SAFETY SCIENCE Monitor

Issue 3 2007

Article 3 VOL 11

IDENTIFICATION OF EMERGING OCCUPATIONAL SAFETY AND HEALTH RISKS

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Abstract: New technologies as well as shifting economic, social and demographic conditions lead to continuously changing work environments and let emerge new occupational safety and health (OSH) risks. Due to this development the assessment and analysis of emerging occupational risks play an important role to ensure most early identification and efficient prevention, thus contributing to the health and well-being of workers and strengthening the economic competitiveness of companies.

Therefore, in 2002, the European Agency for Safety and Health at Work set up a "Risk Observatory". One of the aims of the Risk Observatory is to anticipate emerging risks and their likely consequences for safety and health at work and to develop an information system for new research findings on emerging OSH risks to communicate the findings. With the help of the Delphi method the views of international experts were brought together in a forecast on what might be the most important emerging OSH risks for workers in Europe. These surveys are complemented by a collection of published information on new research findings on emerging risks. The identification of four different types of risks was taken into consideration in order to provide as complete as possible a picture of the world of work. The forecasting activities cover: (a) physical risks, (b) organisational, social and human risks as well as (c) biological and (d) chemical risks – without excluding multifactorial risks, which may be found in several of these categories.

This paper depicts the final results obtained by the surveys for all investigated types of risks (physical, psychosocial, biological and chemical risks) and describes the methods made use of in this European survey.

INTRODUCTION

As society evolves under the influence of new technologies and of shifting economic and social conditions, so the workplaces, work practices and production processes are constantly changing. These new work situations bring new risks and challenges for workers and employers, which in turn demand political, administrative and technical approaches that ensure high levels of safety and health at work.

In this context, the need to identify and anticipate emerging OSH risks was emphasised on several occasions at the political and European level (Commission of the European Communities 2002, Diamantopoulou 2001). More specifically, the community strategy on health and safety at work 2002-2006 mandated the European Agency for Safety and Health at Work (the Agency) to set up a risk observatory.

A key activity of the risk observatory developed by the Agency is the identification and dissemination of information on emerging OSH risks. Two types of information on physical, chemical, biological, and psychosocial risks as well as combinations thereof, are collected: published information (from peer-reviewed journals and from the Internet) and expert forecasts.

In the context of this study an "emerging OSH risk" has been defined as any occupational risk that is both new and increasing (European Agency 2005a). 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
- 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).

In 2002, the European Agency commissioned its Topic Centre Research on Work and Health (TCWH) with the identification of emerging OSH risks. The working group involved some of the principal OSH institutions in Europe, all member organisations of the TCWH: Berufsgenossenschaftliches Institut für Arbeitsschutz – BGIA (Germany), which led the project and co-ordinated the multidisciplinary team, Finnish Institute of Occupational Health – FIOH (Finland), Bundesanstalt für Arbeitsschutz und Arbeitsmedizin - BAuA (Germany), TNO Work and Employment (Netherlands), Health and Safety Laboratory – HSL (United Kingdom), Prevent (Belgium), Instituto Nacional de Seguridad e Higiene en el Trabajo – INSHT (Spain), Istituto Superiore per la Prevenzione e la Sicurezza del Lavoro – ISPESL (Italy) and Institut National de Recherche et de Sécurité – INRS (France). This group was extended to the Central Institute for Labour Protection - CIOP (Poland) in the frame of the new Topic Center Risk Observatory (TCRO) which started in 2005[1].

METHODOLOGY

European experts were surveyed as to what are the emerging OSH risks. In this matter, the Delphi method (Cuhls 1998) was used in order to reach a broad consensus and to avoid non-scientifically founded opinions.

The Delphi method adopted for formulating the expert forecast on emerging risks in this project consisted in three survey rounds (Figure 1).

[1] Detailed information can be found under: http://3griskob.osha.eu.int/

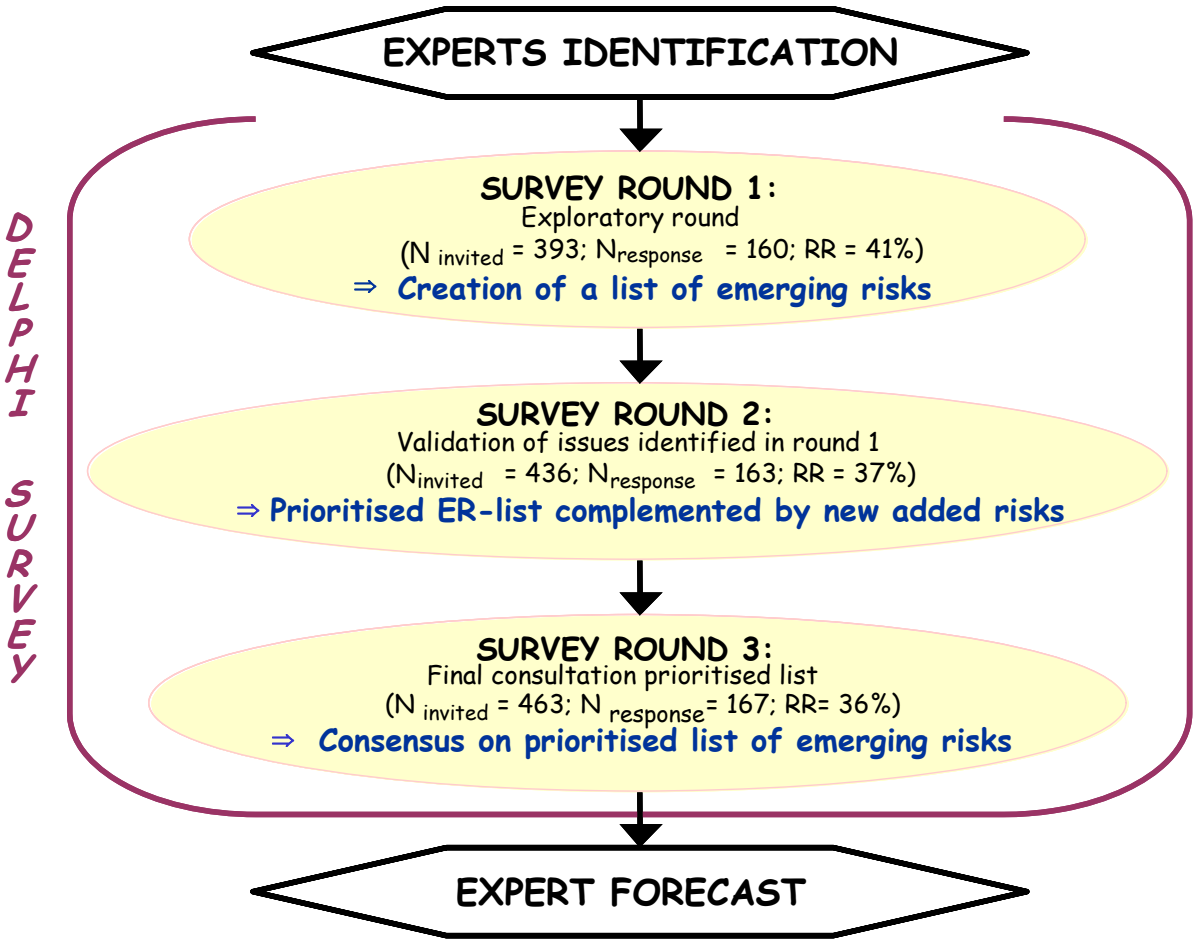

Figure 1: Delphi process implemented for the expert forecast on emerging OSH risks

Different experts were surveyed on the four different risk groups mentioned above. Regarding the physical risks, based on all the issues identified in the questionnaires filled in and returned, a list was drawn up in which the risks were sorted into nine categories according to the field they were related to: risks of musculoskeletal disorders (MSDs), noise, vibration, thermal risks, non-ionising radiation, ionising radiation, risks related to machinery, work processes and technologies, mechanical risks and other general ergonomic risks. Between 10 (thermal risks) and 25 (other ergonomic risks) experts responded in the third survey for the individual categories. The risks identified in the survey on psychosocial risks cover aspects related to work organisation and work characteristics – some being consequences of labour market development; risks intrinsic to the diversity of the workforce; risks linked to OSH management issues. The third round involved 16 respondents, who could rate all risks independently of the category. The chemical risks identified in the survey were sorted into seven categories: particles, dusts and aerosols; carcinogenic, mutagenic and reprotoxic substances; allergens and sensitising substances; flammable and explosive substances; substances and mixtures with newly recognised or unknown health effects; work processes and workplaces; as well as multi-factorial risks related to chemical risks. All experts (49 in the 3rd round) could respond to all of these categories. Based on all the issues mentioned in the biological risks survey, four categories could be defined: OSH biological risks linked to social and environmental phenomena; to substances; to specific workplaces and work processes (recycling and waste handling, health care and service sectors, laboratory and research work, food industry, agriculture); as well as risk to management and handling. Again all experts (36 in the 3rd round) responded to all of the four categories.

