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– National Research Institute (CIOP-PIB)
Director

Technical and organisational prevention of occupational risks

- are we ready for the new challenges?

Occupational Safety and Quality of Life 2016
Prague, 12-13 October 2016

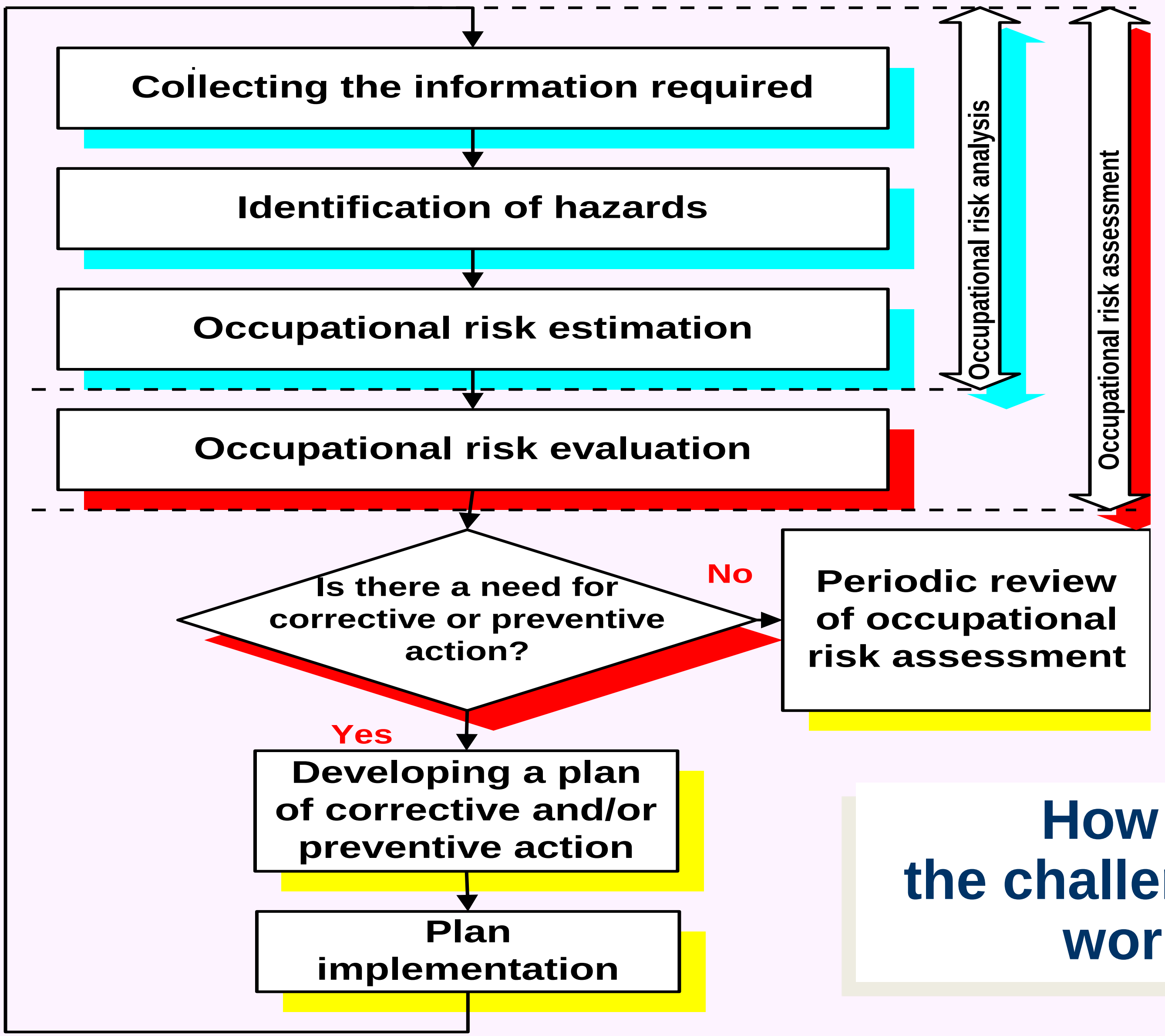
Outline:

1. Introduction
2. Some issues related to the assessment of traditional work-related risks
3. Innovative technical solutions for prevention of work-related risks
4. Innovative organisational solutions supporting prevention of work-related risks
5. Emerging issues
6. Conclusions

Risk:

- The likehood that the potential for harm will be attained under the conditions of use and/or exposure, and the possible extend of the harm

Source:
Guidance on risk assessment at work, Luxemburg, 1996

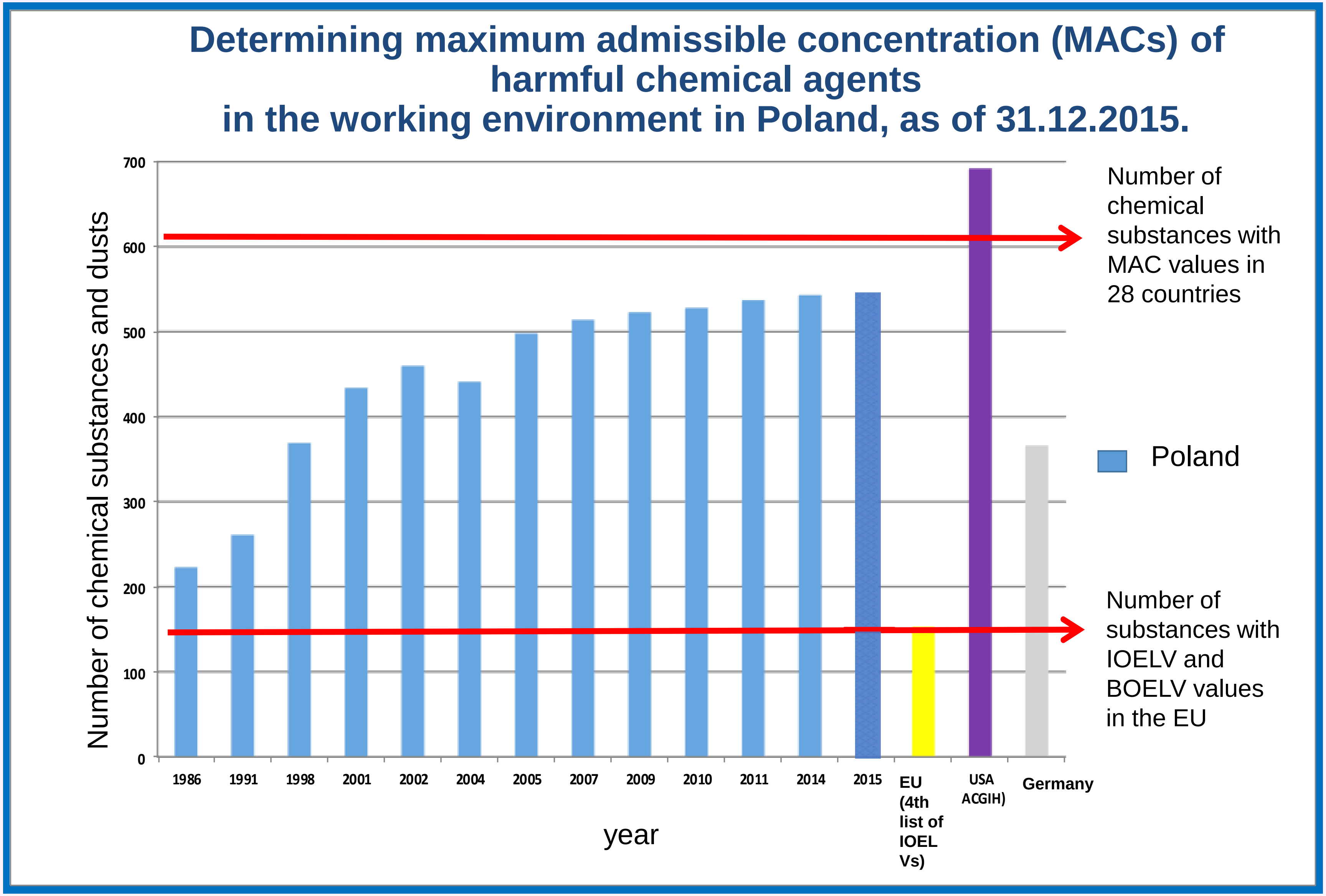


How to deal with the challenges in changing world of work?

2.

Some issues related to assessment of traditional work – related risks

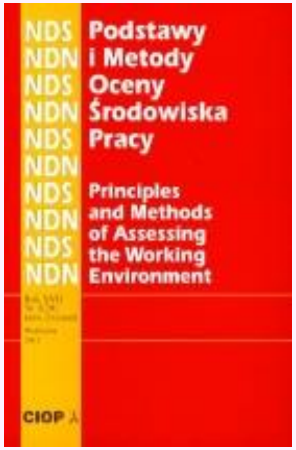
Chemical factors – establishing criteria for risk assessment



CIOP PIB

Contents of Documentation

- ➢Substance characteristics, uses and occupational exposure
- ➢Toxic effects on human and laboratory animals
- ➢ Carcinogenicity, mutagenicity, teratogenicity, embriotoxicity, effects on reproduction
- ➢Toxicokinetics
- ➢Dose-effect and dose-response relationships
- ➢Bases for proposed MAC values and biological tolerance limits
- ➢Methods of determining agents harmful to health in the air
- ➢Pre-employment and periodical medical examinations



Documentations are published quarterly in the publication of the Interdepartmental Commission "Principles and Methods of Assessing the Working Environment"

Types of influence of simultaneous interaction of harmful factors on a human body

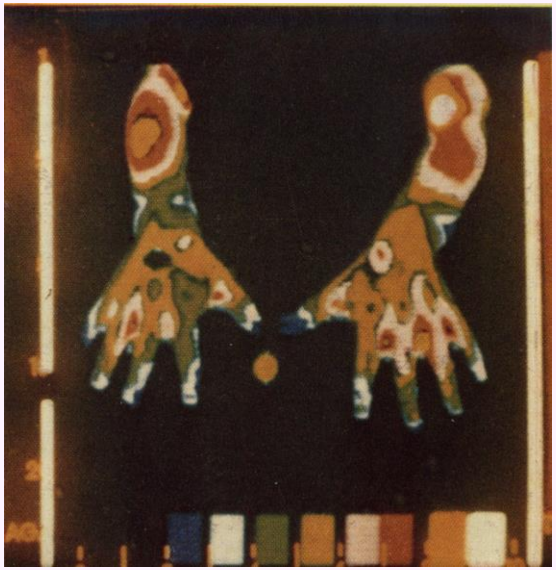
Effect / Substance	Independent	Additive	Supro – additive (synergostic)	Infra – additive (antagonistic)
1 2	1 + 2 = 1 + 2	1 + 2 = 3 <u>Example:</u> morphine and scopolamine in depressive action to Central Nervous System	1 + 2 = 4 <u>Example:</u> phenobarbital which induces cytochrome P-450 potentiates the hepatotoxicity of bromobenzene	1 + 2 = 0 <u>Example:</u> administration of antidotes (for example: administration of ethanol in the methanol poisoning

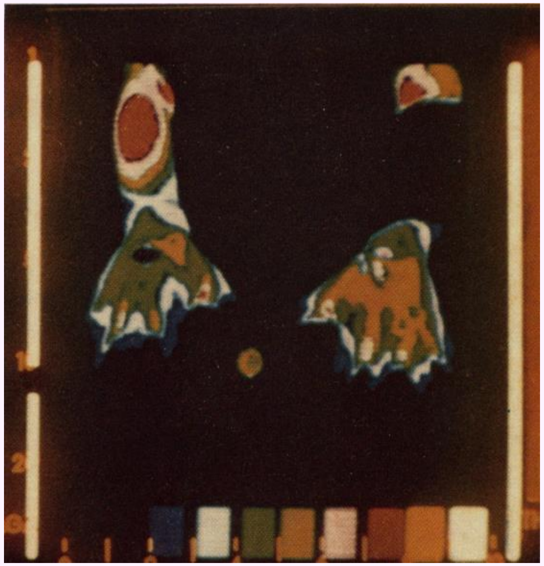
Chemical substances in the workplace that interact with noise

