

NEW APPROACH RELATED TO THE EMERGING RISKS GENERATED IN THE OCCUPATIONAL ENVIRONMENT IN THE PROCESS INDUSTRIES

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Working environments are continuously changing under the influence of new technologies and of shifting economic, social and demographic conditions. In this context, the Community strategy on health and safety at work called on the European Agency for Safety and Health at Work to set up an European Risk Observatory to anticipate emerging risks (any risks that are both new and increasing) in the world of work, in order to ensure high levels of safety and health at work. The emerging risks were identified by means of the Delphi method. (that is based on an iteration process in which the results of the previous rounds are fed back to the experts for new evaluation). The experts invited to participate in this survey covered 27 European countries and the USA. The „top” emerging risks agreed by experts in the process industries are nanoparticles, diesel exhaust, epoxy resins and isocyanates, vibrations, thermal discomfort, new technologies (complex human-machine interfaces, automation), repetitive work, new/ precarious forms of employment contract, job insecurity, work intensification and outsourcing. European Risk Observatory focus on emerging risks in order to ensure, in the future, a high level of safety and health at work.

Keywords: emerging risks, industry.

INTRODUCTION

Because the world of work is constantly changing, multiple exposures is increasing and each year approximately 170.000 workers die in the EU-27 of the consequence of their work, according to estimates from the International Labour Office. As many as 160.000 fatalities can be attributed to work-related diseases (Ossian, 2009). The implementation of the REACH Regulation should encourage the industry to develop safer work environment as well as generate information on the risks in the occupational environment and the means of managing these risks and hence contributing to the improvement of workers’ protection. The Community strategy on health and safety at work 2002-2006 called on the European Agency for Safety and Health at Work to set up a risk observatory and to „anticipate new and emerging risks” in order to tackle the continuously changing of the occupational environment and the new risks and challenges it brings (<http://hwi.osha.europa.eu>). Between 2002 and 2006, the Agency took the first step towards establishing an European Risk Observatory. Four expert forecasts have been carried out through questionnaire-based survey following the Delphi method on emerging risks related to occupational safety and health on physical, biological, chemical and psychosocial risks. In total, 520 experts from 27 countries and one international organisation were invited to participate in the survey. The results of this expert survey on emerging risks should be seen as a basis for discussions to set priorities to manage these new risks in the occupational environment.

METHODOLOGY

Concept of Emerging Risk

An emerging risk can be defined as any risk that is both new and increasing (<http://www.inspectmun.ro/Ziua%20SSM%20index%202010/Ziua%20SSM.html>).

By **new** is meant that:

- the risk was previously unknown and is caused by new processes, new technologies, new types of workplace, or social or organisational change; or

New Approach Related to the Emerging Risks Generated in the Occupational Environment in the Process Industries

- a long-standing issue is newly considered as a risk due to a change in social or public perceptions; or
 - new scientific knowledge allows a long-standing issue to be identified as a risk.
- The risk **is increasing** if:
- the number of hazards leading to the risk is growing; or
 - the likelihood of exposure to the hazard leading to the risk is increasing (exposure level and/or the number of people exposed); or
 - the effect of the hazard on workers' health is getting worse (seriousness of health effects and/or the number of people affected).

Factors Generating Emerging Risks

New and emerging risks for workers and employers arise from:

- the development of new substances or materials with modified composition, such as epoxy resins with enhanced properties;
- the development of new technologies such as nanotechnologies and conversion technologies;
- continuously changing workplaces and work practices (new forms of employment contracts or non-traditional employment practices as outsourcing, temporary work, part-time work, flexible work);
- changing work processes: work intensification associated with shift in production organisation modes towards automation, shift in work organisation towards greater autonomy and more worker responsibility, greater individualisation of human resource management and change in work evaluation and control mechanisms.

Method to Identify the Emerging Risks: Delphi Method

The Delphi method is a methodology used widely to create foresight information on topics for which only uncertain or incomplete knowledge is available. This method is based on an iteration process with three survey rounds in which the results of the previous rounds are fed back and submitted again to the experts for new evaluation. Delphi process implemented for the expert forecast on emerging risk:

Expert identification

SURVEY ROUND 1

(emerging risks were identified using questionnaires with open-ended questions regarding risks of the next 10 years)

creation of a list of emerging risks

SURVEY ROUND 2

(validation of issues identified in round 1) The participants rated each item on a five-point Likert scale (strongly agreed as emerging, agreed as emerging, status undecided, agreed as non-emerging, strongly disagree as emerging)

prioritised list of emerging risks (complemented by new added risks) drawn up based on the mean values (MV) of the item rating and the standard deviation (SD)

SURVEY ROUND 3

(final consultation on prioritised list of emerging risks using the same five-point Likert scale used in the second round)

EXPERT FORECAST

For each risk, the MV of the ratings and the SD were calculated. While the mean values help to prioritise the risks, the standard deviations reflect the level of consensus on one item among the respondents. The following areas have been defined for the interpretation of the MV, based on the definition of the five-point Likert scale used in the survey, and in order to have a reasonable balance of items between the different areas:

- the risk is *strongly agreed to be emerging* if $MV > 4$;
- if $3.25 < MV < 4$ means that the item is considered to be an *emerging risk*;
- when $2.75 < MV < 3.25$ the status of a risk is regarded as *undecided*;
- when $2 < MV < 2.75$ the risk is regarded as *not emerging*;
- if $MV < 2$ the risk is *strongly disagree as emerging*.