For each risk, the mean values and the standard deviations were calculated. While the mean values help prioritising the risks, the standard deviation reflects the level of consensus on one item among the respondents.

Following areas have been defined for the interpretation of the mean values, 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 the mean value of the rating is above four (MV>4)
- a mean value between 3.25 and 4 (3.25<MV≤4) means that the item is considered to be an emerging risk (except for the expert forecast on emerging physical risks in which mean values between 3.15 and 4 (3.15<MV≤4) indicated an emerging risk)
- as a mean value is unlikely to be exactly equal to 3, the "undecided" area has been extended from 2.75 to 3.25 (2.75≤MV≤3.25), which means that the status of the risk is regarded as undecided if the mean value is within this interval (except for the expert forecast on emerging physical risks in which mean values between 2.85 and 3.15 (2.85<MV≤3.15) indicated that the status of the risk was regarded as undecided)
- there is agreement that the risk is not emerging if the mean value is between 2 and 2.75 (2≤MV<2.75, except for the expert forecast on emerging physical risks in which mean values between 2 and 2.85 (2≤MV<2.85 indicated that a risk is not emerging)
- there is strong agreement that the risk is not emerging if the mean value is below 2 (MV<2).

For each item, the response data sets were checked for statistical anomalies (ratings deviating exceptionally low or high from the mean value). No specific respondent profile could be associated to the few exceptional ratings found. As the anomalies had no significant influence on the mean value, they were not removed from the data sets.

The prioritised lists of emerging risks established at the end of the third survey round form the expert forecast on emerging OSH risks. A comparison between the second and third round showed only minor changes for the top 10 emerging risks for each risk group, so that the Delphi survey could be terminated after the third questionnaire.

EXPERT PARTICIPATION

The expertise was collected and used in knowledge of the principles and guidelines of the European Commission (European Commission 2004). The experts were proposed by the TCWH members and the Focal Points of the Agency. Selection criteria were set to ensure a broad coverage of qualified expertise across Europe. For the first exploratory survey round, the experts had to meet the following criteria:

- be a researcher involved in the areas related to OSH and the corresponding risks group;
- have at least 5 years of experience in the sub-field he replies to;
- have authored at least 2 publications in this sub-field.

Concerning their occupation, the majority (more than one third) of the respondents in the four surveys all together were heads of department and researchers involved in OSH. Moreover, experts with a less academic background. but high levels of expertise, such as work inspectors, policy makers, and safety practitioners were included. For instance, for the chemical and biological risk group a high percentage of "work inspectors" responded (15 respectively 19%). Also a high proportion of the experts ticked "Other". Those people were occupied in the following fields of activities related to OSH risks: research and management planning, testing and certification activities, development, law, policies and standards development, promotion and enforcement, training and teaching activities as well as consulting. Concerning their main fields of activity, nearly half of the experts whose answers were taken into account in the third round of all surveys were involved in research. About one third of all experts stated to be active in consulting activities, teaching and/or training activities and policies and/or standards development. For the psycho-social risk group the area of expertise could mainly be found in the field of psychology, work and organisation and work and health. All these activities were acceptable and thus all experts were considered meeting the selection criteria.

The response rates were between 21% (3rd round psychosocial risks) and 48% (3rd survey physical emerging risks).

Over the three survey rounds, experts from 53 organisations from 26 European countries, one international organisation and from the USA participated in the formulation of the forecast on emerging OSH risks (Diagram 1).

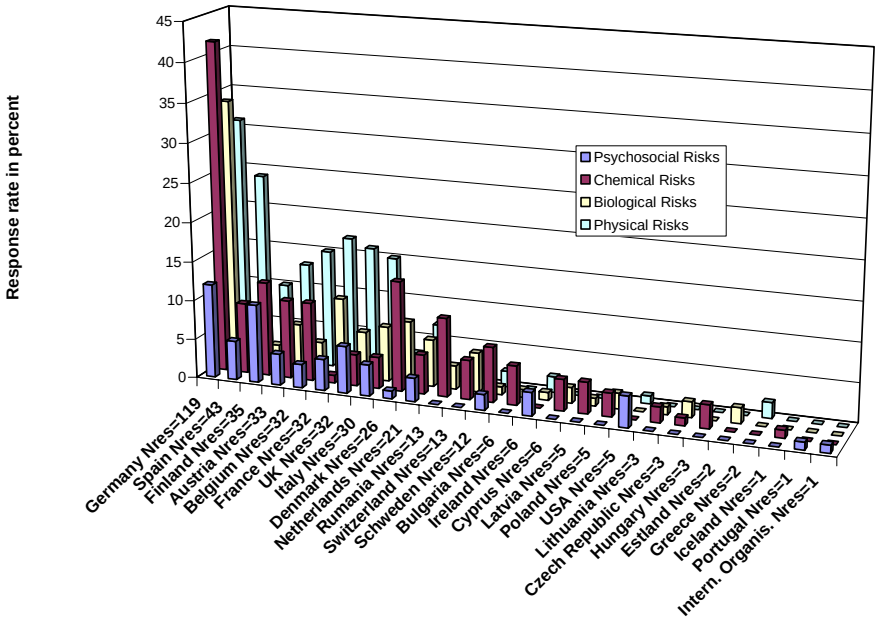

Diagram 1: Country of origin of the respondents to the third rounds of the four surveys
(N_{res} = number of responses)

RESULTS

Physical risk group

In total 74 risks were mentioned (European Agency 2005a). According to the definition of the mean values above 10 were classified as strongly agreed as emerging (see Diagram 2), 48 were agreed as emerging and only 7 were agreed as non-emerging (e.g. environmental noise increasing sensitivity to occupational noise (MV=2.75) or air crews exposed to cosmic radiation (MV=2.36).

