



Industrial Safety in FP7 and Horizon 2020

Report from the EC Workshop on Industrial Safety

Brussels, 24 September 2014

EUROPEAN COMMISSION

Directorate-General for Research and Innovation
Directorate D — Key Enabling Technologies
Unit D.2 — Advanced Manufacturing Systems and Biotechnologies

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Industrial Safety and Research

Report from the EC Workshop

Brussels, 24 September 2014

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1. EXECUTIVE SUMMARY

The EC Workshop on Industrial Safety was organized in order for the different stakeholders in Industrial Safety and Research to confront their visions on what the state-of-the-art and the priorities are in this domain across the different sectors of Industry. The unit in charge of the follow-up of the ETP on Industrial Safety has indeed identified safety as a cross-cutting issue with potentially significant societal impact. Many challenges and opportunities have emerged during this workshop. The challenges and opportunities were also often similar throughout various industrial sectors and environments.

First, it is clear that industrial safety is regarded as very important for all participants (industrialists, academia, and policy makers), and in all industrial sectors that participated in the workshop (chemical industry, biotechnology, nanotechnology, construction, manufacturing, ICT), because it has a positive impact on the business performance and sustainability, the acceptance of innovation and of the traditional industry as well. Second, there was consensus that safety is important for the competitiveness of European companies, and that safety in relation to technological innovations, as well as safety innovations themselves, go hand in hand with profitability of technology and of businesses. Safety brings a positive image of the industry and contributes to the industry acceptance by the public.

Different speakers indicated that safety has come a long way already thanks to research, that safety aspects are currently taken into account in many projects, and confirmed that research focused on Safety is also important. Current safety practices which are based on a long history of theoretical modeling, technological advancements, and casuistic, should be kept and further elaborated and improved, and also disseminated across various organizations and different industrial sectors. Learning, cooperation and building up knowledge across experts, domains, sectors and stakeholders, achievable by using state-of-the-art technology, are seen by the participants of the workshop as pivotal for the advancement of safety. In this context, a suggestion to create a "common house of industrial safety" (as a coordination action) has been made by the ETP on Industrial Safety to support the cooperation between thematic research with safety experts and facilitate the transfer of good practices from one sector to the others.

The following paragraphs discuss some challenges and opportunities that were jointly identified by the workshop participants, and for which an agreement was reached on their importance for safe industrial technologies, including working environments, in Europe. Recommendations for further advancing industrial safety are also given in the paragraphs.

Risk perception

Although the objective safety level has increased substantially in the past decades, risk aversion of the public at large has increased as well. This is not a paradox: the safer the society, the more safety is asked for by the public, and the more safety is demanded by the public, the safer the society. In any case, both real and perceived risks are important and should be identified to understand and foster the acceptability and acceptance of risks by the public and all other stakeholders. The involvement of the public in the discussions is very important for industrial operations to be accepted by the local communities, this being true both for individual companies and for industrial sectors.

Directly linked to the safety/risk perception, is safety communication. If safety communication is adequate, pro-active as well as re-active, many problems in case of incidents, calamities, disasters, can be avoided. Therefore, research on adequate safety and risk communication techniques and practices is needed.

Safety as an economic added value

Participants agreed on the fact that safety can be used as a selling point. Both productivity and safety are essential for sustainable industrial activities. The economic aspects of safety and risk, such as cost-benefit analyses and cost-effectiveness analyses should be further explored, investigated, agreed upon, and more rigorously employed in industry. Research is very much needed in this regard.

Integrating safety and security

A further integration between safety and security should be strived for. Safety is concerned with non-intentional losses, while security concerns intentional acts purposefully causing losses. Although different, both concepts deal with uncertainties and management principles, models and theories as well as technological solutions to avoid losses, are in fact related to each other. There are similarities as well as differences in implementing both concepts. For example, inherent safety principles also lead to more security. A more harmonized view and policy to integrate activities and research on both safety and security, for creating a win-win situation and further increasing efficiency, is needed in the European context.

The T-approach of safety research

Safety requires a horizontal as well as a vertical approach within research and research projects. This is called the T-approach of safety research. Safety expertise in projects should be strongly recommended by e.g. requesting safety to be taken into account in any study. Also innovative safety and safety innovations could be stimulated through projects designed for safety. Current safety solutions may be good, such as static risk assessment methods, but they are often far from excellent and can often – through innovation – be largely improved, e.g. developing easy-to-use dynamic risk assessment methods providing a much more accurate and timely risk picture for making decisions.