EMERGING RISKS IDENTIFIED BY UE EXPERTS IN THE PROCESS INDUSTRIES

Emerging Chemical Risks

The expert forecast identified eight risks **strongly agreed as emerging (MV > 4)**, namely: nanoparticles and ultrafine particles; the risks resulting from the poor control of chemical risks in small and medium enterprises (SMEs); outsourced activities performed by subcontracted workers with poor knowledge of chemical risks; the increasing use of epoxy resins; the exposure to dangerous substances in the treatment of domestic, clinical and industrial waste; dermal exposure leading to skin diseases; diesel exhaust; isocyanates.

Short comments on the strongly agreed as emerging chemical risks in the process industries.

Nanoparticles (NPs) (MV=4.60)

Nanoparticles (NPs) (MV=4.60) is the main *strongly agreed as emergent risk*. Key applications of nanotechnology in the process industries include the chemical industry (manufacturing of the paints, pigments and other covering materials), textile industry (manufacturing both intelligence military and civil clothes) and construction material industry (cement manufacturing). *The risk management* regarding the NP exposure is not satisfactory due to the fact that there is insufficient knowledge and data concerning nanoparticle characterisation, detection, measurement, toxicology and fate in humans and the lack of easy-to-use, portable devices for measurement of nanoparticles in the air and therefore lack of exposure information. The main preventive measures include conventional ventilation, engineering control and filtration approaches. Collective and personal protective equipment should be evaluated and improved for reducing workplace exposures to NPs (DEFRA, 2005; NIOSH, 2005).

Allergenic and Sensitizing Agents: Epoxy Resins and Isocyanates. Dermal Exposure

The prioritised list of the strongly agreed to be emerging risks is presented in Table 1.

Table 1. The prioritised list of the strongly agreed as emerging risks of the allergenic and sensitizing agents

Allergenic and sensitizing agents	MV	SD
Epoxy resins (e.g. manufacturing in chemical industry)	4.14	0.743
Dermal exposure leading to skin diseases.	4.11	1.027
Isocyanates leading to allergic reactions: exposure occurs not only at the production stage (the chemical industry) but also during further processing (e.g. thermal or chemical degradation of polyurethane, grinding and welding of products containing polyurethane)	4.02	1.067

New Approach Related to the Emerging Risks Generated in the Occupational Environment in the Process Industries

Skin diseases are caused both of sensitizing agents (Cr, Ni, Co, epoxy resins, natural rubber protein, pains) and irritative effect agents (cleaners).

The main protective measures include to avoid contact with skin, whenever possible, replace harmful epoxies by alternative epoxy systems with reduced risk of sensitization, provide ventilation to prevent airborne dermatitis, wear protective clothing, particularly effective gloves (e.g. fluorinated rubber gloves), skin protective spray, courses of occupational safety and health, establishing of occupational exposure limits for all ingredients of plastics.

Diesel Exhaust (MV=4.02)

The International Agency for Research on Cancer, (IARC) classified diesel exhaust as „probable cancerigen to humans” and the European Agency for Safety and Health at Work agreed this risk to be strongly emerging. Diesel exhaust is made up of a complex mixture of thousands of gases, vapours and fine particles; the major components are carbon dioxide, carbon monoxide, nitrogen dioxide, nitric oxide, particulate matter and sulphur dioxide (Kittelson, 1998). All workers in the process industries which operate diesel engines are exposed to diesel exhaust. *Risk management and the protective measures* include the use of modern, low emission engines; low sulphur fuel; appropriate exhaust after-treatment devices such as filters and oxidation catalysts; ventilation; closed, environmentally-conditioned cabs; diesel engines should be appropriately operated and maintained.

Emerging Physical Risks

The strongly emerging physical risks identified in the process industries are vibration, thermal discomfort and complexity of new technologies and human-machine interfaces.

Risks Related to Vibration

The risks of vibration both to the hand/arm and to the whole-body systems have gained more attention with the European Directive 2002/44/EC. They are also perceived as emerging as the use of transportation systems and of industrial technologies grows and the working population exposed increases. The physical risks identified in the forecast reflect a growing concern for multi-factorial issues, e.g. combined exposure to vibration, awkward postures and muscular work (see Table 2).

Table 2. Prioritised list of the risks (*strongly emerging*) related to vibration in occupational environment

Risks related to vibration	MV	SD
Combined exposure to vibration and awkward postures	4.56	0,629.
Combined exposure to vibration and muscular work	4.38	0.619

Other risks are related to combined exposure to vibration and poor ergonomic design (e.g. poor seat support for the lumbar spine), combined exposure to vibration and unfavourable environmental factors (e.g. low temperature, exhaust emissions), combined exposure to vibration and dangerous compounds.