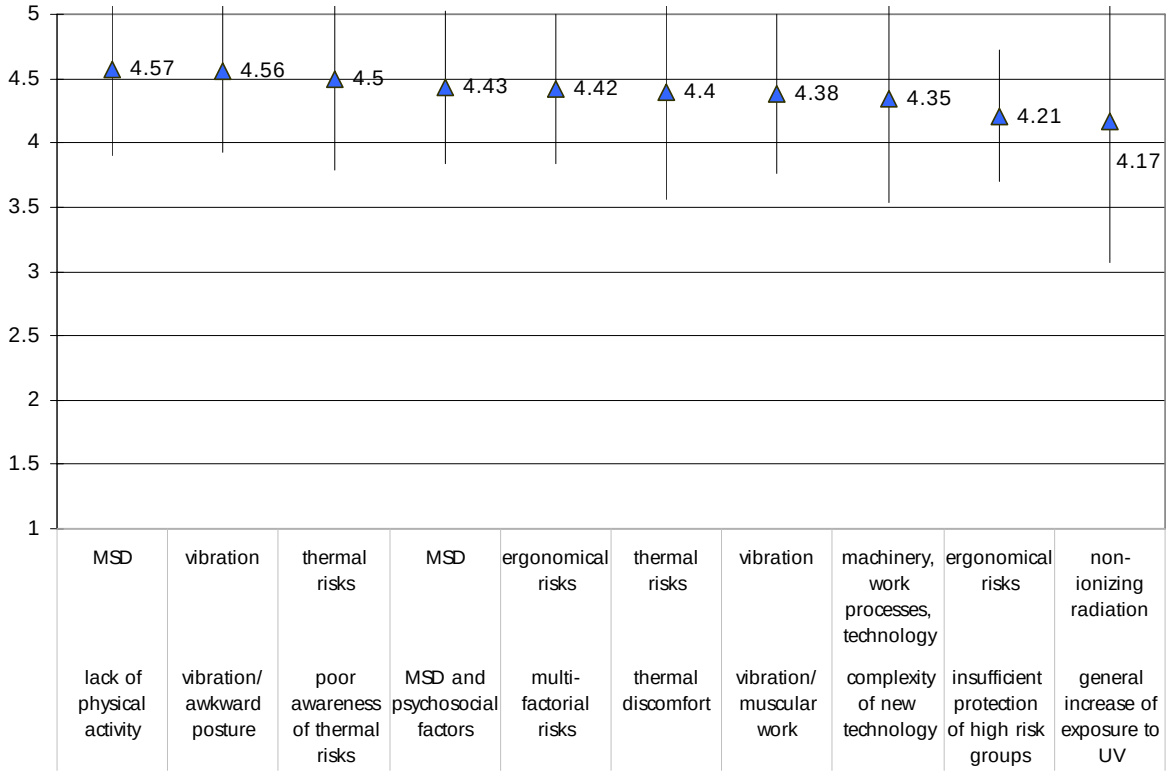

Diagram 2: The ten most important emerging physical risks identified in the survey (mean values; standard deviations). The y-axis ranges from MV=1 (strongly agreed as not emerging) to MV=5 (strongly agreed to be emerging).

A literature review enabled to characterise five of the main emerging risks in terms of workplaces concerned, risk factors, health outcomes and solutions more in depth [2].

Lack of physical activity at the workplace

Examples of occupations with very little physical activity and an increased prevalence of MSDs found in the literature are workplaces implying prolonged sitting. Workers concerned are for instance crane operators, straddle-carrier, truck and bus drivers as well as workers in semiconductor factories, workers operating automated systems and machines, workers at visual display unit (VDU) workplaces and call centre agents. Additionally, prolonged-standing workplaces are pointed out.

The effects identified are MSDs of the upper-extremities and of the back, varicose veins, deep-vein thrombosis, obesity, ovarian cancer, breast cancer and renal cancer.

Working equipment and work organisation supporting a dynamic alternation of body positions as well as on-site health programs help preventing the risk (Ellegast et al. 2004).

Combined exposure to MSDs risk factors and psychosocial risk factors

Combined exposure to MSDs risk factors and psychosocial risk factors dealt with in the literature found mainly occurs at VDUs workplaces and call centre workplaces, but papers also focused on the health care sector and on supermarket cashiers.

The psychosocial factors identified are: Stress generated by the poor ergonomic design of the work equipment, such as VDU stations; high job demands, difficult tasks leading to mental exhaustion and working under time pressure; too low job demands; low job control and low decision level; poor support from colleagues

[2] For each main emerging risk at least 25 references are referenced in European Agency 2005.

and from the hierarchy; fear of downsizing, job insecurity and fear of unemployment; harassment, violence and bullying at work.

The combination of exposure to both MSDs and psychosocial risk factors – rather than to the ones or the others - was shown to affect the workers' health to a greater extent. The subsequent health outcomes are low-back pains, shoulder and neck pains as well as hand-wrist affections. Preventive measures identified are improvements of the ergonomics of the workplace and of the work organisation (Westgaard 2000).

Multi-factorial risks

Typical workplaces exposed top multi-factorial risks are call centre workplaces.

Risk factors affecting call centre agents are prolonged sitting, poor room acoustic and background noise, inadequate headsets, poor room atmosphere, lighting conditions, ergonomic design of the work equipment and inappropriate arrangement of the working premises, but also factors of human and organisational nature such as low job control, high time pressure, poor work organisation as well as high mental and emotional demand (Cramer et al. 2001).

Several health outcomes could be observed: MSDs, varicose veins, nose and throat diseases, voice disorders, fatigue, stress and burnouts.

Complexity of human-machine interfaces

More and more intelligent but complex human-machine interfaces are used in the aerospace and health care sectors (e.g. computer-aided surgery) (Spetzger et al. 2002). Moreover, the use of complex in-cab devices such as remote controls and joysticks to operate heavy trucks and earth moving machineries also increases. Cobots, which are intelligent robots teamed with the operator, are increasingly implemented in handling activities and complex manufacturing processes.

A poor ergonomic design of such interfaces increases the operators' mental and emotional strain and thus the probability of human errors and of accidents at work.

Methodologies for testing design errors of human-machine are available and should help reducing handling errors. The interface should be adapted to the workers and their skills instead of the workers having to adapt to the system. Furthermore, the interface should give proper feedback on the machine operations to the operator. Last but not least, adequate trainings and information on the system should be provided.

Ultraviolet radiation

Literature about the effect of UV exposure in the leisure time on the workers' sensitivity to occupational exposure could not be found.

Nevertheless, besides outdoor workplaces where workers are exposed to sun radiation, occupational sources of UV radiation are found at workplaces requiring UV-based technologies such welding tools, dye and paint drying techniques (e.g. in printing workshops) or UV-based disinfecting applications in the food industry or in the health care sector.

Potential health outcomes of UV exposure are cataracts as well as different types of cancers: non-Hodgkin's lymphoma, myeloid and lymphocytic leukaemia, lip and stomach cancer, and malignant melanoma or squamous cell carcinomas (Hakansson et al. 2001).

When the hazard cannot be eliminated at its source, individual protective measures such as the use of personal protective equipment should be implemented.

Psychosocial risk group

In total 42 psychosocial risks were mentioned by the experts. 8 of them were strongly agreed to be emerging, 19 were considered as emerging risks, the experts were undecided upon 14 items, and one risk was not considered as an emerging risk (deterioration of (specific) physical working conditions, MV=2.31).

Two trends could be observed in this study (European Agency 2007a):

- The experts agreed more strongly that social risks are emerging than risks in work organisation or risks in work characteristics and risks at the individual level. Indeed, issues related to changes in

the labour market were globally rated higher than risks in work organisation or work characteristics, individual risks, and specific OSH risks.

- On average, the consensus amongst experts as to whether a risk is emerging increased from round two to round three, with the exception of risks related to individual issues for which the consensus decreased. A comparison between the second and third round of the TOP 10 emerging risks showed only slight differences.

The main emerging risks identified in the survey are:

- New forms of employment contracts (including temporary work, precarious work and outsourcing) as well as job insecurity. New forms of employment contracts are associated with the emergence or aggravation of psychosocial problems and related health effects. For instance, working conditions of precarious workers are generally poorer than those of permanent workers. Feelings of job insecurity in the context of globalisation and unstable labour markets affect workers' health and workers' safety behaviour at work.

- Work intensification and complexity of tasks lead to increasing work-related stress. As a consequence, workers' safety behaviour and health is jeopardized. Increased working time schedules with irregular and less predictable working hours, and longer working hours in some sectors also contribute to increases in work-related stress.

- OSH risks for the ageing workforce and the health and safety consequences of jobs not being adapted to older workers,

- increasing emotional demands at work, and

- difficulties to balance work and life.