Safety within CSR

Safety ('People') should be a natural and a mature part of Corporate Social Responsibility, comparable with environment ('Planet') and economics ('Profit'). With respect to this observation, continuously improving safety standards and guidelines within industrial sectors, and developing standards if they do not exist, is paramount for safety advancement within the European industry. In particular, guidelines to report safety performance in a harmonized and positive manner should be developed to support the new directive on the disclosure of non-financial information.

State-of-the-art research and safety research topics

Innovations are necessary for economic and scientific advancement, but they bring along new and emerging risks and require new approaches on top of the successful existing practices. Researchers should take this into account as part of the state-of-the-art technological research. Further state-of-the-art safety topics brought forward by different presenters and deserving attention by researchers and practitioners, include leadership, ageing (of workforce and of infrastructure), automation and robotization, safety nudges (making it inherently more difficult for workers to make mistakes or be distracted), inherent safety or design-based safety, and knowledge industrialization (including knowledge management and company memory management). Furthermore, pro-active performance management as well as (cross-sectorial and cross-company) cooperation are important areas to further explore and invest in.

Cross-cutting research

Cross-cutting research needs continuation to assure safety and security of society, and to guarantee resilience and profitability of sustainable industrial activities at EU level.

2. INTRODUCTION

Industrial safety represents a transversal field of knowledge which is essential for a sustainable and healthy European economy. Various European industrial sectors have particular safety focus and interests, such as manufacturing, chemical industry, biochemical industry, pharmaceutical industry, oil and gas, construction, transport system, ICT, and others.

Occupational health and safety of workers in the industries, as well as environmental safety, and the prevention of major accidents with off-site consequences are all important facets of industrial safety. The approach to deal with industrial safety, is the consideration of technical, human, organizational and cultural aspects. However, in general to further advance safety, and also in case of certain risks such as for example emerging risks, supplemental or additional state-of-the-art models and methods are required. Improvement of industrial safety is important not only in human terms, to reduce workers' pain and suffering, death toll and environmental and societal impact in case of major accidents, but it is also a way of ensuring that enterprises are successful and sustainable in economic terms.

However, industrial safety research and policies are currently fragmented not only over the EU member states, but also within some of the states on the regional level, as well as across the industry branches. At the same time, the adding up of single safety solutions cannot guarantee to be a successful global safety solution. In the first phase of the Horizon 2020 programme the safety related issues have been linked to single topics and areas such as nano-safety, infrastructures, new energy systems or food. The area of industrial safety as unique project topic is not considered at the moment.

In parallel, new technologies and innovations are raising questions of possible real or perceived new risks. Therefore, a dynamic structure, following industrial safety research and innovation across the European Union, is called for.

This workshop was organized to show the interest of the EC in considering industrial safety as a cross-cutting issue in a number of industrial technology research projects. The workshop should be considered as a forum to debate developments and needs, identify gaps and opportunities, establish priorities in order to create a sound, authoritative, consensual, science-based, economy pushed, society-driven Europe-wide knowledge base of industrial safety science and engineering.

3. WORKSHOP APPROACH

The agenda of the workshop is included in Appendix 1, while the attendees of the workshop are listed in Appendix 2. The workshop was organized on one day in 5 sessions.

The first session treats regulatory and policy affairs on industrial safety. Session two discusses state-of-the-art and future research and innovation issues regarding industrial safety on a European level, while in session three safety within different industrial sectors of the contractual PPPs (that is, manufacturing, process industry and construction industry) is dealt with. Session four presents strategic priorities and industrial safety in biotech and nanotech industries. The final session concludes with organizational aspects of industrial safety in large enterprises and SMEs.

A total of 23 presentations are included, and the workshop ends with a public debate and capturing attendees' concerns, comments and suggestions. The rapporteur provides a final wrap-up of the workshop.

4. PRESENTATIONS AND DISCUSSIONS

8:30 – 9:00 Registration and welcome coffee

9:00 – 9:45 **Opening session**

Chairman of the workshop:

Jose-Lorenzo Valles, Head of Unit Advanced Manufacturing Systems and Biotechnologies, DG RTD

1. *Welcome address*

Clara de la Torre, Director Key Enabling Technologies – DG RTD

Mrs de la Torre expressed the importance that industrial safety be taken into account when addressing Key Enabling Technologies: safety should be emphasized in project proposals. She sees a more and more risk averse EU society, wherein safety considerations are necessary for all product developments, competitiveness and sustainability. One of the most important topics in this regard is design-based safety or safety at the earliest stage. Ideally, all sectors have to learn successful practices and models of safety from each other, and industries should understand that the competitiveness of companies can partly be achieved by putting more focus on safety. Furthermore, ETPIS is an important partner for the EU to obtain feedback and advice from different stakeholders and different layers of society. An interesting fact is that FP7 has 18 projects addressing safety, with in total 68 M€.