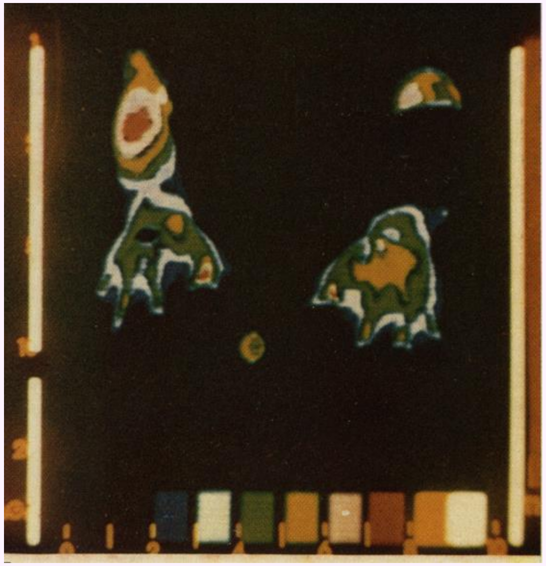
- Organic solvents
  - toluene
  - styrenes
  - xylene
  - trichloroetylene
  - ethylobenzene
  - alkohols
  - CS_2
  - n-hexane
  - mixtures
  - fuels
- Heavy metals – lead, mercury, arsenic, cadmium
- Suffocating gases – carbon monoxide, hydrogen cyanide
- Pesticides

VIBRATION and COLD – combined exposure

rest	influence of cold in 2^{nd} minute	influence of cold in 7^{th} minute



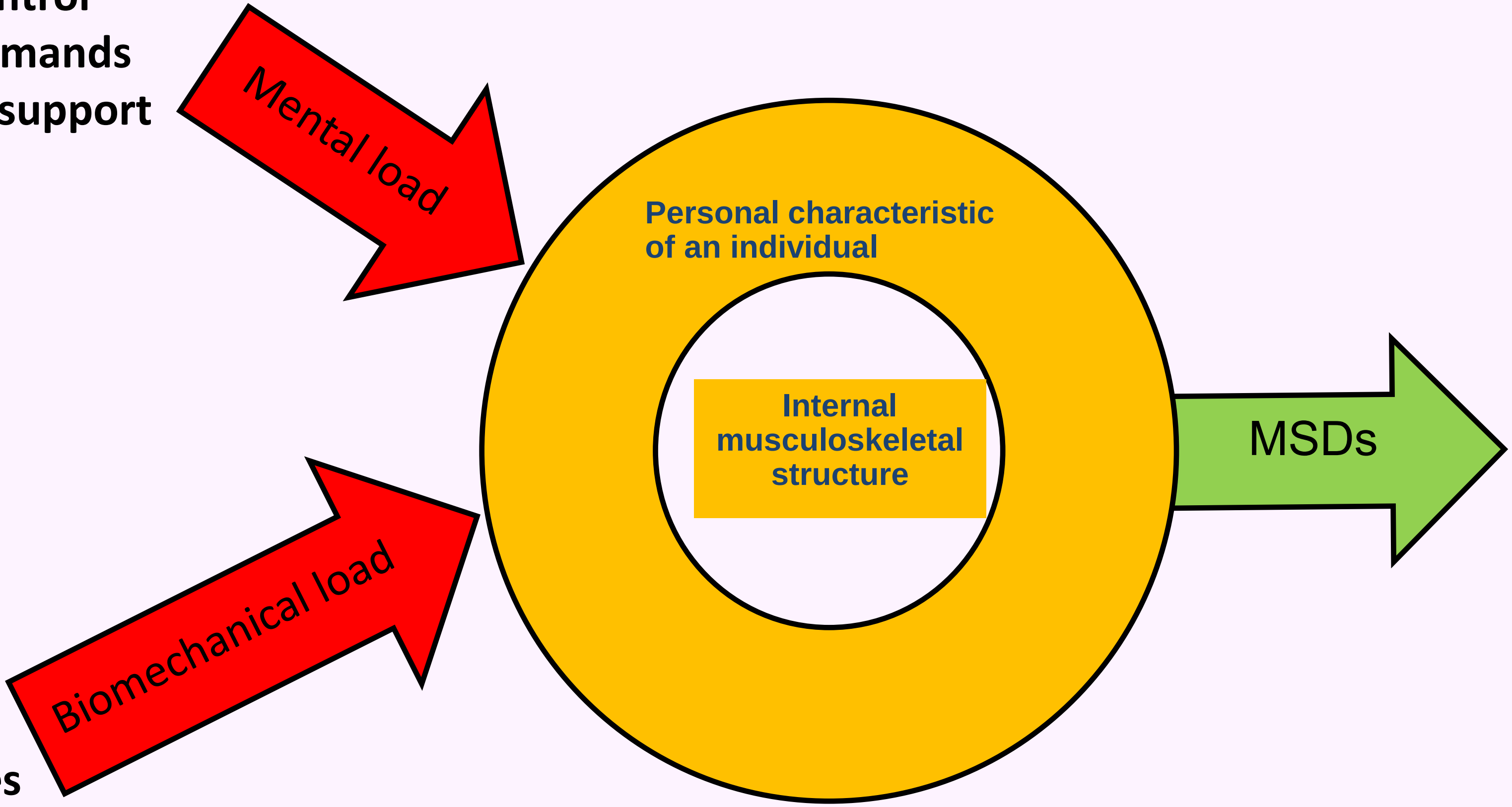




Source: D. Koradecka: *Periphere kreislaufreaktionem durch Arbiten mit vibrierenden Werkzeugen. Bundesanstalt fur Arbeitsschutz und Unfalloforschung.* Dortmund 1982

Psychosocial and biomechanical factors – combined exposure

- Job control
- Job demands
- Social support



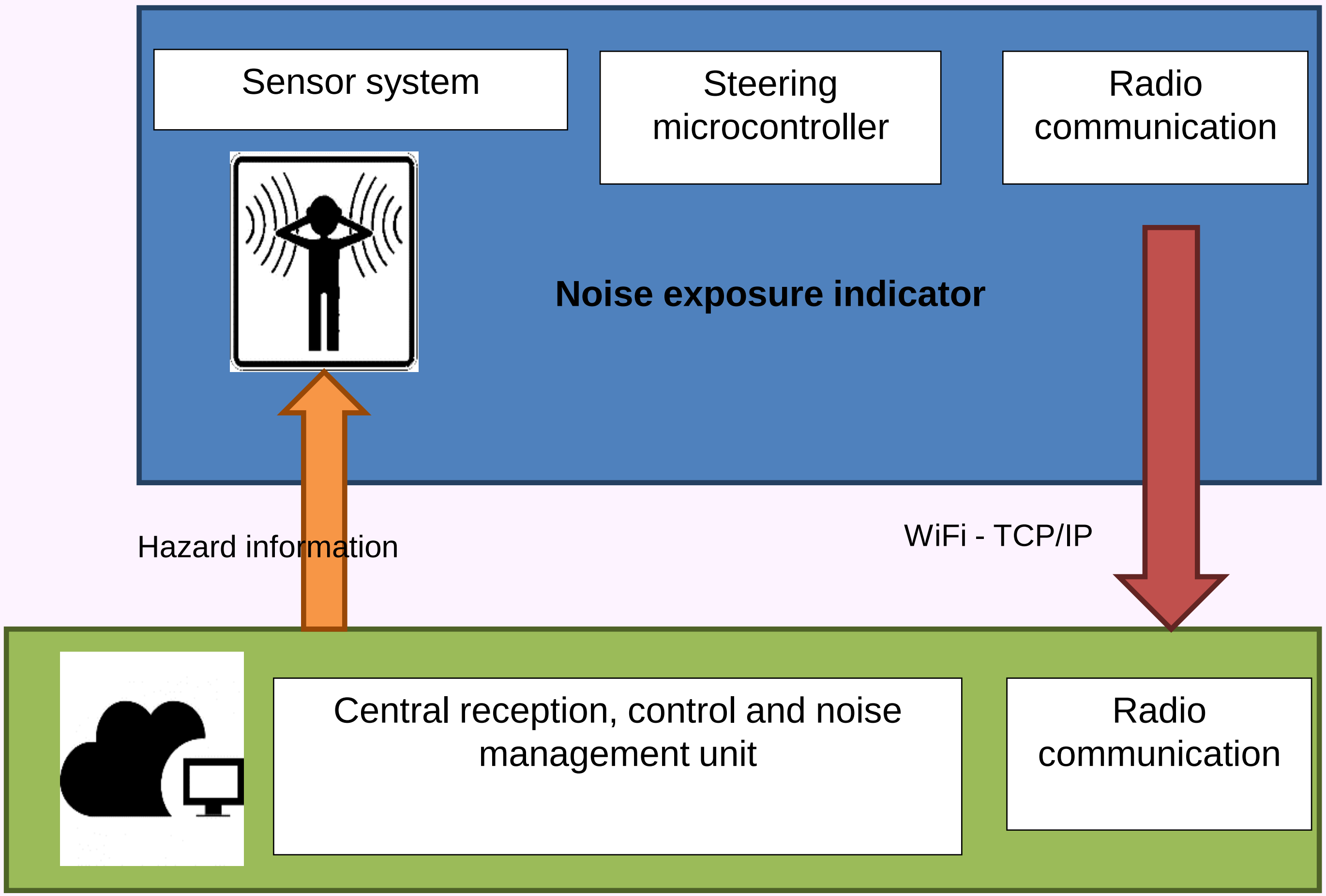
- Body posture
- Forces
- Time sequences

3.

Innovative technical solutions for prevention of work-related risks (examples)

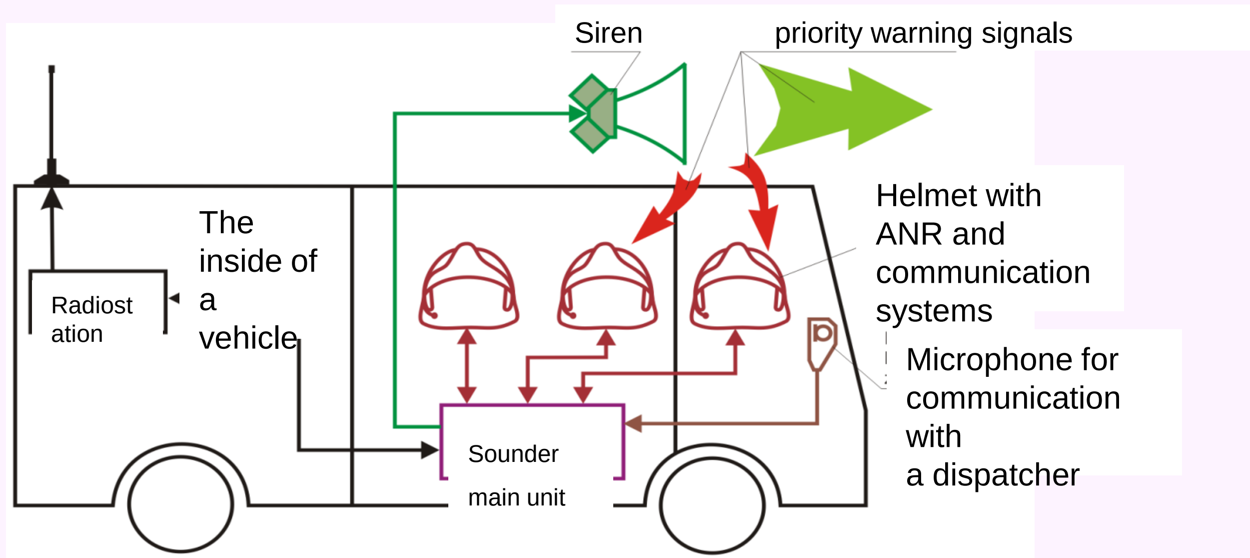
Noise and vibration disturb and cause harm

Prototype of personal noise exposure indicator

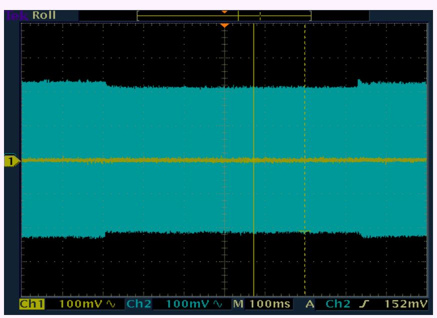


Patent application

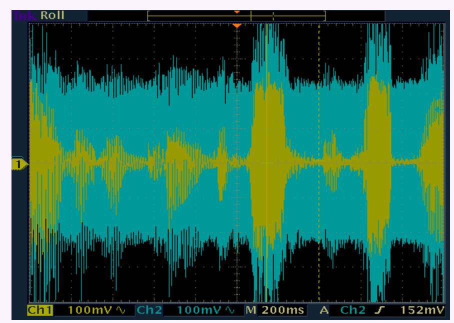
Development of an active noise reduction system from the priority warning signals intended for use in a firefighter's helmet



A scheme of the acoustic system in a privileged fire fighting vehicle



Active reduction of the priority warning signals (blue – before reduction, yellow – after reduction)