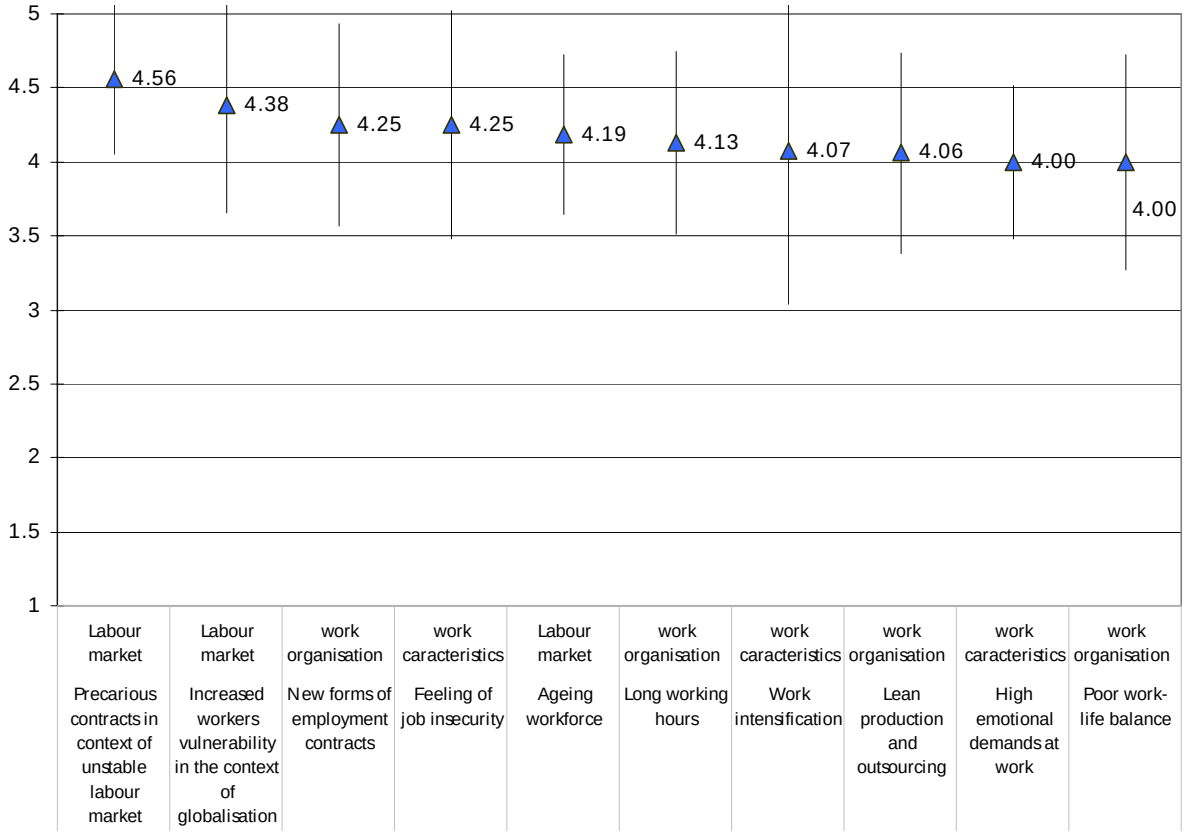

Diagram 3: The ten most important emerging psychosocial risks identified in the survey. The y-axis ranges from MV=1 (strongly agreed to be not emerging) to MV=5 (strongly agreed to be emerging).

Detailed literature reviews were conducted to focus more in depth on six of the emerging risks identified in the forecast in terms of workplaces concerned, health outcomes and prevention measures.

Precarious work

Working conditions have notably changed in the last two decades (European Foundation for the Improvement of Living and Working Conditions 2006). Due to global economic strategies and governmental attempts to avoid unemployment by increased labour market flexibility (Benach et al. 2000) new kinds of flexible employment like temporary work, part-time work, on call work, day-hire work, home-based work etc. have emerged and have affected an increasing part of the workforce. Those "non-standard" forms of work can mostly be considered as precarious as they often only offer temporary employment, low levels of income, low control over work, and low social protection (Benavides et al. 2006). Thus, they also go along with job insecurity.

Characteristics of working conditions which accompany precarious work are directly and indirectly linked to health problems. On the one hand they are important sources of work-related stress or strain (Benach et al. 2000) which, in turn, have been linked to divers phenomena of ill health, inter alia cardiovascular diseases, musculoskeletal diseases, and depression. On the other hand workers under "non-standard" contracts work more likely under poor occupational health and safety and may face exposure to more dangerous or hazardous work situations than employees working under standard contracts (Benach et al. 2000).

Irregular, flexible working time

Besides classical working time models, flexible or irregular working time becomes more and more common. Employers take increasingly advantage of flexibility in working hours in order to cope with competition and to meet customers' demands (Goudswaard & de Nanteuil 2000). However, it can be distinguished between flexible working hours which can vary from day to day and which are rather fixed by the employer without influence of the employee, and those which allow the employee in certain boundaries to organise his working hours according to his personal needs.

Flexible or irregular working hours range from flexitime to shift work, night work, evening work, weekend work, overtime, extended working hours, compressed work weeks, unpredictable working hours and part-time work.

If the workers can adapt their working hours to their personal needs, flexible working time arrangements increase job satisfaction and work life balance (Riedmann et al. 2006). Stressful commuting times to work can be avoided and control over working time is enhanced. Company controlled variability of working hours and low control over working hours are linked to impaired wellbeing. Regularly. working long hours (50 – 60 hours a week) seems to be associated with somatic symptoms and the risk of cardiovascular diseases. Familiar relationships are jeopardized and behaviours associated to ill health like smoking augment. Sleep disorders, gastrointestinal and cardiovascular diseases are linked to shift work.

Job insecurity

Global economic strategies, the current tendencies towards precarious work, downsizing, outsourcing and mergers as well as the public spending cut and weakened trade unions go along with a rise in job insecurity in many industrialized societies (De Witte 1999).

Job insecurity is an important stressor and leads to reduced well-being (psychological distress, anxiety and depression), reduced levels of job satisfaction and increases psychosomatic complaints as well as physical strains (De Witte 1999).

The degree of job insecurity depends on the one hand on individual and personal characteristics (socioeconomic status, age, gender, optimism vs. pessimism) which determine the level of security an individual prefers and on the other hand on job characteristics (plans for organisational changes, communication). The more the preferred and perceived levels of security diverge and the more job characteristics favour unpredictability, uncertainty and stress, the more job insecurity is likely (Kinnunen et al. 2000).

To help employees to cope with planned or realised organisational reorganisation and to prevent negative health outcomes by job insecurity, researchers recommend, for instance, realistic and honest communication during reorganisation processes as well as the use of restorative strategies in order to reassure survivors of reorganisation processes (Kinnunen, et al. 2000).

Work intensification

Since the 1990s, the phenomenon of work intensification could be observed in many European countries and in the USA due to the reduction of the workforce, budgetary constraints, and just in time or lean production. Work intensification is mainly caused by three factors: (1) changes and innovations in organisations (concerning structure, technologies, objectives, procedures, etc., (2) the decline of trade unions strength, and (3) the increase of job insecurity (Askenazy 2005).

In 2000, 49% of all workers in Europe worked at least half of the time to tight deadlines and 44% worked at least half of the time at very high speed. 21% did not have enough time to finish their work (Daubas-Letourneux, & Thébaud-Mony 2002). Moreover, 17% of all European full-time employees were affected by long working hours (≥45 hours per week).

Work intensification is directly linked to a higher pace of work, densification of work, and thus to increasing physical and mental strain. Especially, the development of stress and musculoskeletal diseases as well as the increase of injuries and accidents at work are favoured (Askenazy 2005; Daubas-Letourneux & Thébaud-Mony 2002). Work intensification is also linked to violence at work due to increased pressure at work (Daubas-Letourneux & Thébaud-Mony 2002).