2. **Ortwin Renn**, President of EU-VRi & member of the STAC committee

Title: Industrial Safety and the question of Risk

An excellent record can be shown of industrial safety in Europe over the last decades. For example, in Germany there were in 2008 a total of 4800 fatal accidents, in 2013 a total of 2805 accidents with 80% in transport due to successful approaches. We are ever more successful in reducing the number of accidents. This is partly due to very effective regulations. Nonetheless there are still challenges to be tackled due to the new working environments we are experiencing.

He proposed to consider the following 5 main challenges:

1. New materials - for example nanoparticles, certain chemicals and structures, etc. - have an impact on health and safety, that is not known at present => elementary for the competitiveness of organisations, being part of the new materials challenge

2. New emerging technologies: new areas of application (e.g. nano-technology, IT technology, etc.) need new application styles (new production ways for example); different types of technology can interact in a way that is currently not known; from "traditional safety" towards "innovation safety"

3. Different types of illnesses as related to workplace exposure, thus resulting from employment issues: psychosocial factors, social mobbing, stress, hierarchical levelling increases unclarity in responsibility. Digitalization of production leads to MSD.

4. Safety & security division. Policies distinguish both concepts, however there is a strong connection between safety and security and the distinction between both concepts decreases ever more. The division therefore is obsolete, safety issues are linked to security and vice versa: smart grids, smart cities... We should not strengthen one and diminish the other. Integration of safety and security is recommended.

5. People become ever more risk averse. We are very good at lowering the risk of illnesses, so accident prevention becomes more the focus of public perception and concern. People become for example more aware of accidents in transport. Therefore, the perception of risks should be addressed, as well as public support of innovations and new solutions. Public support is crucial to be part of politician's agenda.

Some recommendations and ideas on how to address the 5 challenges are also formulated. First, we need to keep the traditional safety work and ongoing safety research integrated in product development. Then, common issues of new innovations need to be addressed under the ceiling of the precautionary approach, which is typical for the EU. A third point is that anticipative research on innovations needs to be carried out, using simulation and pre-testing before products entering the market. The question is to know whether we can provide new methodologies to do ex-ante assessments and evaluation. Fourth, there should be a network approach: what are the common grounds, safety issues, - challenges in different areas and how to adequately address them? Horizontal themes are very important in this regard. Fifth, the ultimate objectives should be to protect civilians and be strong in innovation.

3. **Olivier Salvi**, EU-VRi General Manager & Secretary General of ETPIS
Title: ETPIS Platform: Strategic Research Agenda 2013-2020

<http://www.industrialsafety-tp.org/>

In 2007, 5580 industry-related accidents resulted in deaths and 2,9% had accidents resulting in more than 3 days absence from work. The costs of accidents amount to 2,9 - 4,8% of the GDP (ILO) and are getting larger over time. In total, some 30 major accidents happen per year in the EU according to e-MARS. Such accidents have an important impact on public perception. The vulnerability increases as well.

ETPIS with 12 flagship projects has become a cross-ETP together with Nanofuture and Prosumer:

http://cordis.europa.eu/technology-platforms/individual_en.html

The community was built by ETPIS with industry, policy makers, and academics. Safety needs to be applied to all industrial sectors, and the rules with respect to safety have to be made equal for everyone.

There are three lines of research in Horizon 2020:

- (i) Conventional risks (e.g. safety culture)
- (ii) Innovative industry (e.g. emerging risks related to innovative technologies)
- (iii) Safety technologies, products and services (e.g. inspection, new equipment, etc.)

For Horizon 2020 there are the following grand challenges: (i) safe energy; (ii) safe infrastructures; (iii) safe production & products; and (iv) cross-cutting issues. The ERANET SAFERA is composed by 22 members, mainly ministries, funding organizations, research institutes and agencies. It has worked on the identification of a strategic research and innovation agenda on industrial safety.

In terms of new challenges, there is a need to improve practices and performance on safety culture, the acceptance (or not) of certain risks by the public, including residual risks, and also the minimisation of the impact of new approaches on the industry, cfr. a 'reasonable' precautionary principle in a way that it can be used by industry.

