessment focuses on quicker performance. Note that there is no fundamental legal requirement in the Framework Directive or elsewhere that risk assessment should be done with digital systems; the incentive seems to be financial or simply attempting to work with the state of the art.

Author: Coen van Gulijk, TNO Healthy Living, University of Huddersfield, Delft University of Technology.

Project management: Annick Starren, European Agency for Safety and Health at Work, (EU-OSHA)

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