Violence at work

As a consequence of current global economic strategies and increased competition, interest has risen for and light has been shed on violence at work in the recent years, especially as a considerable part of the workforce is affected by this phenomenon (Di Martino et al. 2003). In general, physical violence (aggression, threats and attacks) can be distinguished from psychological violence like mobbing, harassment, and bullying.

Especially psychological violence represents an emerging risk at the workplace (Di Martino et al. 2003). In 2000, 11% of the female workers and 9% of the male workers experienced bullying. Physical violence was experienced by 7% of the female and 5% of the male workers. Violence at work mainly occurred in the service sector whereas the percentages of workers affected by psychological violence were slightly higher than those affected by physical violence (numbers in brackets): 14% (11%) in health and education, 14% (9%) in public administration and defence, 14% (7%) in the hotel and restaurant sector, 12% (5%) in the transport, and 9% (3%) in the sector of trade (European Foundation for the Improvement of Living and Working Conditions 2005). Physical violence rarely stems from colleagues and mostly comes from people outside the workplace (e. g. customers). Psychological violence, however, mostly occurs inside the workplace, among colleagues or among colleagues and superiors (European Foundation for the Improvement of Living and Working Conditions 2005).

On the individual level, violence at work is associated with stress, reduction of the psychological well-being, impaired general health, concentration problems, reduced self-confidence, reduced satisfaction at work, fear reactions, and post-traumatic stress. According to the British Crime Survey 2002/2003, 42% of the incidents of physical violence at work lead to physical injury. Due to e.g. a high rate of absenteeism, ill health, and employees' turnover, violence at work also leads to high costs for the companies (Di Martino et al. 2003).

OSH and ageing workers

Nowadays, many modern societies face serious problems with their social systems and pension schemes due to considerable increases of the life expectancy combined with low birth-rates. To deal with these problems, many countries are prone to prolong the duration of the working life (OECD 2006).

The process of ageing is highly individualised and goes along with the decline of certain abilities (e. g. sense of sight and hearing, flexibility) but also leads to new skills due to gained experiences. To help older workers maintaining skills until the end of their working lives, trainings are often included in programmes for older workers. Nevertheless, measures of OSH are not yet sufficiently adapted to the needs of older workers but it is crucial to take them into consideration. Furthermore, working conditions need to be improved in a way that they allow a healthy and safe exertion of work during a prolonged work life (Peulet 2005). This aim can for instance be reached by means of widespread workplace health promotion, enhanced investment in injury prevention, ergonomic solutions to prevent workers from physical disabilities, age-based workplaces, as well the avoidance of age-related prejudices and age discrimination which might cause stress and dissatisfaction in older workers.

Chemical risk group

- All in all 98 chemical risks were mentioned by the experts. 8 chemical risks were classified as strongly agreed as emerging, 59 were agreed as emerging and only 4 were agreed as non-emerging (e.g.

nitrogenous fertilizer, ammoniac and nitric acid (MV=2.67), oil refining (MV=2.69) or toner for printer/copiers (MV=2.69)) (European Agency 2007b). A comparison between the second and third round of the TOP 10 emerging risks showed only slight differences.

The main emerging chemical risks identified are

- Nanoparticles and ultrafine particles
- Poor control of chemical risks in small and medium enterprises
- Outsourced workers with poor knowledge of the chemical risks related to the workplace they have been assigned to.
- Increased use of epoxy resins
- Exposure to dangerous substance in industrial, medical and municipal waste treatment activities
- Dermal exposure leading to skin diseases
- Diesel exhaust
- Isocyanates
- Man-made mineral fibres
- Exposure to chemical agents in the construction sector

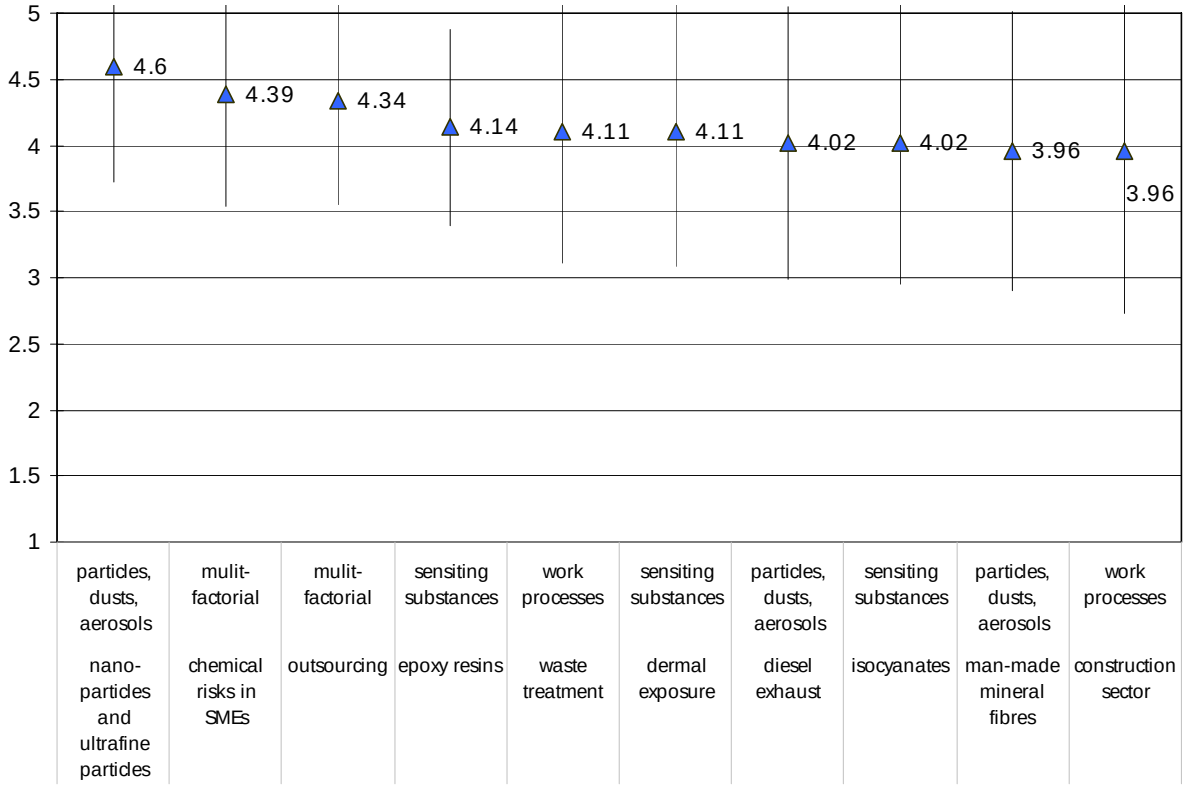

Diagram 4: The ten most important emerging chemical risks identified in the survey (mean values, standard deviation). The y-axis ranges from MV=1 (strongly agreed to be not emerging) to MV=5 (strongly agreed to be emerging).

Six of the main emerging chemical risks were focused on in a literature review[3] characterising risk factors, the workplaces concerned as well as health outcomes of the specific risk.

Nanoparticles and ultrafine particles

Ultrafine particles have at least one dimension of less than 100 nm and have been produced as unintentional by-product in the frame of many longstanding processes for a long time. Conversely, nanoparticles are produced intentionally. They are increasingly being used and, as they are expected to contribute to a lot of technologies, nanotechnology can be regarded as a rapidly growing economic sector. Mainly, workers who are involved in research and development activities of the nanotechnology sector, in powder processes including paints, pigments and cement manufacture, in welding activities as well as in other processes where nanoparticles are by-products, are exposed (NIOSH 2005). There is concern, but also considerable evidence that nanoparticles have toxic health effects. Indeed, nanoparticles are able to enter the body via inhalation, via dermal contact, via ingestion and inoculation. Once in the human body, nanoparticles can further translocate to organs and tissues of the body. In addition, biopersistent nanoparticles may bioaccumulate in the lungs, the brain and the liver. However, more research is needed to assess the degree of damage nanoparticles can cause in the body once they have entered into the body.