Mr. Salvi explains that there are 3 types of priorities for research for the next period:

- Integration:
 - common house of Industrial Safety
 - coordination action integration safety and security
- Understanding of the influencing factors for better safety performance and perception:
 - Value of safety (different types of value: point of view of psychologists, sociologists, philosophers (ethical issues) and viewpoint of engineers and economists)
 - Guidelines for disclosure of non-financial information: http://ec.europa.eu/internal_market/accounting/non-financial_reporting/index_en.htm
 - Use of cognitive sciences
- Implementation of the emerging risk management knowledge on practical situations (e.g. nano)

Societal challenges where safety is important or part of the solution has been presented:

- For manufacturing industry:
 - performance of personal protective equipment
 - safety solutions for new products and processes
 - Factory of the Future

- For energy and climate change:
 - new energy (cfr. biogas industry and farmers: waste (such as manure) as new energy poses a safety challenge, not in the least due to farmers having not much knowledge of safety culture, such as in traditional industries)
 - share best practices (cfr. also biogas by farmers who become industrial process producers)
 - learning mechanisms by new sectors
- For construction and infrastructures:
 - Life extension management for plants and infrastructures
 - Adaptation of the design of infrastructures with regard the intensification of Natural Catastrophes (NaTech)
 - Adaptation of infrastructures to new energy systems, e.g.:Tunnels, check the compatibility of the existing underground infrastructures with the mix of new energy carriers

The T-approach promoted by ETPIS consists in having safety embedded in new projects, and at the same time there should be in-depth research in the field of safety. Moreover, standardization and Education are essential in the field of industrial safety, as well as to disseminate results and have them implemented and to transfer knowledge and good practices.

09:45 – 10:30 *Session 1: Regulatory and Policy Aspects of Industrial Safety*

4. **Dionysios Tsiagkris**, Policy Officer(DG ENTR) – Unit D1:
 Entrepreneurship & Social Economy
 Title: European Commission policy on CSR

Corporate Social Responsibility is important in the European Union, as also in the international landscape (ILO, ISO, OECD, the global compact...). In the light of this, companies in the EU are ever more asked to work for society as well, not only for themselves. The modern understanding of CSR is: 'the responsibility of enterprises for their impacts on society'

Two points of departure for a 'responsible company' have been identified : (i) companies should always comply, and (ii) integration of certain values into the business strategy should be strived for.

The perception of people on companies' impact on society is positive in the north of Europe, less so in the south. People and companies should be more concerned with CSR than is currently the case. CSR is very important for the competitiveness and sustainability of the EU. Therefore, it is important to put CSR on the agenda of companies.

The future actions that have been decided for CSR in the EU are: (i) sector-specific multi-stakeholder platforms (plenary meeting on 3-4 Feb 2015); (ii) consulting the citizens; (iii) writing guiding materials, SMEs, case studies CSR-

related activities; (iv) new disclosure rules for companies of more than 500 employees (it amounts to around 6000 companies in EU); and (v) writing of guidelines for disclosure of non-financial information: [http://europa.eu/rapid/press-release MEMO-14-301_en.htm](http://europa.eu/rapid/press-release_MEMO-14-301_en.htm)

5. **Alexandros Kiriazis**, Policy Officer - DG ENV (Unit C3: Air & Industrial Emissions)
Title: EU legislation on the control of major-accident hazards involving dangerous substances

Well-known Seveso Directives are very important for practitioners and regulatory offices in the pro-active as well as in the re-active phase. In Europe, there are already good safety figures and standards. However, major accidents, if they happen, are not only disastrous for the country in which they occur, but also for (European) society as a whole.

The Seveso III Directive provides a framework and minimum requirements for companies for the prevention of major accidents, and enters into force from the first of June 2015.

The legislation includes rules for:

- safety management (operator)
- inspections (authorities)
- Limitation of consequences:
 - emergency planning (before)
 - disaster management (after)

The content of SEVESO III is 3-fold:

1. Safe technology & safe management : Safety report
2. Emergency planning & land-use planning: potential effects
3. Reporting and lessons learnt

Some changes have been made compared to Seveso II:

- technical updates
- alignment with EU chemicals classification

- access to information by public:
 - * risks resulting from activities,
 - * how to behave in case of an accident
- access to justice for citizens
- stricter standards for inspections.

Hence, only few adjustments for better 'alignment' have been done in Seveso III, no radical changes were introduced. The aim is to have companies think and handle in a pro-active way.

Furthermore, Mr. Kiriazis indicates that safety communication and safety reporting are essential. Feedback from the industry about industrial practices and concerns is key for determining what actions are necessary from the regulatory side. At the same time, there is a lot of communication within the EC/EU. Similar thinking with respect to other directives, e.g. in the public health sector, may use the success of Seveso regulation and export it to other industrial sectors.