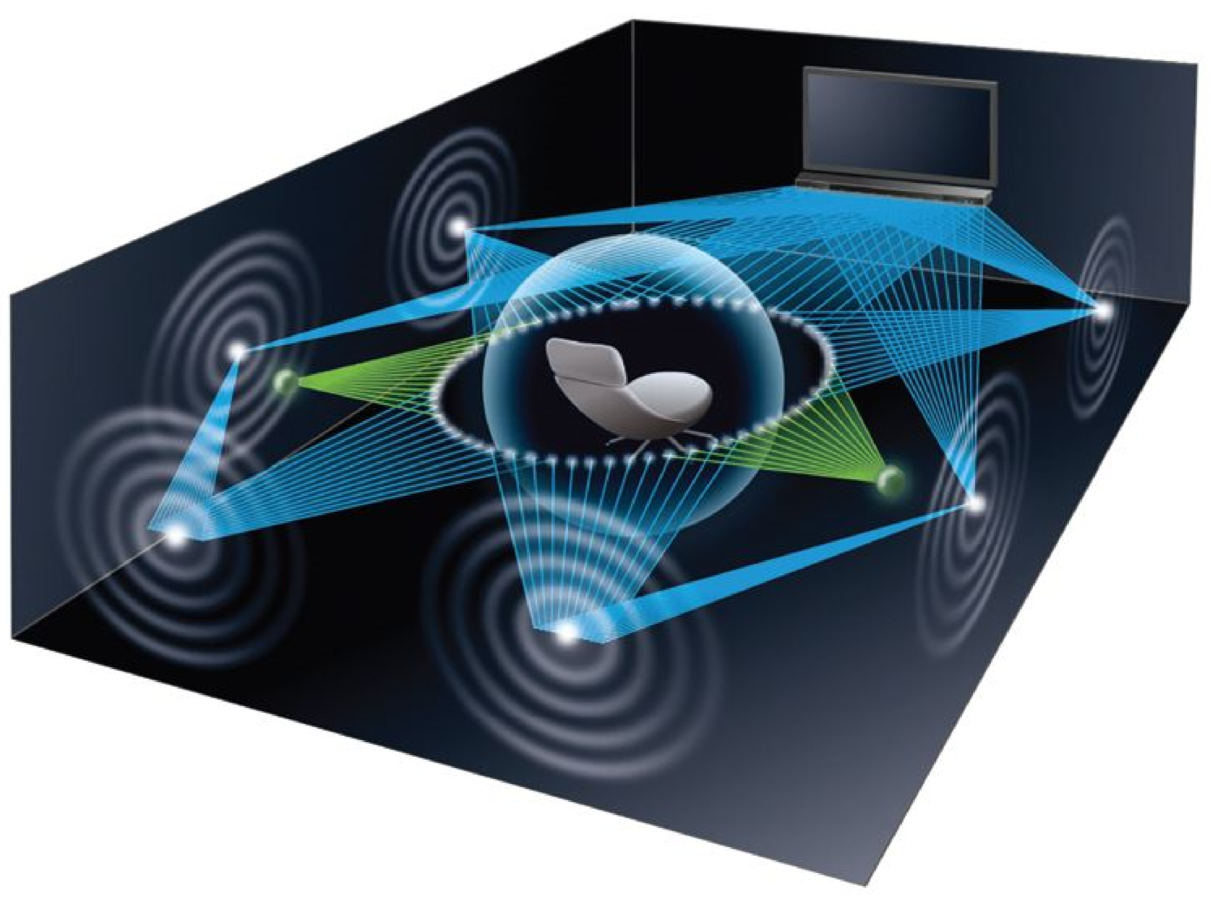


Noise reduction of speech signal (blue – signal before noise smoothing , yellow – signal after noise smoothing)

Enriching the acoustic working environment with sounds that support spatial orientation of persons with hearing and visual disability

Controlling the sound in order to eliminate hazards and obtain comfort

Creating private sound zones

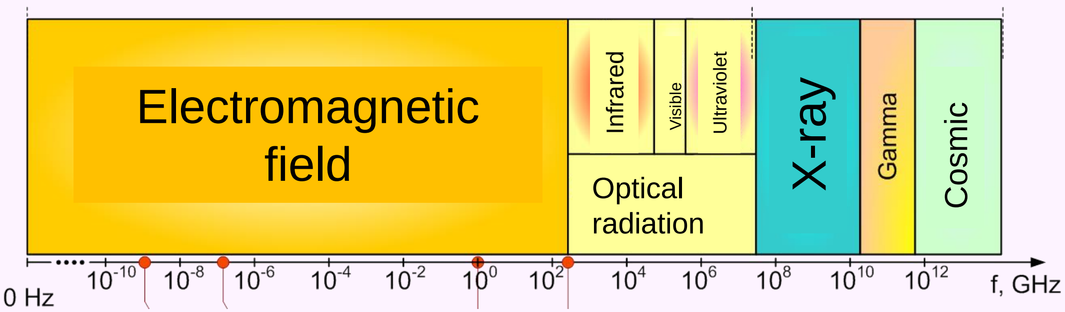


Electromagnetic field is everywhere

DIRECTIVE 2013/35/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 26 June 2013 on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (electromagnetic fields) (20th individual Directive within the meaning of Article 16(1) of Directive 89/391/EEC) and repealing Directive 2004/40/EC

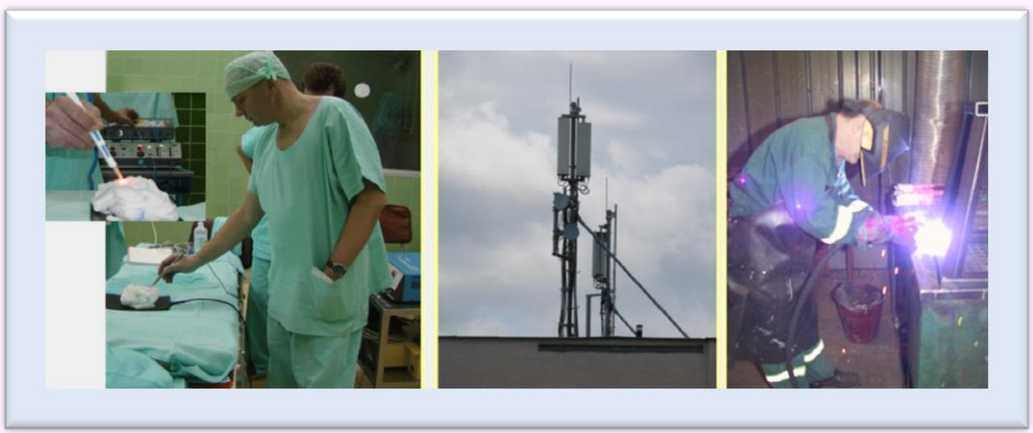
Termin transpozycji to 1 lipca 2016 r.

Electromagnetic fields



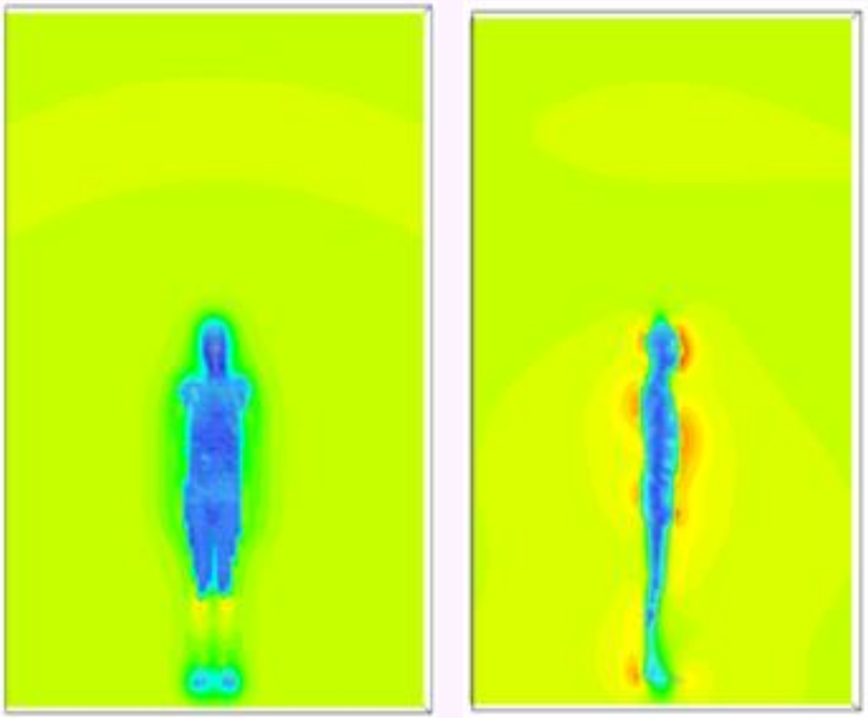
EMF sources:

- Energy
- telecommunication
- Industry
- Medicine
- ....

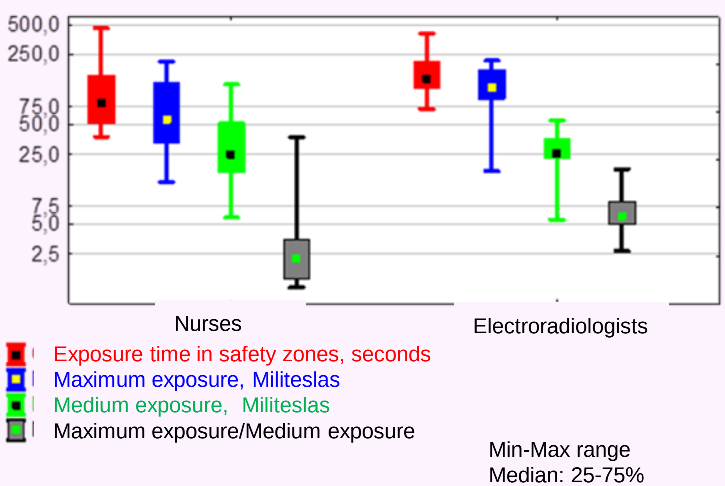


Exposure of:

- **- population (38 mln)**
- **- workers (0.5 mln)**
- **- patients (?)**

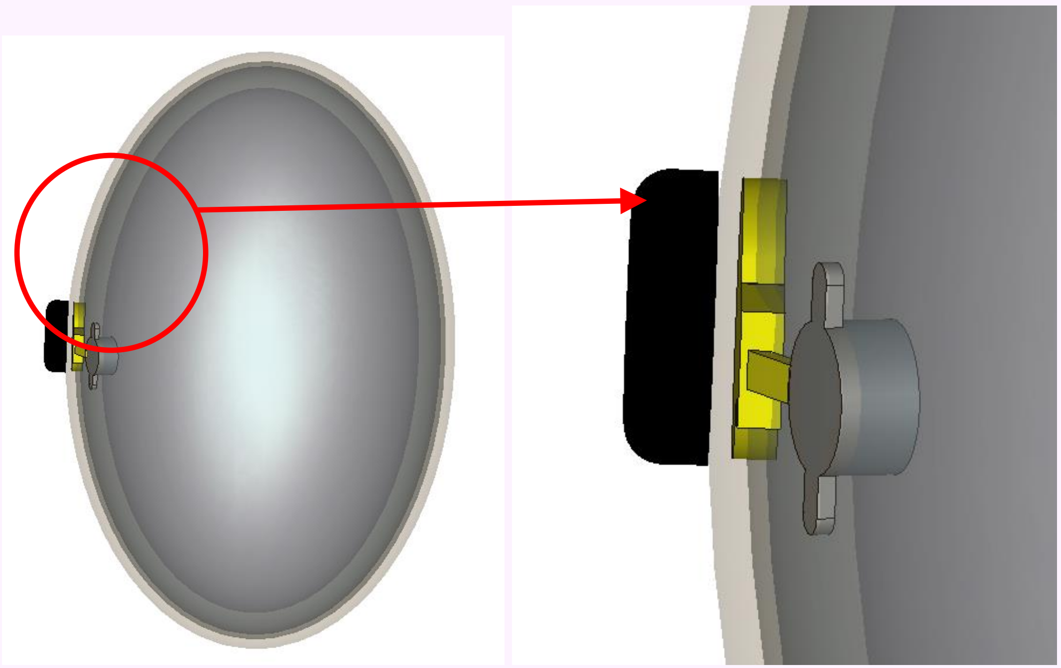


Comparison of exposure of different group of workers handling magnetic resonance imaging (MRI) to magnetic fields



Developing personalised methods to assess the impact of electromagnetic fields on people

Modelling and assessment of electromagnetic hazards for the users of personal medical devices supporting life-functions