Occupational exposure circumstances in the process industries include the work to concrete mixers (construction material industry), to mechanic looms (textile industry), to forge, pneumatic hammers and to press.

The main *protective measures* are related to technical measures (e.g. the installation of damping elements) and organisational measures (e.g. proper maintenance of equipments, improvement of the work programme a.o.).

Thermal Discomfort (MV = 4.40)

These type of risks were identified in the construction material industry (manufacturing of cement, lime, brick, ceramic materials, terra cotta a.o.), oil distillation, glass manufacturing (hot microclimate). The food industry use especially the cold microclimate (activities of food freezing). Special protective clothes causing thermal stress represents today a problem insufficiently tackled.

Complexity of New Technologies and Human-Machine Interfaces (MV = 4.35)

If the design of the interface does not take into consideration the cognitive processes involved when operating such a system, the mental and emotional demands on the operator is higher. Hence a potential increase in the incidence of stress, human errors and accidents. *The risk management* consists of the determination of a maximum number of function units that an operator can handle without his mental workload, so decreasing the risk of accidents, the ergonomic design of the joystick, its compatibility with the machine response and the positioning of the functions on the device.

Emerging Psychosocial Risks

The list of 10 most important emerging psychosocial risks identified in European Agency for Safety and Health at Work' survey is the following (<http://riskobservatory.osha.europa.eu>):

- precarious contracts in the context of unstable labour market (MV=4.56, SD=0.51);
- increased workers' vulnerability in the context of globalisation (MV=4.38, SD=0.72);
- new forms of employment contracts (temporary-work, part-time, telework, mobile-workers, day-hire, on-call) (MV=4.25, SD=0.68);
- feeling of job insecurity (MV=4.25, SD=0.77);
- ageing workforce (MV=4.19, SD=0.54);
- long working hours (MV=4.13, SD=0.62);
- work intensification (MV=4.07, SD=1.03);
- lean production and outsourcing (MV=4.05, SD=0.68);
- high emotional demands at work (MV=4.00, SD=0.52);
- poor work – life balance (MV=4.00, SD=0.73).

One can see that all the identified risks are *strongly emerging*. Not only the industrial sector is characterised by this type of risks, but also all sectors of economic activity (health, education, wholesale and retail trade, public administration, immovable and bussines activities and other service sectors).

The risk management and preventive measures are related to start prevention programmes focusing on communication on health and safety or training and instruction on general and job-specific safety and health practices. With regard to *shift work*, night work should be reduced as much as possible; a semi-rapid to rapid rotation with two to four similar shifts in a row is preferable to slow rotation. A later start of the morning shift is also preferable. The resting period between two or more night shifts and the day shifts should be at least 56 hours (two complete nights). The duration of shifts should not exceed 10 to 12 hours. To prevent the job insecurity, the company management has to inform employees in good time about the planned changes, even if this information might be painful, because a realistic information helps employees to adapt to the situation. The company management has also to use the services of outplacement agencies, which through their job advisors, can help employee choose a new job. Also, a better work design can result in the *reduction of work intensity*. *Age management* is related to an ergonomic workplace design, an age-appropriate job design, fostering healthy work

New Approach Related to the Emerging Risks Generated in the Occupational Environment in the Process Industries

processes, reducing time pressure, support the intergenerational transfer of know-how in companies. *Violence and bullying management* includes avoiding deficiencies of the design of the job (e.g. adequacy of workers' workload, demands and control, elimination of conflict); maintaining good quality leadership and management systems (e.g. recognition of conflicts and handling them adequately, managing information well); and good management of discrepancies, complaints and conflicts (Sterinman, 2006).

The employees should not constitute a collection of individuals working nearby one another, but a group where solidarity has evolved and where feelings of trust connect the individuals. Over the course of time, this leads to group-specific structures of mutual help and cooperation, helping the company.

CONCLUSIONS

New work situations existing in present (the introduction of new technologies, substances and work processes, changes in the structure of the workforce and the labour market and new forms of employment and work organization) bring new risks and challenges for workers and employers. In this context, the European Agency for Safety and Health set up an European Risk Observatory to identify emerging risks related to occupational safety and health (OSH), using expert forecast. The expert forecast on emerging OSH risks were reached through questionnaire-based survey following the Delphi method.

This work shows, first time in our country, the strongly emerging risks identified by the experts in the process industries, namely, chemical risks (nanoparticles, allergenic and sensitizing agents: epoxy resins and isocyanates, diesel exhaust), physical risks (vibration, thermal discomfort and complexity of new technologies and human-machine interfaces) and psychosocial risks (precarious work contracts, new forms of employment contracts, feeling of job insecurity, long working hours, work intensification, high emotional demands at work a.o.).

The work emphasizes the main preventive measures and means of managing these risks, which can ensure in the future high levels of safety and health at work.

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