6. Fabio Taucer, Ispra (Ipsc-ELsa unit), JRC
Title: JRC activity on managing process safety risks

Chemical accidents are responsible for 5% of injuries. The e-MARS database registers all major accidents and is essential to plan new policies. The future focus of process safety research in the JRC is threefold. Firstly, research on market trends and their effects on quantity and type of substances used and developed is of interest. Secondly, management and ownership trends such as new sites and production transfer to other countries deserve focus. Thirdly, external influences, such as certain political choices (eg. Sanctions to Russia), should be investigated.

The STREST project has been presented: it addresses the question of a harmonized approach to test vulnerability and resilience of critical infrastructures (non-nuclear) by natural hazards (earthquakes, tsunami, floods, geotechnical effects, cascading effects). Now case studies are done for chemical industry, dams, and electric power plants¹.

10:30 – 11:00 Coffee Break

11:00 – 12:00 *Session 2: Research and Innovation on Industrial Safety at European Level*

11:00-11:15 *Areas of interest for Horizon 2020 and support provided by the EC in FP7*

7. Sébastien Mortier, DG RTD / D2

¹ Cfr. www.strest-eu.org

The speaker reminds first the past records for safety research in FP7 in Industrial Technologies.

A total number of 18 safety projects have been funded, for a total amount of 68 M€ (hence, on average funding of 3,8 M€ per project). The repartition of sectors is as follows: 40% in Manufacturing related projects, the others equally shared among Nano, Construction and Organizational issues. Process Industry projects have tackled safety as side aspects of their research/world, and are not taken into account in these statistics.

The plan of the day's discussions is then presented.

Industrial safety as is considered in this workshop is the safety of production processes towards workers, the public, the equipment and the environment (and reliability aspects for civil and industrial infrastructures). Industrial Safety is obviously an issue cutting across all sectors of interest for the KET directorate.

The subject of safety has good potential for social sciences and humanities - safety can even be seen as a "societal challenge" in itself:

- safety is generic
- safety is transversal to technology topics
- Safety is also a management practice.

At the end of the presentation, a distinction is made between risk and safety.

A risk is an uncertain event or condition that if it occurs, has a positive or negative effect on project objectives. (PMBok 4th Ed). This definition is broader than safety and includes for example financial risks as well. It is then explained to the audience that the discussion of the day shall not extend to the broader notion of general risk management.

From this point of the Report on the 'Workshop Industrial Safety', FP7 projects were presented. The websites where all information about the projects is available, are indicated.

11:15-12:00 *Presentation of FP7 Industrial Safety Projects*

- 8. Piotr Pietrowski** (I-Protect): <http://www.i-protect.pl/>
Title: Intelligent PPE system for personnel in high-risk and complex environments

This project concerns professional rescuers (fire fighters) and aims at modeling and developing materials for the benefit of innovative personal protective equipment. Sixteen partners from seven EU countries participated in the project, which provided a number of results: a physiological sensor module equipped with wireless communication, integrated with the necessary underware to carry the module and ergonomically designed, an environmental sensor module, a gas sensor based on nano-engineering, a communication unit, a PPE system, and an RCC interface. A number of validation tests have been performed to verify the exploitability of the developments.

9. **Helmut Wenzel** (IRIS): <http://www.vce.at/iris/> -
Title: Industrial Safety and Life Cycle Engineering

IRIS is a project where sensor techniques are used to measure on-line and monitor the impact of earthquakes, use or other events on infrastructures like bridges. The project starts from the new paradigm that risk assessments should be dynamic (taking time into consideration, e.g. aging of materials has an important impact on safety). It has been adopted as a DIN standard (DIN 91298); USA and UK adopted it as well. It is now transferred to USA, South-America, China and other Asian countries (standardization adopted in 17 countries worldwide). Further development has been made to become a full standard for Building Information Management (cf. Eurocode 2015). The project concerns cross-cutting research, with most focus on the civil sector, with applications on bridges, in offshore and in the chemical industry (e.g. interesting for the extension of the lifetime of industrial plants). Innovative aspects: simulation tool for crisis support, research on resilience and sustainability, integration of security aspects.

The objective is the prioritisation of decisions for ageing infrastructures.

10. **Aleksandar Jovanovic**, Integ-Risk - <http://www.integrisk.eu-vri.eu/>
Title: An important step towards (successful) "Early recognition, monitoring and integrated management of emerging, new technology related risks"

Integ-Risk is a project where an emerging risk radar has been developed with partners like Swiss Re, Allianz and AXA as well as EDF and GdF Suez, is now promoted and transferred to South-Africa and China.