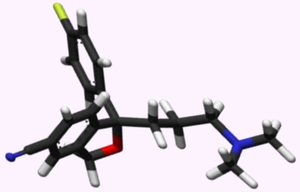


Cochlear implant

- **Impact on bone conduction of electromagnetic field (100 Hz or 50 kHz)**

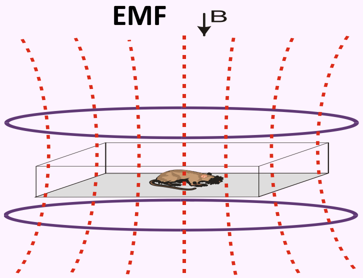
Exposure to electromagnetic field eliminates the effects of antidepressant (Escitalopram) on the decrease of anxiety and activity

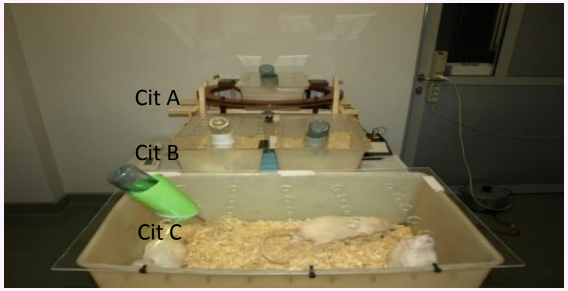
+



Escitalopram
(1 per day, 10mg/kg)

+



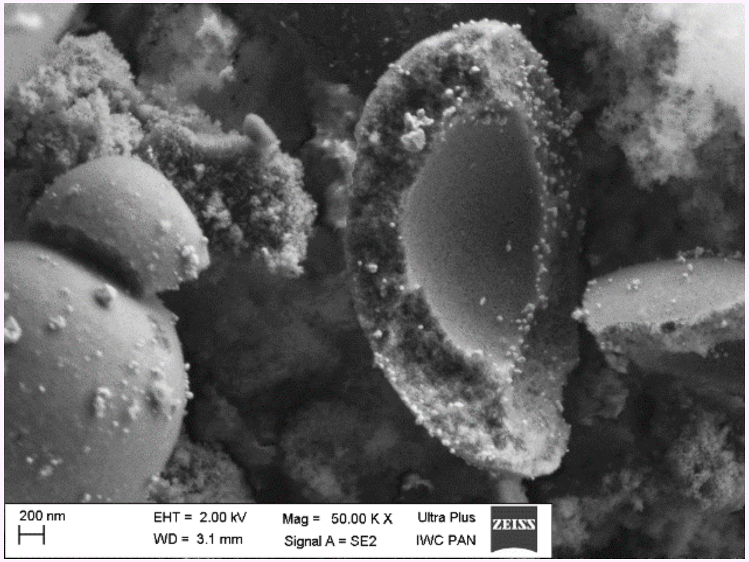


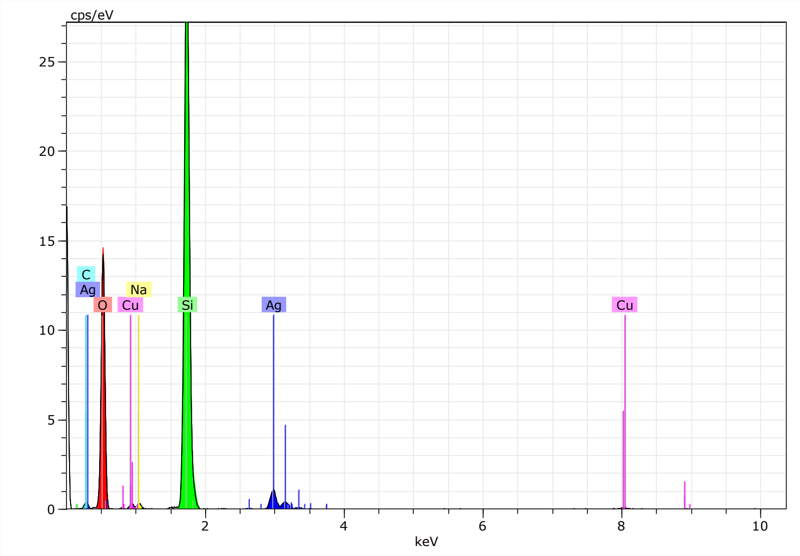
Exposure: 28 days

Nanobjects
– versatile applications
in technical and medical solutions,
but also
unrecognised hazard
after entering the body

Generating and testing nanoaerosols of stable concentrations and dimensions

Example of research: nanoparticles





a) Microscope picture (SEM) particles (EDS) in the process using silver-modified silica

b) Chemical composition of

- In **19** out of **26** studied processes the exposure to nanoobjects achieved the highest level **>4**, indicating high risk for the health of workers

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Testing the efficiency of air filters for particles emitted from nanomaterials

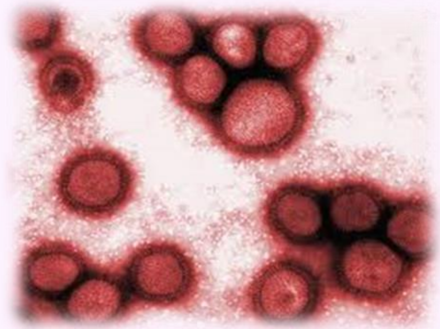
Testing at the emission site

Testing in laboratory

Biological hazards in the working environment

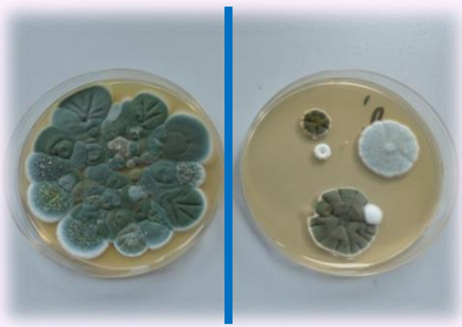
Viruses – spreading and risk assessment

The use of highly efficient meters for controlling ultrafine aerosol fractions



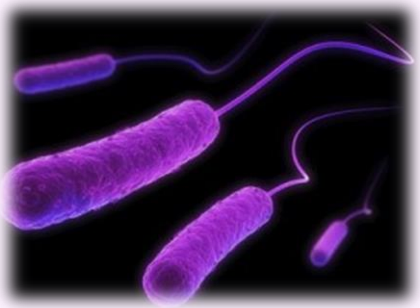
The efficiency of cleaning and disinfection of air-conditioning equipment

(e.g. in aircrafts, cars)



Waste combustion plants

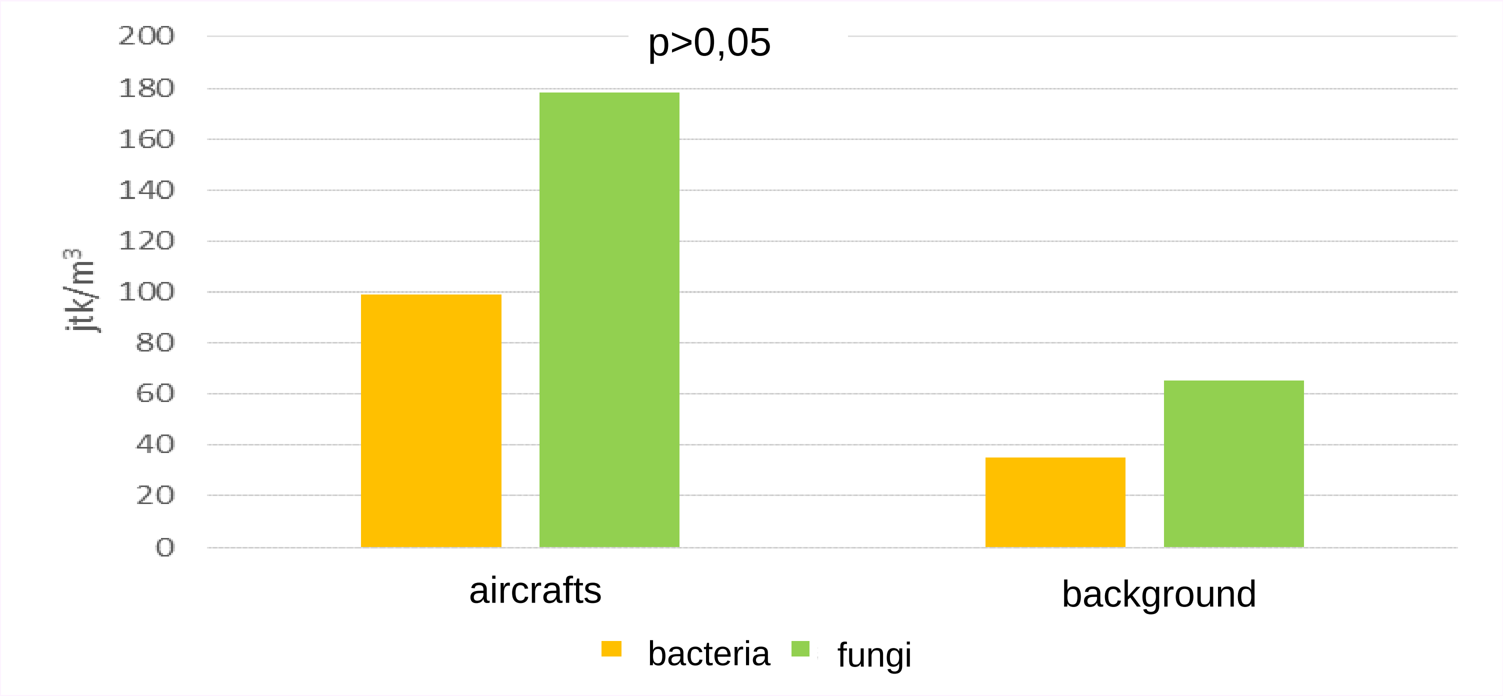
Unrecognized exposure to bacteria, fungi and their toxins present in the air at workstations



Wood processing plants

Hazardous microbiological factors in wood dust

Mean concentration of bacteria and fungi in ventilation systems of aircrafts compared with external background (atmospheric air)



Personal Protective Equipment

i-Protect

Intelligent PPE solutions for personnel in high risk and complex environments

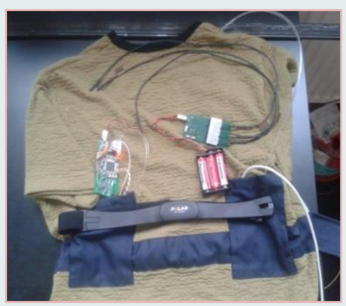
SEVENTH FRAMEWORK PROGRAMME

Chemical and mining rescue, fire fighting

Visualization of parameters

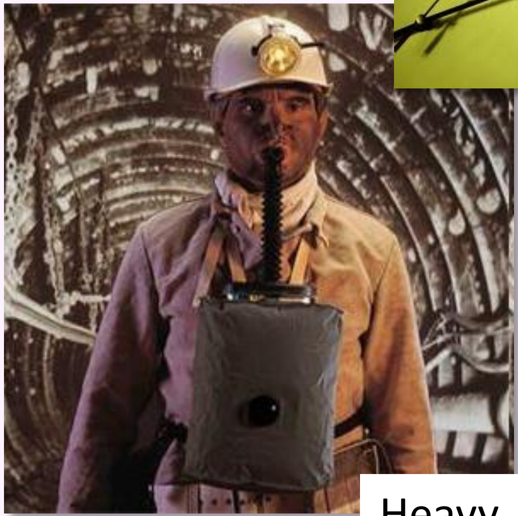
Command centre

Physiological and environmental sensors



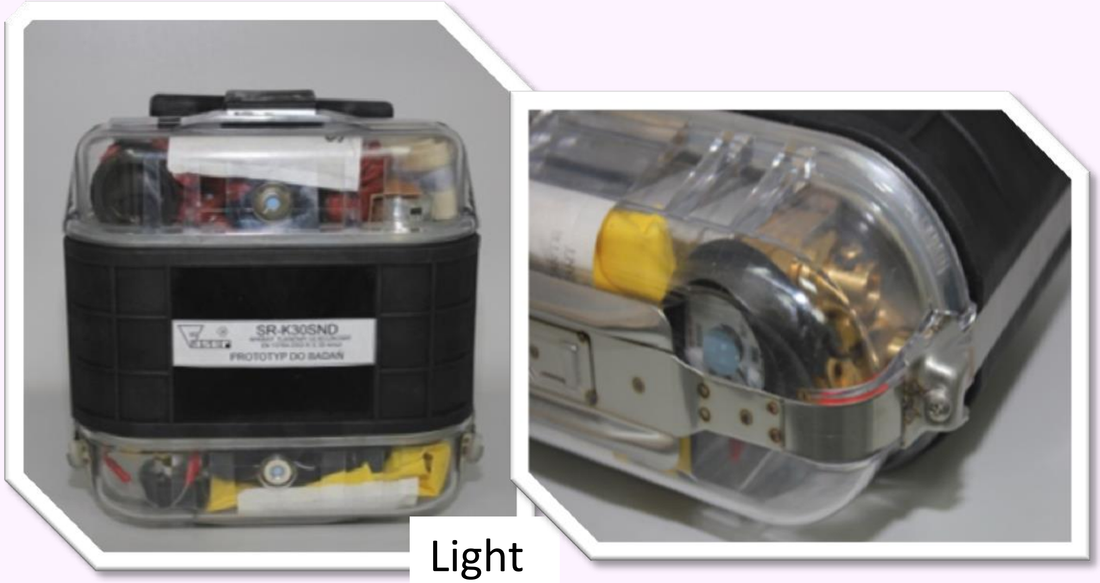
System of immediate starting time of oxygen escape apparatus