Poor control of chemical risks in small and medium enterprises

The occupational exposure to chemical agents takes place in many workplaces - in the chemical industry as well as in other branches of economy, e.g. in offices, hospitals and in the agricultural sector. According to UE Directives (98/ 24/ EC, 1998) and regional law, employers are legally obligated to carry out a risk assessment and to take appropriate preventive measures. This is also the case for small and medium-sized enterprises (SMEs). Nevertheless, few companies seem to be prepared to meet this obligation, as the assessment of occupational risk posed by chemical agents is complicated (Balsat et al. 2003). The difficulties in the assessment of chemical risks result from the variety of agents present in the workplace and the difficulty to measure the concentration of airborne agents, from the diverse exposure routes of these agents, and from the diverse levels of negative health effects they may generate. Because of their lack of resources and knowledge to cope with these difficulties - and hence to manage their working environment properly - occupational safety and health (OSH) conditions in SMEs tend to be less favourable than in bigger companies.

Increasing use of epoxy resins

Epoxy resins are one of the most important polymeric systems that are mainly and increasingly used in adhesives, paints and coatings, sealants, inks, varnishes and reinforced polymer composite structures with glass fibre, carbon fibre or metal substrates. The increasing use of epoxy resins is expected to continue. Workers exposed to epoxy resins include construction workers, painters, workers in the electrical and electronics industry as well as employees in the manufacturing of composite products. Epoxy resins, especially epichlorohydrin, which is one of the compounds use to produce epoxy resins, is known to be carcinogenic. Moreover, workers exposed to epoxy resins may suffer from severe irritation of the eyes, the airways, the skin and mucous membranes as well as from allergies (Tavakoli 2003).

Dermal exposure leading to skin diseases

The increasing rate of occupational skin diseases due to dermal exposure to dangerous substances is a major issue of concern. This disease can still be found among the main occupational diseases in industrial countries. Most of the occupational skin diseases are hand eczema, but also work-related contact urticaria, photo dermatitis, contact leukoderma, asthma, infectious dermatitis and skin cancer are found. Chemicals as well as proteins in natural materials can be regarded as skin sensitisers. In addition frequent and prolonged exposure to weak skin irritants, such as water and detergents – beside fragrances – has also been identified as a risk. Therefore, especially health care workers (masseurs, physiotherapists and geriatric nurses), hairdressers, cleaners and food handlers, but also tile setters and terrazzo workers suffer from skin diseases (van Hemmen, et al. 2003).

Industrial, medical and municipal waste treatment: Exposure to dust, microbe and endotoxin

Waste treatment activities have been dramatically increasing since the 90's decade of the last century and expose more and more workers. The risk is linked to the presence of organic dust, which contains bacteria, fungi, endotoxins and microtoxins. Hence, workers at risk are involved in the collection, handling and treatment of

[3] For each main emerging risk at least 25 references are referenced in European Agency 2007b.

organic wastes, including municipal and medical waste but especially waste coming from agricultural activities. The health symptoms reported are organic dust toxic syndrome (ODTS), respiratory and pulmonary diseases (irritation of the airways, asthma, alveolitis, bronchitis), gastrointestinal symptoms like e.g. nausea and diarrhoea, as well as skin diseases (Wouters et al. 2002).

Man-made mineral fibres

Man-made mineral fibres can be inhaled and the ones with a geometric diameter of less than 3 μm may reach the pulmonary alveolar zone of the lung. The fibres have inflammatory, cytotoxic, and carcinogenic potential. Some are even biopersistent, which means that they may accumulate in the lungs. Man-made mineral fibres are used in high-temperature thermal insulation of industrial furnaces or blast furnaces and in casting moulds as well as in car manufacturing and in the aerospace and aeronautics industry. Moreover, workers involved in the thermal and acoustic insulation in housing, in the tertiary sector and in technical installations are exposed to man-made mineral fibres. Man-made mineral fibres can be found in filtering applications as well as in industry engineering applications and increasingly enter into the compositions of sports and leisure items. Additionally, man-made minerals are used in order to reinforce high-temperature resistance of composite materials. In addition to these sectors, workers handling fibre-based products may be exposed especially during laying or removal operations. Due to the potentially severe health effects of man-made mineral fibres, manufacturers curtail the health effects of existing siliceous fibres by altering their composition or reduce their biopersistence, which is relatively favourable to worker health and safety (Maxim et al. 2006).

BIOLOGICAL RISK GROUP

- In total 42 biological risks were mentioned by the experts (European Agency 2007c). 2 biological risks were classified as strongly agreed as emerging, 17 were agreed as emerging and only 8 were agreed as non-emerging (e.g. clostridium tetani (MV=2.26) or lack of interest in developing new antibiotics (MV=2.46)). A comparison between the second and third round of the TOP 10 emerging risks showed only slight differences.

  The main emerging biological risks identified are

  - Workers' exposure to global epidemics
  - Poor and difficult assessment of biological risks
  - Workers' exposure to antibiotics-resistant bacteria in the health care and livestock industry
  - Lack of information on biological risks
  - Poor maintenance of air-conditioning
  - Inadequate training on OSH risks for local authorities staff
  - Biohazards in waste treatment plants leading to allergies, infectious diseases, toxinic diseases and cancers
  - Combined exposure to bioaerosols and chemicals
  - Endotoxins in various industrial settings
  - Moulds in indoor workplaces

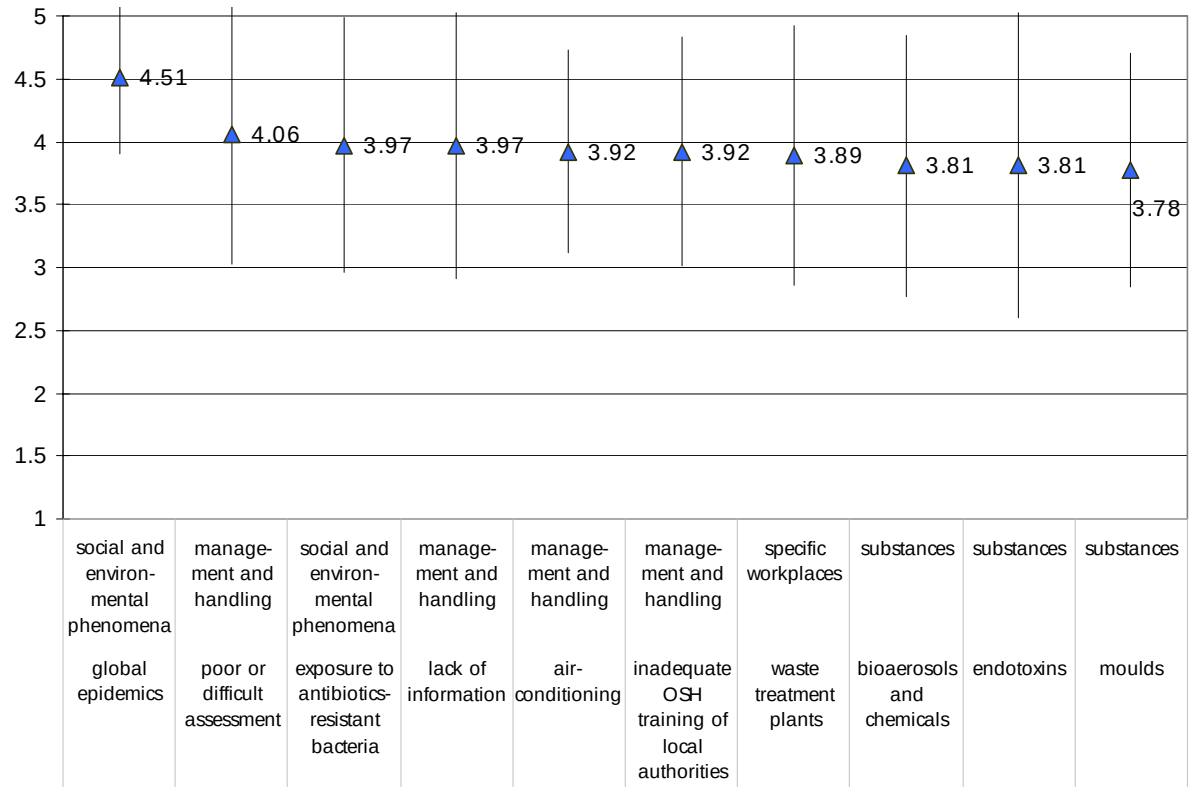

Diagram 5: The ten most important emerging biological risks identified in the survey (mean values, standard deviation). The y-axis ranges from MV=1 (strongly agreed to be not emerging) to MV=5 (strongly agreed to be emerging).