It also includes the development of an 'emerging risk catalogue/library' containing more than 1000 emerging risks and 17 priority risks, a tool that predicts the change of public perception if any new info concerning emerging risks gets public knowledge, it gives an answer to the need for more quality of risk communication, for increasing trust.

Innovations should not only be safe in themselves, but they should also be perceived by the public as safe.

11. **Carita Aschan**, SAF€RA - <http://safera.industrialsafety-tp.org/>
Title: Coordination of European research on industrial safety towards smart and sustainable growth

The ERA-Net SAF€RA is a coordination mechanism for national funding schemes for research on industrial safety. It was initiated by ETPIS, and currently encompasses 22 partners from 11 EU countries.

Saf€ra aims at coordinating research investments on industrial safety, to enhance the coherence of the current research. Its main goals are: (i)

cooperation improvement between researchers; (ii) creation of new perspectives and opportunities for industrial safety research; (iii) sharing societal concerns and research results within EU; and (iv) promote research on industrial safety as a competitive advantage for companies and Europe.

The current priority themes of Saf€ra are:

- Value of industrial safety
- Good practices in managing new and emerging risks
- Safe transport system for dangerous goods
- New technologies in improving safety
- Human and organizational factors

The future of such actions could be their extension to Occupational Health and Safety and to transportation safety.

12:00 – 13:00 Lunch Break

13:00 – 14:30 *Session 3: Industrial Safety within the sectors of the contractual PPPs*

12. *Safety in Manufacturing (FoF/Manufuture)*

Chris Decubber, EFFRA – European Factory of the Future (FoF) Association - <http://www.effra.eu/> Title: *Strategic priorities in Industrial Safety for FoF in H2020*

Mr. Decubber explains that safety is a social & health issue as stated in paragraph 5.3.2. of the EFFRA Roadmap for Horizon 2020 and in the FoF call. Social sustainability of manufacturing includes the increase of human achievements in future European manufacturing systems, the creation of sustainable, safe and attractive workplaces for Europe 2020, and the creation of sustainable care and responsibility for employees and citizens in global supply chains. Safety is therefore very important in the manufacturing of the future products, economically, socially, and environmentally. Technologies and enablers to achieve these challenges, are: advanced manufacturing processes, mechatronics for advanced manufacturing systems, information and communication technologies, manufacturing strategies, knowledge workers, and modelling, simulation & forecasting.

In summary:

- The new people-centered production site, where safety is pivotal, is to be modeled
- Safety is a selling point in manufacturing
- Safety should be inherent as much as possible

13. **Michiel de Looze, Johan van der Vorm**, TNO - <http://www.robo-mate.eu/>

Title: *Industrial Safety in Robo-Mate*

The RoboMate project concerns the development of an intelligent exoskeleton based on human robot interaction for the manipulation of heavy goods in Europe. The objective is to build an exoskeleton to help with certain manual work tasks which are difficult to automate. The project is also aimed at improving safety for the worker (wrt ergonomics, heavy weight hazards, etc.). Some important aspects of the different phases of the project, are the safe design of the exoskeleton technology and the development of safety guidelines/standards for using the robo-mate concept. The three phases are: Design, Test and Use. Hazard identification

was thus fully integrated into the project and scenario-development thinking was used to assess H&S hazards.

14. *Safety in Process Industries (SPIRE/SUSCHEM)*

Roeland Adriaansens, DOW Chemicals - <http://www.spire2030.eu/>

Title: Safety in Process Industry

Mr. Adriaansens explains that the process industry has known a fair share of disasters since its origin, but that health and safety within the chemical and process companies are continuously improving. Since the 1960s where mainly reactive chemicals management was the norm, the progress has been substantial and since 2010 we entered a period of focus on EH&S culture and leadership. The CEFIC viewpoint on the improvements in safety and the current priorities are further explained. Focus lays on process safety (risk assessment and management, process control, inherent safe design, mechanical integrity and inspection), workplace safety (industrial hygiene and equipment/tool safety, behavior-based safety), legislative compliance, environment, product safety and community outreach. Mr. Adriaansens explains that there is still room for safety improvement within the industry, and the industry is motivated to "approach zero".

Furthermore, safety cross-fertilization innovations examples are given:

- automatic cleaner in process plants
- inspection of jetty piling
- communication between shifts
- optimal shift systems to support HSE alertness
- ergonomics and aging work force
- EH&S culture assessments
- leading HSE indicators
- Leadership in HSE
- HSE Health check
- Compliance management
- peer-to-peer (cross-company) HSE assessments.

The focus areas are: (i) new techniques and tools, (ii) safety through improving EH&S culture and safety management systems, and (iii) behavior-based safety.