Present starting time of apparatus is 40 seconds



Heavy

New solution guarantees the possibility of first breath in 4 seconds from the starting of apparatus



Light

BIOACTIVE AND BIODEGRADABLE RESPIRATORY PROTECTIVE DEVICES

- **protection efficiency against bacteria – 99 %**

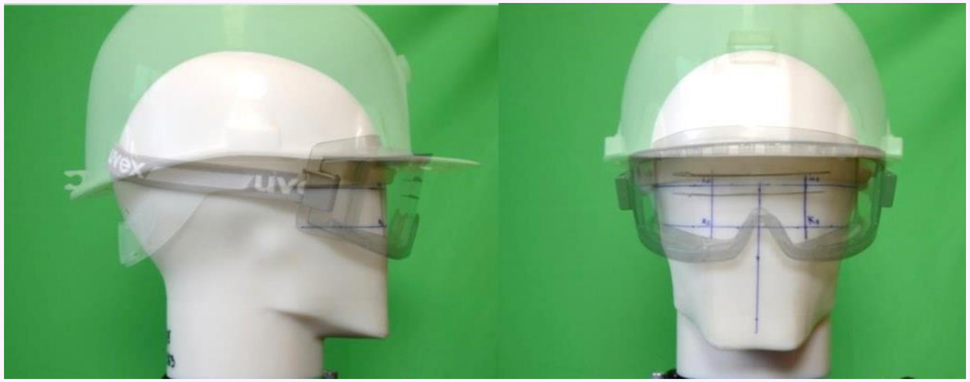
- **survival –**
  1000-fold reduction of bacterial population in 2 h

- **biodegradability in the compost environment –**
  100% mass loss after 28 days

kompostowalny

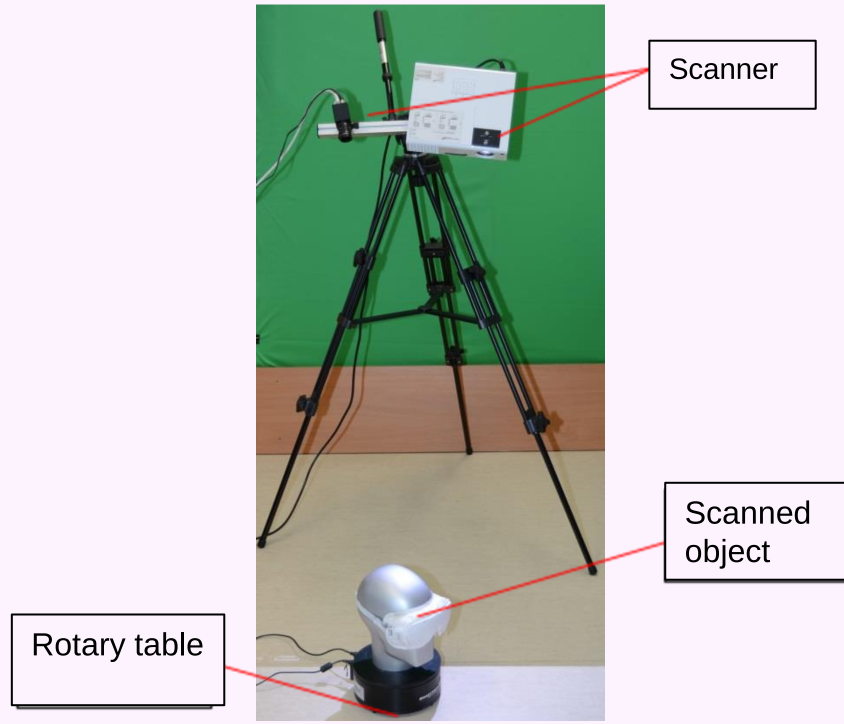
Patent and utility model application to the PPO

Research on simultaneous use of helmets, eye and face protection and respiratory protection



Pictures modified with graphics software

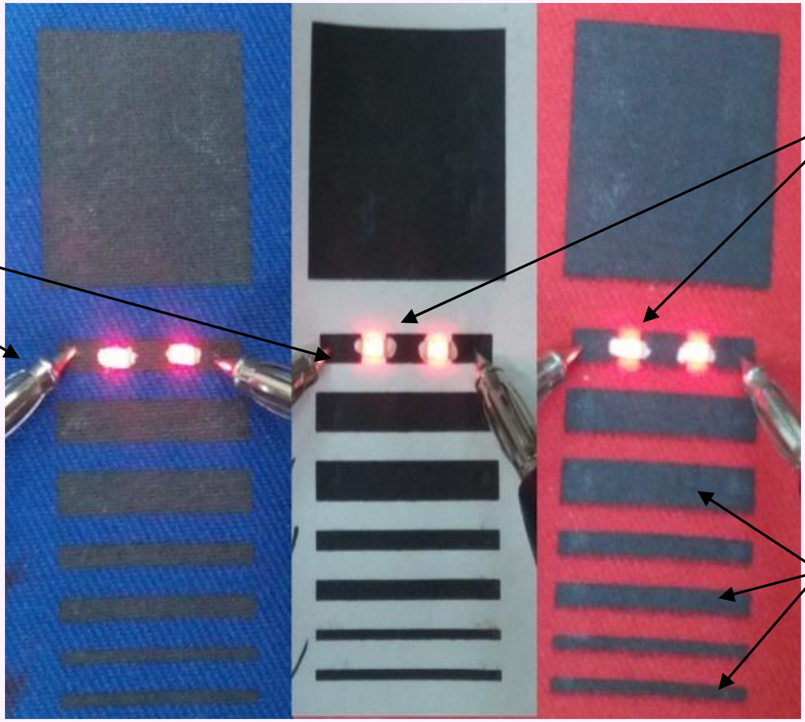
Visualization of 3D scans



3D scanning

Smart PPE - Textiles with electrical conductive paths containing carbon nanoparticles and graphen used for power supply to LED diodes

Power supply from laboratory direct current power supply

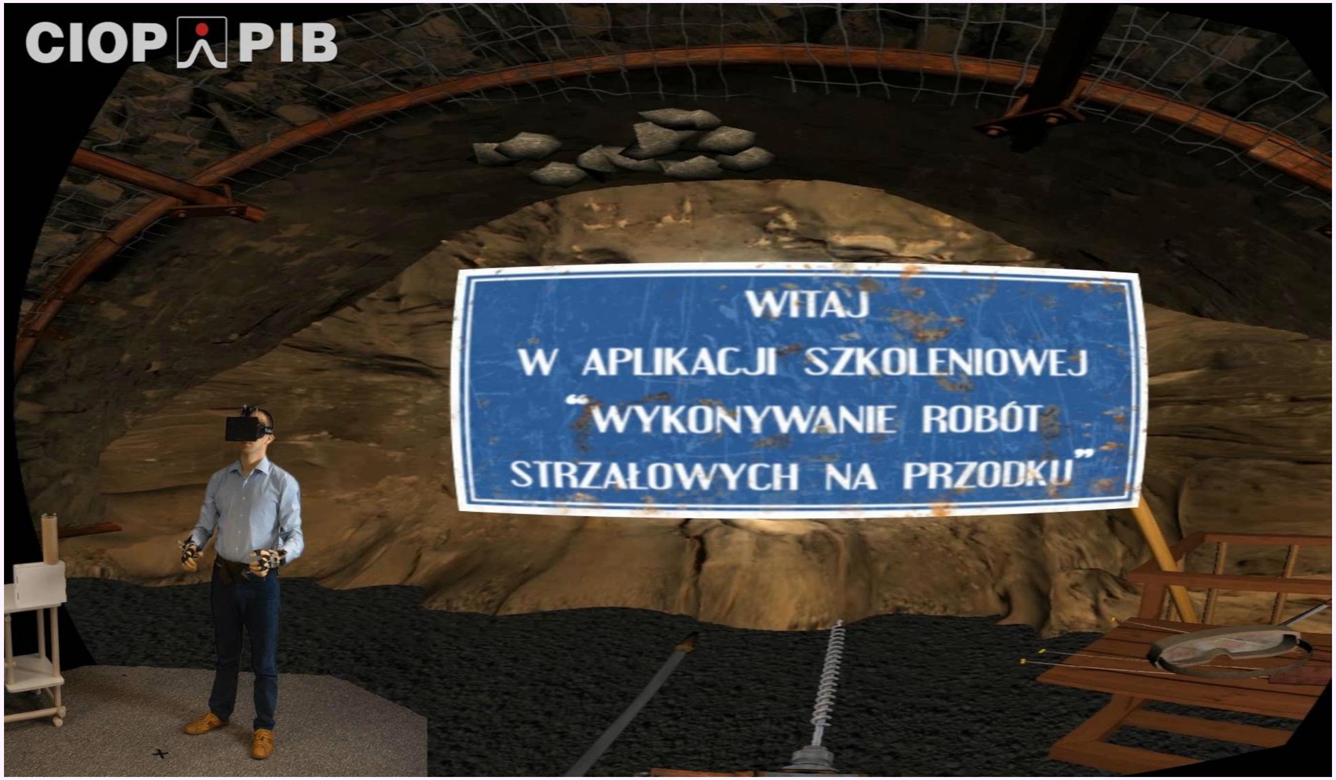


Electrical conductive paths on textiles

Virtual reality

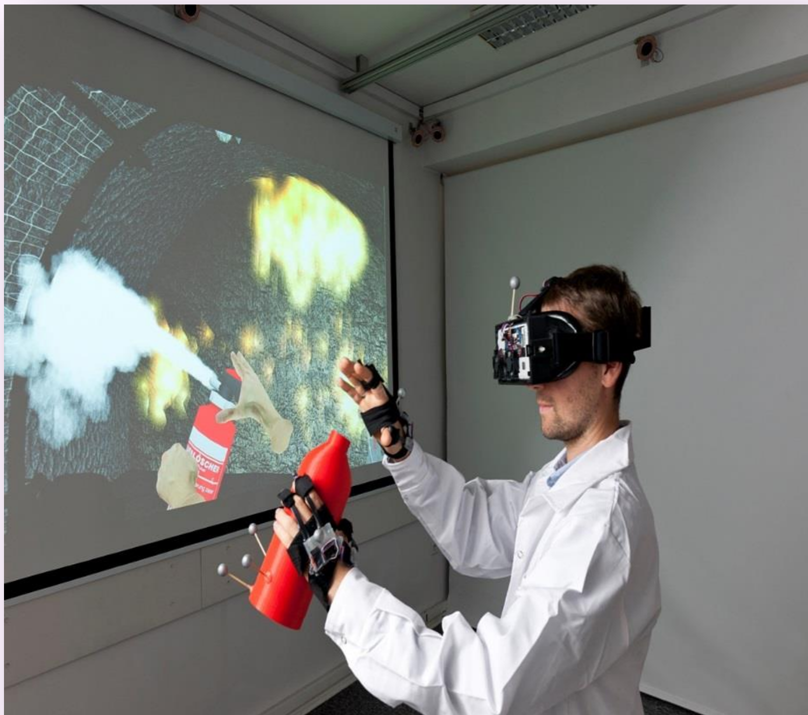
Mapping with the use of virtual reality of particularly hazardous workstations