Six of the main emerging biological risks were focused on in a literature review[4] characterising risk factors, the workplaces concerned as well as health outcomes of the specific risk.

Workers' exposure to global epidemics

From the 16th century onwards, ocean navigation has resulted in different populations exchanging pathogens. Whereas in those days diseases took a long time to pass around the world, nowadays due to the use of aircrafts "we all swim in a single microbial sea" as the WHO director-general declared earlier on. Consequences of a pandemic will certainly have repercussions in the occupational field. Occupations which are at risk are not easily to identify, as the sources of exposure vary. However, workers in the livestock industry, tourist industry personnel working in foreign countries, expatriates or those on assignments abroad, transport workers, workers in companies involved in global trade, health-care workers and those in medical laboratories, the armed services (war, peace-keeping or long-term assistance) and humanitarian aid workers are at risk of being contaminated in the case of global epidemics. Infected staff may become potential reservoirs for further wide-spreading of the disease (Brown 2004).

General increased use of antibiotics for human health care and for animal breeding in the food-industry

Since the discovery of antibiotics in the 20th century, antimicrobial agents have substantially reduced the threat posed by infectious diseases (NIAID 2004). Nowadays this gain is jeopardized by the emergence and spread of drug-resistant bacteria as a consequence of the unreasonable use of antibiotics for human or animal health care and agricultural purposes. Workers most at risk of being contaminated with antibiotics-resistant bacteria are health care workers including hospital staff, laboratorium workers, employees of the food-industry such as e.g. handlers of animals, slaughterers, butchers, farmers, workers in broiler houses or in the poultry production. Health consequences of the general increased use of antibiotics include infections that would not have otherwise occurred, increased severity of infections and increased frequency of treatment failures. There are

[4] For each main emerging risk at least 25 references are referenced in European Agency 2007c.

evidences that morbidity and mortality rates are increasing because of delays in administering effective treatment against resistant pathogens.

Endotoxins in various industrial settings

Workers are exposed to endotoxins in the workplace mainly through organic dust (Rylander 2004). Therefore workers of the agriculture and forestry sector, in the textile industry, in the sewage, waste and recycling industry, in the paper industry as well as in the metal industry and in food production and processing are exposed to endotoxins. The individual susceptibility to endotoxins is known to vary and studies indicate that the exposure to endotoxins may lead to, but may also protect from asthma. The exposure to organic dust and endotoxins in the occupational environment is also associated with a wide range of health effects such as respiratory diseases and lung function impairment, infectious diseases, acute toxic effect and allergies, and cancers.

Moulds in indoor workplaces

Moulds have been present in indoor workplaces for centuries but have lately drawn more attention, especially as a consequence of inadequate construction material and insulation techniques and technologies resulting in the apparition of moisture in relatively new buildings. Mould exposure can potentially affect any worker in indoor workplaces, e.g. in office buildings, schools, hospitals, commercial buildings (Burr 2001). In addition, other occupations concerned with exposure to fungi include jobs in the agricultural sector, manufacturing operations and waste treatment activities. Fungi such as Cladosporium, Alternaria and Penicillium may have serious effects on workers' health: allergies, infections, irritations and toxicity due to fungal exposure can be found. Moreover, it contributes to the sick building syndrome (SBS) and other building related illnesses. Nevertheless, occupational exposure limits could not yet been proposed due to the lack of research data.

Biohazards in waste treatment plants leading to allergies, infectious diseases, toxinic diseases and cancers

Since waste is increasingly considered as a resource, the recycling industry represents an expanding sector with an increasing number of employees. Especially employees in the areas where bioaerosols concentrations are high, such as waste unloading, in service and maintenance activities of machinery, and indoor waste sorting activities (without effective air conditioning) are exposed to biohazards. The health outcomes depend on the kind of biological agents present, on the exposition level, and the individual susceptibility of the exposed workers. Infections of the skin and of the respiratory system, toxicosis like transient symptoms with flue-like symptoms, type III allergy as well as inflammations are especially observed in waste treatment workplaces (Swan et al. 2003).

Poor or difficult assessment of biological risks

According to Directive 2000/54/EC a determination and assessment of biological risks should be applied to any occupational activity where human beings are potentially exposed to biological agents as a result of their work (ISPESL 2005). However, due to the variety of biological agents, diverse levels of health hazards and a problematical sampling process, the methods of measurement and assessment of occupational exposure should be chosen and evaluated carefully, which is seldom the case.

CONCLUSION

The expert forecasts introduced in this paper are only one part of the Risk Observatory of the European Agency. In addition, trends in the existing quantitative information in the EU-27 are analysed in the project "OSH in figures". Data on occupational health and safety outcomes (such as accidents, occupational diseases, other health problems, absenteeism, etc.), work situations (work features such as work organisation, workplace design, workplace exposures, working hours, etc.) as well as on appropriate context features (such as demographics, labour market, technology, etc.) are collected and analysed. The main results are published by the European Agency. The outcomes of the expert forecasts triggered future studies on vibration, skin diseases and dermal exposure, ultraviolet radiation and biological agents, including pandemics.

The top 10 of every expert forecast will be presented to socio-economic, policy and industrial management areas. One step into that direction was already taken in December 2005, when discussing the results with the European Commission. The aim of these discussions is to initiate calls for proposals for the main priorities or even to influence the new framework programmes on research and development (European Agency 2005b).

REFERENCES

Askenazy, P., 2005: Sur les sources de l'intensification. Economie et sociologie, 56 (2), 217-236.

Balsat, A., De Graeve J., Mariaux P., 2003: A Structured Strategy for Assessing Chemical Risks, Suitable for Small and Medium-sized Enterprises. The Annals of Occupational Hygiene, 47(7), 549 -556.

Benach, J., Benavides, F. G., Platt, S., Diez-Roux, A., Muntaner, C., 2000: The health-damaging potential of new types of flexible employment: A challenge for public health researchers. American Journal of Public Health, 90(8), 1316-1317.

Benavides, F. G., Benach, J., Muntaner, C. Delclos, G. L., Catot, N., Amable, M., 2006: Associations between temporary employment and occupational injury: What are the mechanisms? Occupational and Environmental Medecine, 63, 416-421.

Brown, C., 2004: Emerging zoonoses and pathogens of public health significance – An overview. Review Scientifique et Technique, 23 (2), 435-42.

Burr, M. L., 2001: Health Effect of Indoor Moulds. Reviews on Environmental Health, 16(2), 97-103.