15. **Patrick Loebb, Fraunhofer ICT-IMM -**

http://www.imm.fraunhofer.de/en/product_areas/m4chemistry/project_copiride.html

Title: Safety Aspects in Chemical Industry in View of Modular, Mobile and Small-Scale Plants – Perspectives from the EU FP7 Project CoPIRIDE

The CoPIRIDE project concerns the combination of process intensification-driven manufacture of microstructured reactors and process design with respect to industrial dimensions and environment. The objectives of this project is the development of new modular production and factory concepts for the chemical industry using adaptable plants with flexible output for intensified processes under consideration of ecological sustainability and economic viability. Novel reactor equipment, microstructured reactors, use process intensification which is advantageous for safety in some ways (safe operation in explosive regimes, smaller inventories of hazardous materials), but may also be disadvantageous for safety in other ways (due to the need for higher pressures, higher probability of runaway reactions, etc.). Hence, novel process windows are

searched for, both entailing advantages and challenges, since more dynamic process control is required in case of process intensification. New safety issues arise due to the modular approach, requiring pilot plants. A container was employed to serve to house multi-functional elements (control room, gate section, labo, and logistics section). The safety features are particularly interesting and include constructive fire protection, ATEX conformity, integrated disaster plans, pre-wiring of cables, and a process control system. Albeit case by case considerations have to be made, and novel concepts such as these need to follow existing safety regulations.

16. *Safety in the Construction Industry (EeB/ECTP)*

Miguel Segarra, Dragados - <http://www.ectp.org/TFI.asp>

Title: Strategic priorities in Industrial Safety for ECTP/EeB/reFINE in H2020

The question how to deal with and improve safety and security in construction and infrastructure, is discussed in this presentation. One particular difficult matter in this regard, is how to respond to public concern. The construction industry is regarded by society as '3D': dirty, difficult, and dangerous. To tackle this perception stemming from poor ergonomics and a high level of hazards from accidents at work and occupational diseases, safety strategic priorities were identified: (i) development of tools enabling the creation of a vigilant organization, based on collaborative work on construction sites, (ii) development of innovative systems for preventing workplace hazards (independently of workers' will), (iii) new concepts of inherently safe and ergonomic temporary equipment, (iv) new technologies to improve ergonomics and to reduce the impact of construction sites to workers and surrounding communities/people, (v) new construction technologies, (vi) new tools for the assessment of intermediate construction stages and for automatic evaluation of hazards, and (vii) service-oriented business and systems

17. **Bastien Caillard**, EU-VRi / **Christos Christoglou**, Bayer - <http://www.safelife-X.eu-vri.eu/>

Title: Industrial Safety in a FP7 construction project (SafeLife-X)

The objective of SafeLife X is to build cost-effective solutions to handle the problem of infrastructure ageing in 2015-2025, by providing specifications for new RDI projects. The operational goals include synergy enhancement between industrial sectors, identifying successful practices, defining a strategic research agenda and a roadmap, and initiating and developing pre-standards and standards. In summary, the project is concerned with cost-effective solutions for ageing infrastructure and ageing plants, finding a new approach for ageing management, and developing a risk-based inspection framework via a European standard (standards are available in the US (API), China, and other countries, but not in Europe).

14:30 – 15:00 Coffee Break

15:00 – 16:00 *Session 4: Safety in Biotech and Nanotech Industries*

18. *Safety in Biotech Industries*

Patrick Rüdelsheim, PERSEUS - <http://www.efb-central.org/index.php/Members/profiles/31037>

Title: Strategic priorities in Industrial Safety for Biotech

Mr. Rüdelsheim explains that the difference between 'prevention' (known hazards) and 'precaution' (uncertainties) is often misunderstood. Precaution is very vague and sometimes seems to be overrated. Goals should be able to be measured, e.g. how can it be demonstrated that a project is safe or unsafe? Safety has evolved from intuitive towards evidence-based, and then towards performance-based; and in this way biosafety and biosecurity improved over time from a prescriptive towards a management system approach. In any case, the focus should be on real risks, and not on perceived risks.