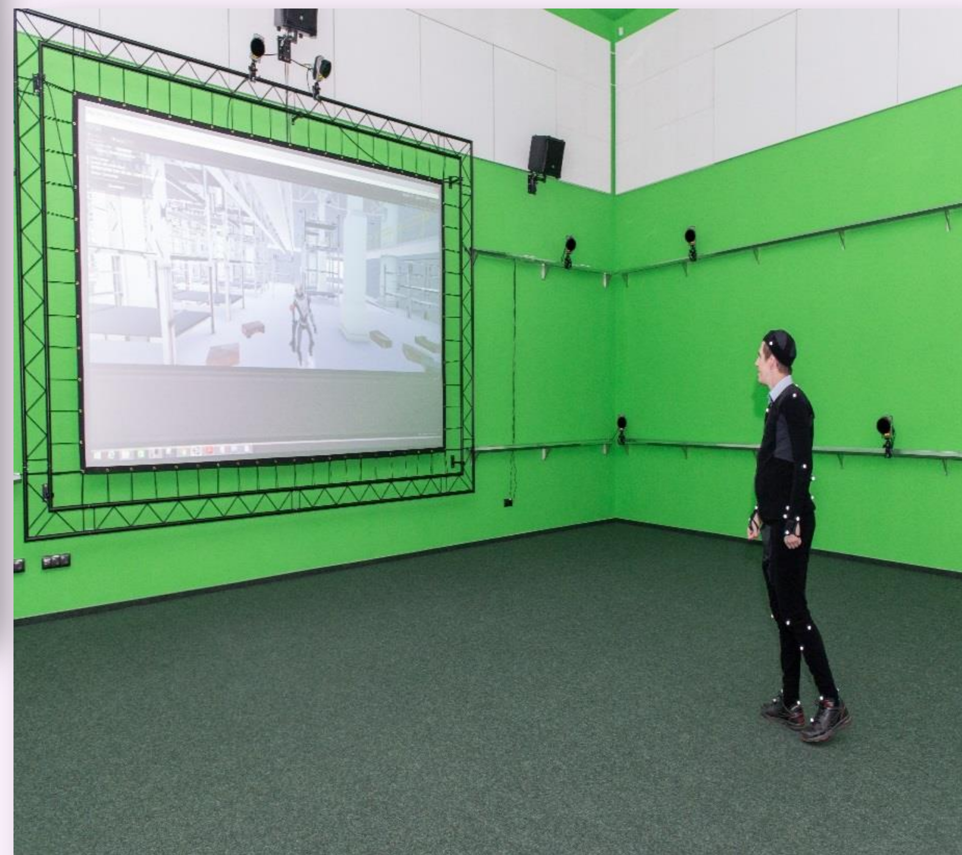
- great level of realism
- simulation of scenarios on controlled conditions



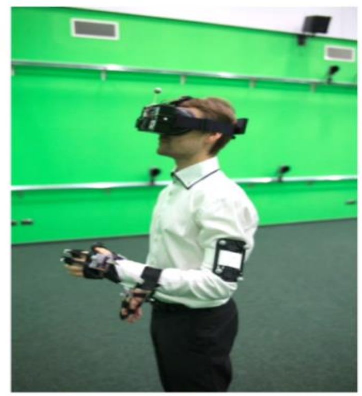
- developing correct habits without exposure to risk.

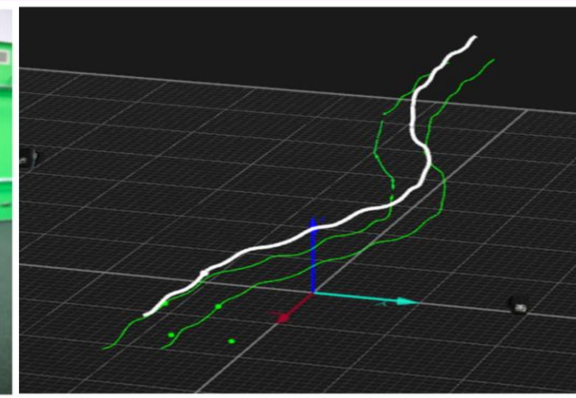
Laboratory of virtual reality technologies





The registration of movement trajectory in persons with reduced mobility





4.

Innovative organisational solutions supporting prevention of work-related risks

**Technological innovation accounts for 25%
of the success in radical innovation, whereas workplace innovation accounts for 75%**

Volberda et al, 2006 cited in Pot and Koningsveld, 2009

GERMANY

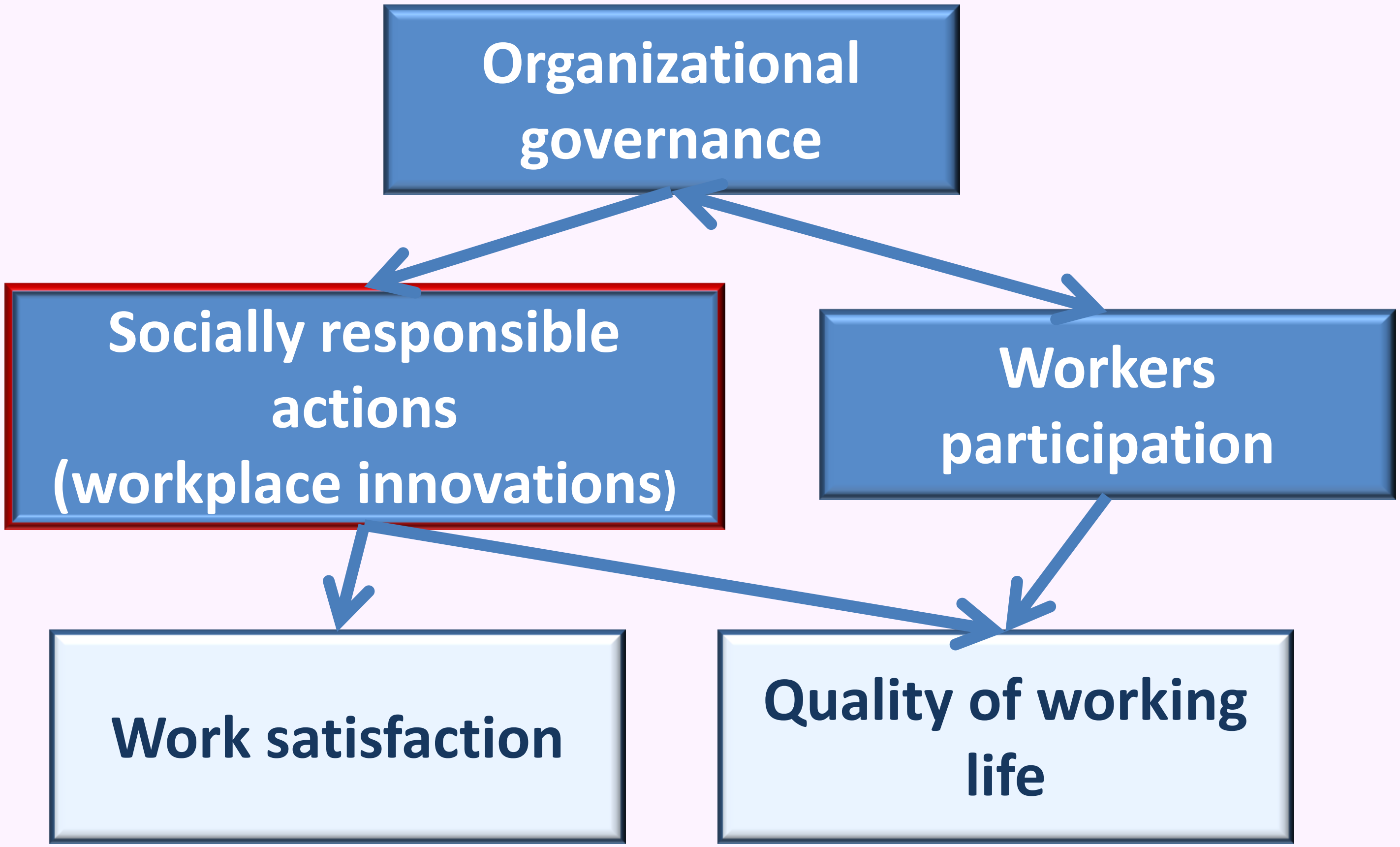
Study carried out by social insurance institution (212 companies)

Impact of social innovations (ergonomic) on the improvement of working conditions

- **physical workload (improvement by 91.5% in production; 80% in trade and services)**
- **stress management (improvement by 30.8% in production; 50.5% in trade and services)**

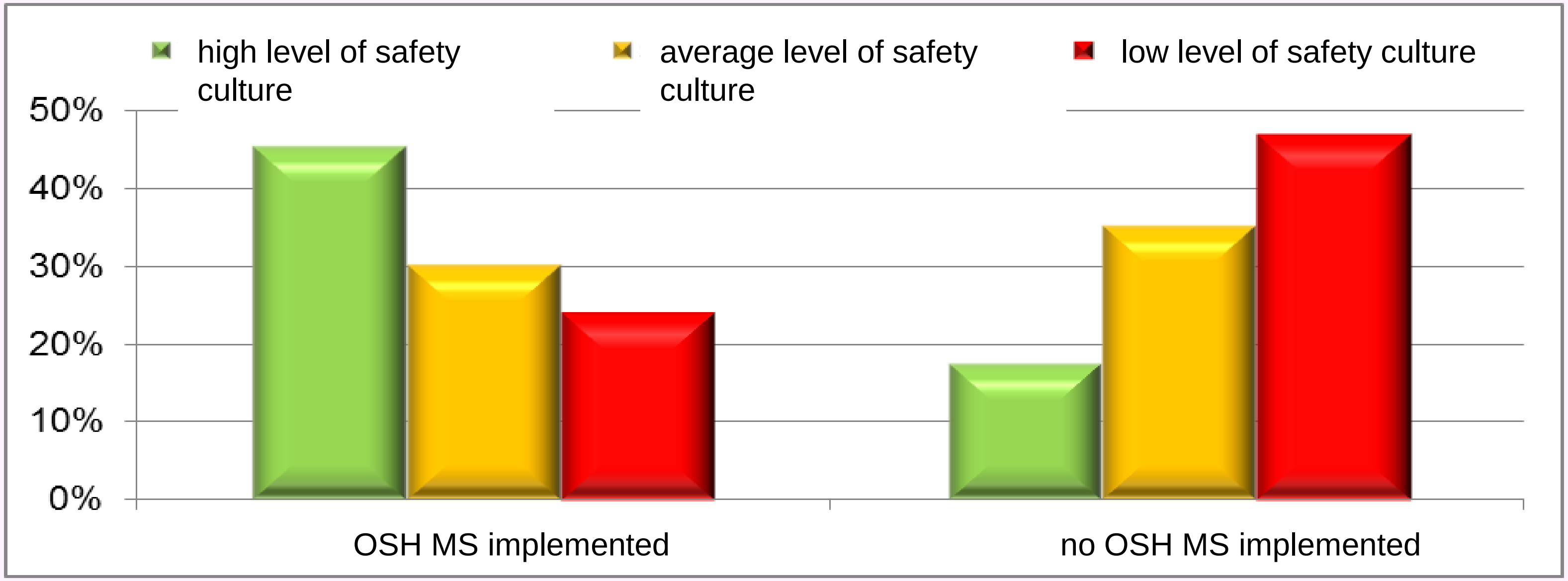
AOK Die Gesundheitskasse.

Developing organisational governance supports implementation of CSR-related actions (mainly workplace innovations)