Commission of the European Communities, 2002: Adapting to change in work and society: A new Community strategy on health and safety at work 2002-2006. COM (2002) 118 final, Brussels.
http://europe.osha.eu.int/systems/strategies/future/

Cramer, J., Ellegast, R. P., von der Heyden, T., Liedtke, M., Pfeiffer, W. Stamm, R., 2001: Arbeitsumgebung und Ergonomie. Ccall Report 4. Hrsg.: Verwaltungs-Berufsgenossenschaft, Hamburg.

http://www.ccall.de/download_dat/ccall_report04.pdf

Cuhls, K., 1998: Technikvorausschau in Japan – Ein Rückblick auf 30 Jahre Delphi-Expertenbefragungen. In: Technik, Wirtschaft und Politik, Vol. 29. Schriftenreihe des Fraunhofer-Instituts für Systemtechnik und Innovationsforschung (ISI). Physica, Heidelberg.

Daubas-Letourneux, V., Thébaud-Mony, A., (European Foundation for the Improvement of Living and Working Conditions), 2002: Organisation du travail et santé dans l'Union Européenne. Office for Official Publications of the European Communities, Luxembourg. http://www.eurofound.europa.eu/pubdocs/2002/06/fr/1/ef0206fr.pdf

De Witte, H., 1999: Job insecurity and psychological well-being: Review of the Literature and Exploration of some unresolved issues. The European journal of work and organizational psychology, 8(2), 155-177.

Diamantopoulou, A. (European Commissioner responsible for Employment and Social Affairs): Preventing accidents at work: A new European strategy for safety and health. SPEECH/01/571 held at the European Conference on Health and Safety, 23/11/2001, Brussels.
http://europa.eu.int/rapid/pressReleasesAction.do?reference=SPEECH/01/571&format=HTML&aged=0&language=EN&guiLanguage=en

Di Martino, V., Hoel, H., Cooper, C. L., (European Foundation for the Improvement of Living and Working Conditions), 2003: Preventing violence and harassment in the workplace. Office for Official Publications of the European Communities, Luxembourg. http://www.eurofound.eu.int/pubdocs/2002/109/en/1/ef02109en.pdf

Ellegast, R.P., Herda, C., Hoehne-Hückstädt, U., Lesser, W., Kraus, G., Schwan, W., 2004: Ergonomie an Näharbeitsplätzen. In: BIA-Report 7/2004. Hauptverband der gewerblichen Berufsgenossenschaften (HVBG), Sankt Augustin.
http://www.hvbg.de/d/bia/pub/rep/rep04/pdf_datei/biar0704/bia0704.pdf

European Agency for Safety and Health at Work, 2005a: Expert forecast on emerging physical risks related to occupational safety and health. Office for Official Publications of the European Communities: Luxembourg.
http://3griskob.osha.eu.int/risks/forecasts/physical_risks/

European Agency for Safety and Health at Work, 2005b: Priorities for occupational safety and health research in the EU-25. Office for Official Publications of the European Communities, Luxembourg.
http://osha.eu.int/publications/reports/6805648/full_publication_en.pdf

European Agency for Safety and Health at Work, 2007a, in print. Expert forecast on emerging psychosocial risks related to occupational safety and health.

European Agency for Safety and Health at Work, 2007b, in print. Expert forecast on emerging chemical risks related to occupational safety and health.

European Agency for Safety and Health at Work, 2007c, in print. Expert forecast on emerging biological risks related to occupational safety and health.

European Commission, 2004: Collection and use of expertise by the Commission – Principles and guidelines, Luxembourg.
http://europa.eu.int/comm/research/science-society/pdf/guidlines_ss_en.pdf

European Foundation for the Improvement of Living and Working Conditions, 2005: Violence, bullying and harassment in the workplace. Office for Official Publications of the European Communities, Luxembourg.
http://www.eurofound.eu.int/ewco/reports/TN0406TR01/TN0406TR01.pdf

European Foundation for the Improvement of Living and Working Conditions, 2006: Working conditions in atypical work. Office for Official Publications of the European Communities, Luxembourg. http://www.eurofound.eu.int/pubdocs/2001/59/en/1/ef0159en.pdf

Goudswaard, A., de Nanteuil, M. (European Foundation for the Improvement of Living and Working Conditions), 2000: Flexibility and Working Conditions: A Qualitative and Comparative Study in Seven EU Member States. Office for Official Publications of the European Communities, Luxembourg. http://www.eurofound.eu.int/pubdocs/2000/07/en/1/ef0007en.pdf

Hakansson, N., Floderus, B., Gustavsson, P., Freychting, M., Halling, N., 2001: Occupational sunlight exposure and cancer incidence among construction workers. In: Epidemiology, Vol. 12 (5). 552-557.

ISPESL, 2005: Guidelines: Risk assessment on biotechnology. Istituto Superiore per la Prevenzione e la Sicurezza del Lavoro, Rome; http://www.ispesl.it/linee_guida/fattore_di_rischio/ biotec.htm

Kinnunnen, U., Mauno, S., Nätti, J., Happonen, M, 2000: Organizational antecedents and outcomes of job insecurity: a longitudinal study in three organizations in Finland. Journal of Organizational Behavior, 21, 443-459.

Maxim L., Galvin, J., Niebo, R., Segrave, A., Kampa, O., Utell, M., 2006: Occupational exposure to carbon/coke fibers in plants that produce green or calcined petroleum coke and potential health effects Inhalation Toxicology, 18, 1-32.

National Institute of Allergy and Infectious Diseases (NIAID, USA), 2004: The problem of antibiotic resistance. http://www.niaid.nih.gov

National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention, US, October 1, 2005, Approaches to safe nanotechnology: an information exchange with NIOSH. http://www.cdc.gov/niosh/topics/nanotech/nano_exchange.html

Organisation for Economic Cooperation and Development, 2006: Life longer, work longer. OECD Publications, Paris. http://213.253.134.29/oecd/pdfs/browseit/8106021E.PDF

Peulet, J. P., 2005: Ageing and work in Europe. European Foundation for the Improvement of Living and Working Conditions. Office for Official Publications of the European Communities, Luxembourg. http://www.eurofound.eu.int/pubdocs/2004/83/en/1/ef0483en.pdf

Riedmann, A., Bielenski, H., Szczurowska, T., Wagner, A., (European Foundation for the Improvement of Living and Working Conditions), 2006: Working time and work-life balance in European companies. Establishment survey on Working Time 2004-2005. Office for Official Publications of the European Communities: Luxembourg. http://www.eurofound.eu.int/pubdocs/2006/27/en/1/ef0627en.pdf

Rylander, R., 2004: Organic dusts and disease: A continuous research challenge. American Journal of Industrial Medicine; 46(4), 323-6.

Spetzger, U., Hubbe, U., Struffert, T., Reinges, M. H., Krings, T., Krombach, G. A., Zentner, J., Gilsbach, J. M., Stiehl, H. S, 2002.: Error analysis in cranial neuronavigation. In: Minimally invasive neurosurgery, Vol. 45 (1). 6-10.

Swan, J. R. M., Kelsey, A., Crook, B., Gilbert, E J., 2003: Occupational and environmental exposure to bioaerosols for composts and potential health effects: A critical review of published data. RR130 HSE Books www.hse.gov.uk/research/rrhtm/rr130.htm

Tavakoli, S. M., 2003: An assessment of skin sensitisation by the use of epoxy resin in the construction industry. Sudbury: Health and Safety Executive; Report No.: RR 079

http://www.hse.gov.uk/research/rrhtm/rr079.htm.

van Hemmen, J, Auffarth, J., Hebisch, R., Lechtenberg-Auffahrt, E., Marquart, J., Oppl, R., Rajan, B., Wriedt, H., 2003: RISKOFDERM – Europas Beschäftigte sollen nicht länger ihre Haut zu Markte tragen. Gefahrstoffe – Reinhaltung der Luft, 63, 10, 399-405.

Westgaard, R. H., 2000: Work-related musculoskeletal complaints: Some ergonomics challenges upon the start of a new century. In: Applied Ergonomics. Vol. 31 (6), 569-580.

Wouters, I. M. et al. 2002: Upper airway inflammation and respiratory symptoms in domestic waste collectors.

Occupatinal and Environmental Medecine, 59(2), 106-112.