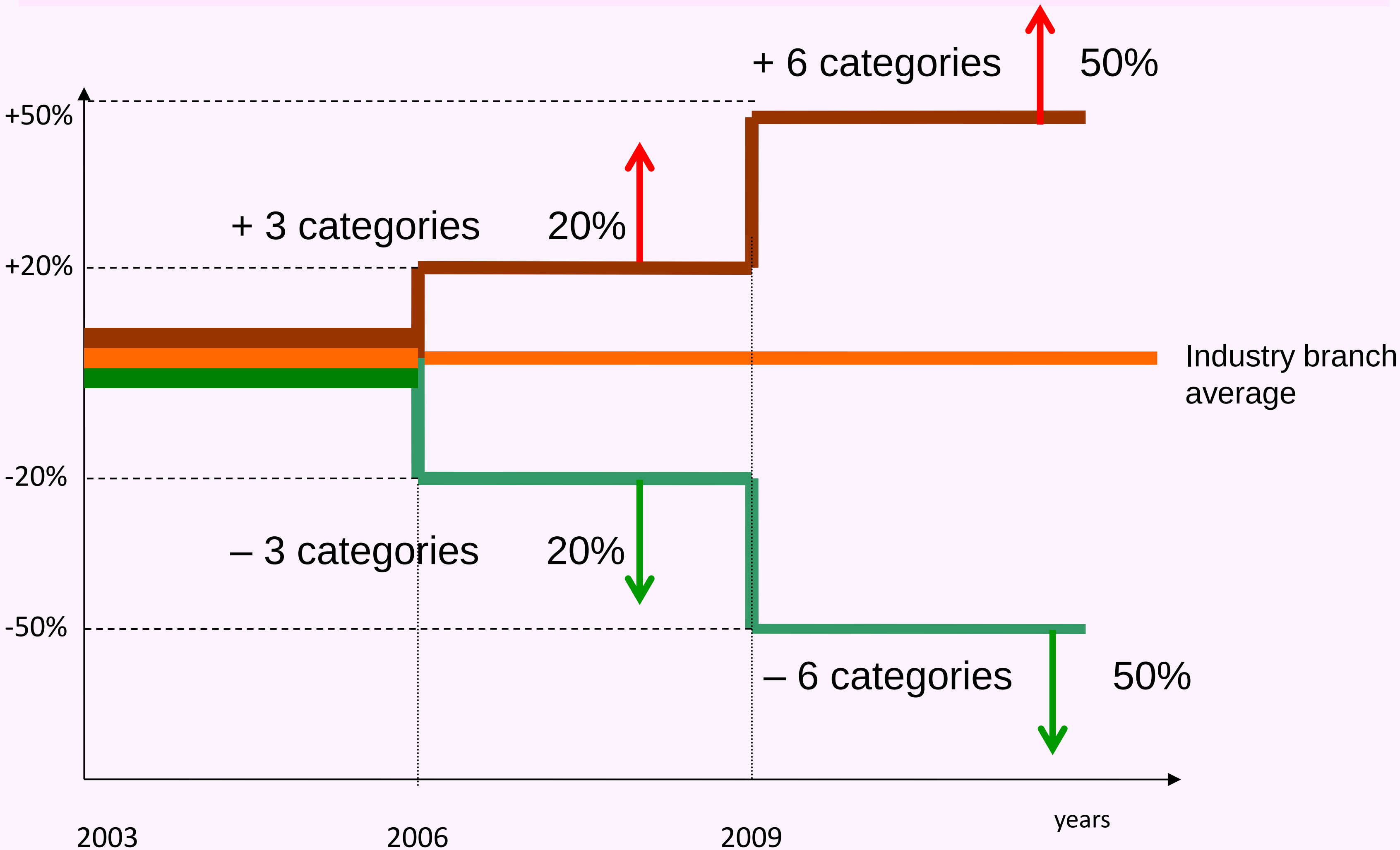


Source: Z. Pawłowska , Examining companies' activities related to CSR, CIOP-PIB, 2008

Evaluation of safety culture level in enterprises, depending on the implementation or non-implementation of OSH management system



Differentiation of insurance premium rate of enterprises in relation to accidents at work and number of people exposed to hazards



New task of the Social Insurance Institution (ZUS) in accident prevention (Poland)

- Financing activities related to the prevention of accidents at work and occupational diseases, taking into account work ability through the entire occupational activity period.

Since 2013 as many as 910 were included and working conditions of 13.500 employees were improved.

Innovative legislative instruments to support occupational risk prevention - example of implementation

Manufacturer of furniture
– state before modernization



Inefficient fume exhaust system

Innovative legislative instruments to support occupational risk prevention - example of implementation

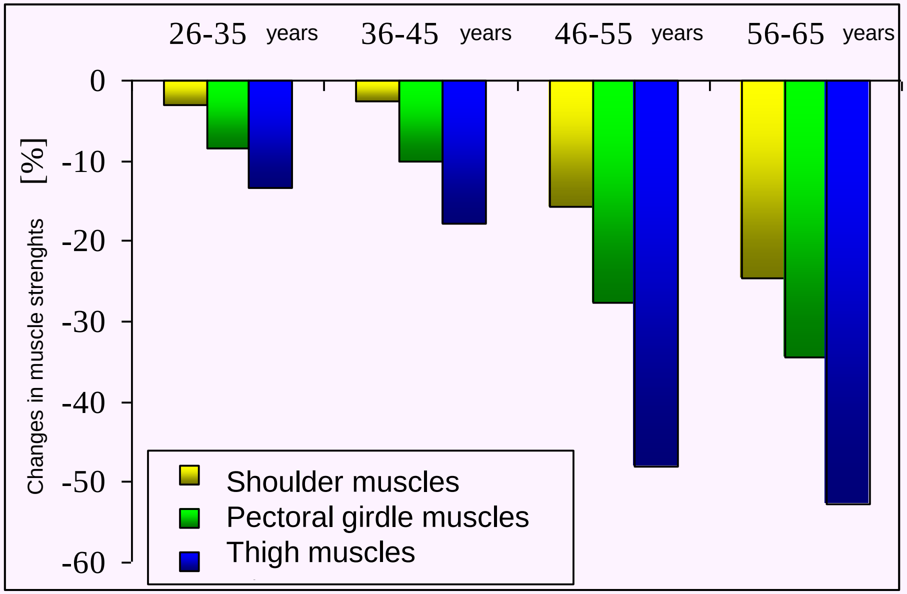
Manufacturer of furniture
- state after modernization

Combined system of local fume exhaust system of the milling machine, grinding machine and band saw

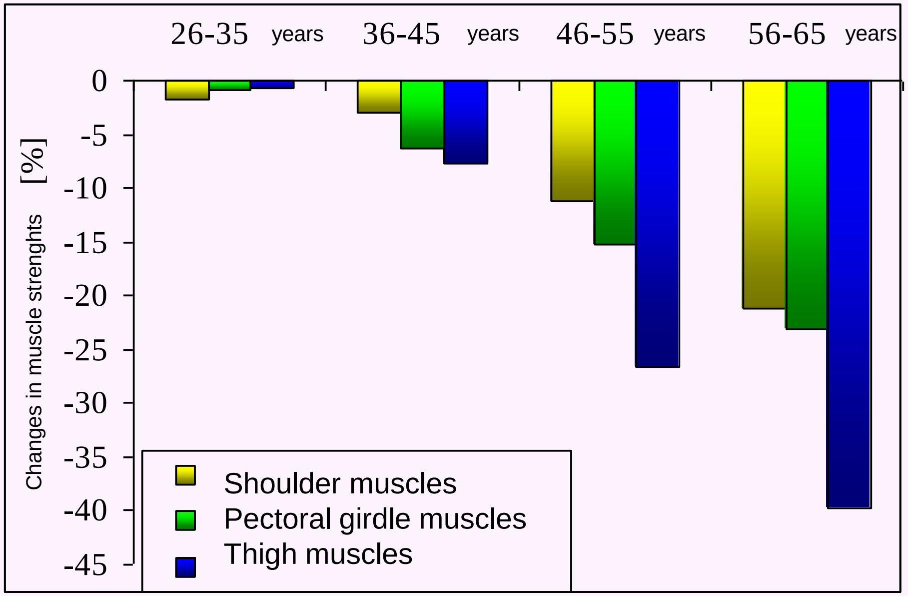
5.
Emerging issues

Ageing and work

Changes in muscle strength with age in professionally active persons (Kamińska J, Tokarski T, 2010, CIOP-PIB)



IN WOMEN



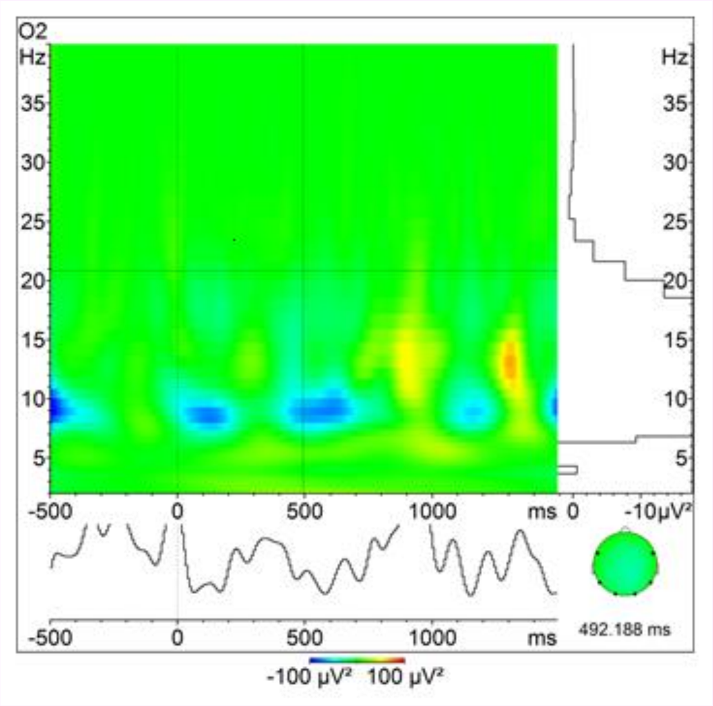
IN MEN

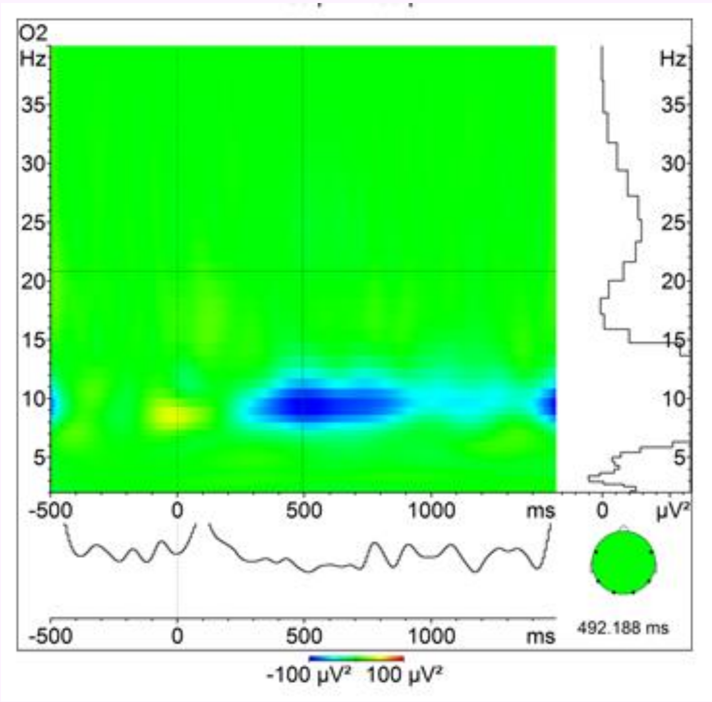
The assessment of speech intelligibility and directional hearing at workers aged 50+

1. **No problems** with differentiating whether the alarm sound is heard from the **right or left top**

2. **Problems** with defining the direction of the alarm sound **from the top**, when it is heard **in the back or in front** of the person.

The increase in vigilance of workers (55+) after the exposure to blue light (EEG record)





a)

b)

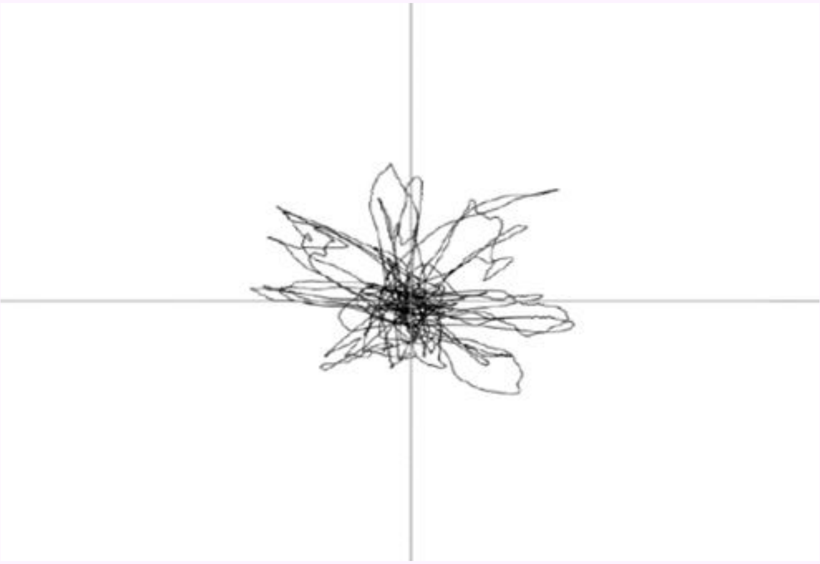
a) before,

b) after the exposure to blue light

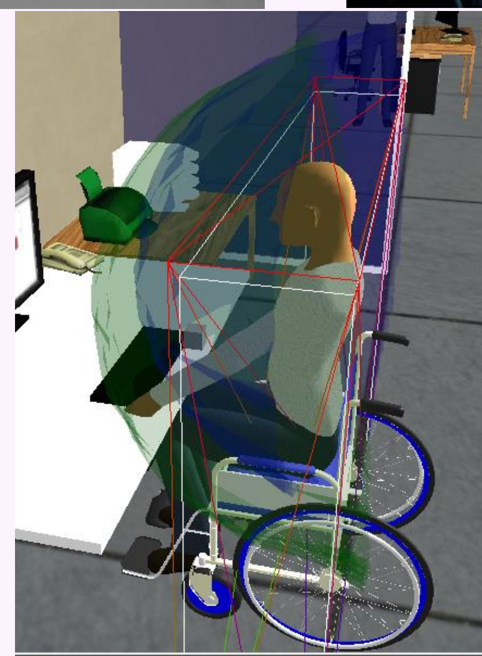
Selection of protective shoes for aging workers to prevent the risk of slipping and falling.

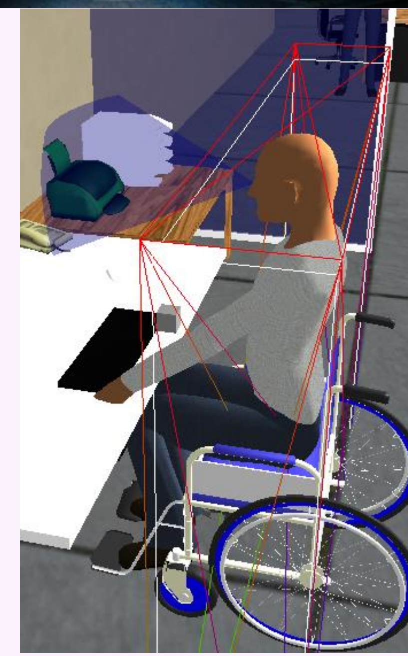
A) **Older workers**
Shoes without ankle protection

B) **Older workers**
Shoes with ankle protection



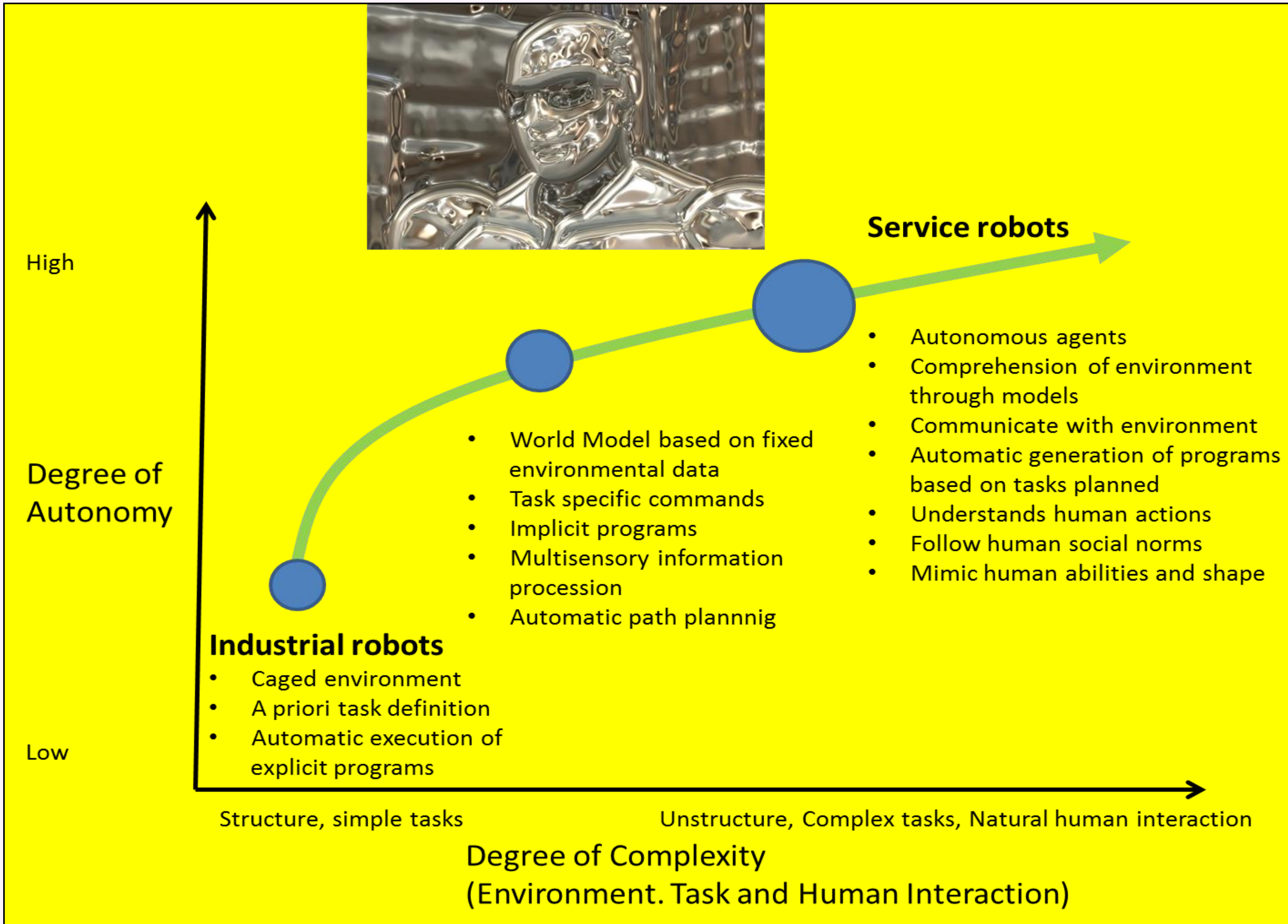
Framework guidelines for design of facilities and rooms, and adaptation of workstations to the disabled with specific needs /2013-2015/





Robotics

Robotics roadmap (Haidegger et al. 2013, p. 1216)



Source: Dr Jari Kaivo-oja, Finland Futures Research Centre, University of Turku: Robotics, AI and future of work, 2016

Model education programmes for teachning safe behaviour to school children with the use of social robots (PIAP)

LEMO robot

Crowdsourcing

Crowdsourcing

Crowdsourcing is the process of outsourcing tasks to unidentified, usually very large group of people in the form of „open call", especially an online community.

Crowdsourcing can be translated as a tool to „obtain the information from the crowd".

Source: http://www.crowdsourcing.org.pl/dwa-oblicza-crowdsourcingu.html and https://pl.wikipedia.org/wiki/Crowdsourcing

Variety of issues relating to occupational safety and health risks

- **What is the legal status of online work exchange platforms?**

- **Who is the employer?**

Source: Prof. Huws U., Online labour exchanges, or 'crowdsourcing': implications for occupational safety and health, EU-OSHA, 2016

Variety of issues relating to occupational safety and health risks

- **Ambiguities/gaps relating to:**
  - **insurance coverage**
  - **legal and professional liability**
  - **coverage by European Directives and national regulations**

Source: Prof. Huws U., Online labour exchanges, or 'crowdsourcing': implications for occupational safety and health, EU-OSHA, 2016

Opportunities

- Provides new opportunities for **flexible ways** to combine work and private life
- Enables **low-cost entry into market** for new enterprises or firms trying out new products or services
- **Enables social innovation**

Risks

- **Race to the bottom** (undercutting of good employers)
- Health and safety **risks** to general **public as well as customers and workers**
- **Lack of regulation** may lead to criminal activity (e.g. money laundering)
- **Unravelling of national / EU regulatory** environment

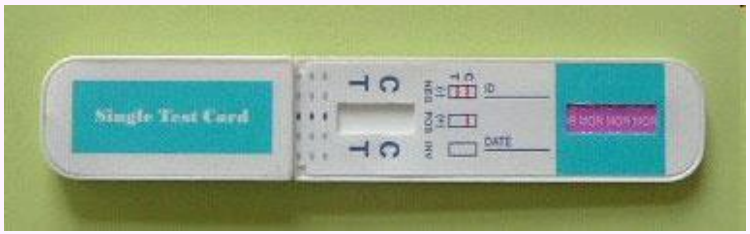
Source: Prof. Huws U., Online labour exchanges, or 'crowdsourcing': implications for occupational safety and health, EU-OSHA, 2016

Enhancing / cognitive drugs

What are performance cognitive enhancers?

Cognitive–enhancing (CE) drugs (also described as 'smart drugs') are pharmaceutical substances which are claimed **to improve mental performance**, such as **attention or focus, concentration, memory or motivation**.

Dr Karen Dale and Professor Brian Bloonfield, Lancaster University, UK; EU-OSHA Seminar



"...modafinil (and chemically related compounds) may **offer the most significant potential as an *efficacious*** and *safe* chemical countermeasure **to fatigue** and could be *of* ***assistance*** **to commercial drivers** (even for chronic use) in the quest for *alertness management* in highway driving"

(Krueger and Leaman, 2011: 30, emphasis added).

Prevalence of Current Use

- Associated with certain groups:
  - **Military:** both authorised use and supervised research
  - **Students:** for **enhanced study** (focus, concentration, memory). Possibility of **continuing into professional life**
  - **Long-distance transport:** aid concentration and wakefulness
  - **Shift workers: including emergency/medical services**, to aid **wakefulness** and coping with work/life balance. *Shift Work Sleep Disorder* is a diagnostic category
  - **City traders and other high pressure occupations**

Dr Karen Dale and Professor Brian Bloonfield,
Lancaster University, UK; EU-OSHA Seminar

''Go pills': A war on drugs?
Air Force use of amphetamines raises questions'
MSNBC, January 2003.

Study: Doctors Taking 'Smart Drugs' Perform Better Surgery

Published October 17, 2011 / NewsCore

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In the City that never sleeps… traders stay up on 'smart' drugs

Article | Culture of the magic roundabout

James Dean
Last updated at 12:01AM, November 22 2013

◀ ▶ 1 of 2

Moritz Erhardt, an investment banker, worked three days without sleep before he died

Ambitious executives in the world of high finance are increasingly turning to a "smart" drug to stop them falling asleep, the founder of a City addiction clinic says.

News & analysis

Emergency!

The pill that could get you a pay rise

Neuro-enhancing drugs could create a breed of super-staff – or an office full of burned-out addicts

Looking for the edge in the workplace? Forget clocking up the hours: a new generation of neuro-enhancing drugs that claim to increase concentration and productivity and reduce fatigue may soon be making their way to an employee near you.

Used extensively by US students and tested by the military, stimulants such as Provigil are sufficiently widespread to be worrying HR departments across the Atlantic, and sparking studies in the UK. And while experts are worried about long-term side effects, and the social and moral implications of a chemically altered workplace, some suggest it could even bring benefits.

Students in the US are increasingly using Ritalin and Adderall to aid their focus during exams and raise grades. Research suggests 16 per cent of college students use the chemical boosters, rising to as many as one in three on certain campuses. It is believed they are accessing these prescription-only pharmaceuticals from fellow students who suffer from attention deficit hyperactivity disorder (ADHD).

"Provigil can be the difference between making it through the day and having the best day of my life"

Doctors and military personnel in the US are also known to be using such chemical uppers to remain alert during night shifts or extended periods of flight. Hank Greely, a professor at Stanford Law School specialising in the implications of new biomedical technologies, suggests more workers in the US might already be users – particularly of Provigil, which increases alertness and may improve cognitive performance.

"We do know that Provigil is sold to a heck of a lot of people who can't have the listed conditions it is designed to treat," he says. "These include narcolepsy, severe sleep apnoea and shift work disorder."

Greely also has anecdotal evidence from his doctor wife. "She knows people who

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INTERNATIONAL BUSINESS TIMES

FRIDAY, AUGUST 21, 2015 AS OF 9:41 AM EDT

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TECHNOLOGY

FDA Approved 'Smart Drug' Modafinil Improves Brain Function With Almost Zero Side Effects

By Guneet Bhatia @Guneet_B on August 21 2015 9:12 AM EDT

Effects on Workers and on Work

- Not only cognitive, but physical and emotional effects:
  - studies show over-confidence with abilities over-estimated

    ⇨ implications for safety critical situations;

  - informal accounts suggest that task focus leads to corresponding dislike of social interaction/interruption

    ⇨ potential impact on team situations.

Dr Karen Dale and Professor Brian Bloonfield,
Lancaster University, UK; EU-OSHA Seminar

Issues

This is an evolving area, which suggests dynamic changes in the future. At present there is not a distinct group of drugs which can be obtained and used for CE. Health and safety, and managerial responses need to take this diversity and lack of medical guidance into account.

Dr Karen Dale and Professor Brian Bloonfield, Lancaster University, UK; EU-OSHA Seminar

Are we ready for new challenges?

Conclusions:

- ➢ **Prevention of traditional risks is still important in the changing world of work but**
  - ✓ **The applicable standards define as a rule the admissible exposure to single harmful chemical or physical factors**
  - ✓ **Comprehensive risk assessment requires however taking into account all harmful factors that the worker is simultaneously exposed to, including psychosociological**
  - ✓ **Interdisciplinary research is indispensable to evaluate the effects of combined exposure to harmful factors in the working environment.**

Conclusions:

- Developing and implementing innovative, effective solutions for technical and organisational prevention remains a challenge.

Conclusions:

- **Dynamic and diversified changes in technology and work processes organization require research on their effects on safety and health of workers and general public as well.**


THANK YOU!
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