19. **Guy Marlair**, INERIS - <http://www.biocore-europe.org/>

Title: Safety-related research needs as perceived from biorefinery focused FP7 projects (BIOCORE, EUROBIOREF, SUPRABIO)

Mr. Marlair indicates and proves with funding figures that the importance of biorefining research in Europe increases significantly. Hence, the step from apparent simplicity (small-scale) towards major involved processes (large-scale) is in full progress, biological as well as chemical and thermal. In this regard, safety becomes a major issue as well. Actually, safety was not always a keyword in the goals of past projects – now it is. Some focus areas for safety are to assess how far micro-organisms can affect the environment and to look at corrosion potential (e.g. in ionic liquids). Some take-away messages on safety in biorefining are:

- There is still limited achievement in research devoted to safety management in advanced biorefining
- Safety is an often underscored aspect of sustainable development
- Inherently safer design goals should be established and strived for
- Proactive safety is always preferable over remediation

In any case, an important advice – and challenge – is to scale-up the safety and risk knowledge and know-how of farmers and biologists to that of chemical engineers and chemists! Mr. Marlair further suggests to establish a WG in ETPIS to make progress on this issue.

20. *Safety in Nanotech Industries*

Daniel Bernard, TTL -

http://www.ttl.fi/en/publications/Electronic_publications/Nanosafety_in_europe_2015-2025/Documents/nanosafety_2015-2025.pdf

Title: Strategic priorities in Industrial Safety for nanotech in H2020

The potential risks of Engineered NanoMaterials (ENMs) have a negative impact on their development, and are a barrier to innovation. Therefore, nanosafety research is a global issue. Nanomaterials are characterised with uncertainties, and constitute a complex risk. For example, the classification of nanomaterials is a difficult question in itself, holding several possible classification dimensions. A question of concern is also to know whether the current regulation is enough. The societal acceptance of ENMs is very important, since the 'license to do research about and produce ENMs' depends on this acceptance. Current research priorities on hazards assessment include hazard assessment enabling grouping of ENMs, bio-kinetics and bio-accumulative properties of ENMs, research for effects on sensitive populations and individuals in vulnerable conditions, and research on environmental issues.

21. **Marco Pontiggia**, d'Appollonia -
<http://www.toscaproject.eu/home;jsessionid=0de0d8549274c9742ade97e4ab0a>
And: <https://www.promis.eu/eu/the-service/>
Title: An illustration of safety in Total Quality Management: TOSCA project

TOSCA stands for 'Total Operation Management for Safety Critical Activities', and is a project related to process safety in the process industries and others. TOSCA is aimed at improving technical, human factor and organizational aspects. A premise is that risk is related to safety, but also to quality and productivity. TOSCA is also much concerned with the importance of Human Factors, and their analysis in risk assessments. Mr. Pontiggia further explains that more sophisticated tools for consequence assessment are needed. Currently, in SMEs, safety management is often struggling with static and scattered paper-based information. Therefore, a new management paradigm is needed, and the solution is integrated data management, the integration of ISO31000 into existing safety management systems, the creation of knowledge communities and of practical tools and an online platform for SMEs to ensure adequate communication.

22. **David Tjong**, Global Director HS&E, Ideal Standard International
Title: Integrated Management of Health, Safety & Environment

Mr. Tjong argues that management of HSE needs to be looked at from three dimensions: (i) the moral/ethical dimension, (ii) the demand by society/legislation dimension, and (iii) the business case. The HSE strategy pillars are coined by Mr. Tjong as Talent, Culture and Process. Talent involves the right people, skills, role and structure. Culture encompasses safety being regarded as a value, environmental protection being a responsibility, that there is a visible leadership drive, as well as employee involvement and ownership, and a systemic integration of HSE. The pillar 'Process' is composed of the basic foundation, compliance and prevention, and that HSE is systematic and integrated.

Safety culture is considered an extremely important pillar to further advance safety within the organisation, and it culminates in employees' engagement. Although at a certain point in time when organisational accident figures are very low it is very hard to get them even lower, focus is always, and ever more, needed on the human factors (human behavior, the job, etc.) of safety.

23. **Johan Gort**, TNO
Title: Resilience for adaptive safe performance

Mr. Gort explains that TNO is involved in several safety-related projects for a total funding of about 4 M€. He further argues that resilience will lead to a paradigm shift, and that it is the next important step forward in safety, after safety culture (the current focus of organisations). Next to 'traditional safety thinking' organisations need to learn 'new resilience thinking'. Resilience thinking brings forward the ability to tackle complexity, which is very important in an ever more complex world/environment.

17:00 – 17:30 *Final discussion*

Comments by the public/participants:

Several comments and suggestions were raised by the public present. One comment was that the public as an important stakeholder should be more involved in the general process of risk assessment/management, and that some risks need to be assessed by the public as well as by experts. This could have been more explicitly mentioned. A suggestion made by the participants was that experts for a given field, e.g. within biology and experts of industrial risks, need to communicate and cooperate more. Such communication and cooperation would be largely beneficial for both parties. Furthermore, ICT should be seen as, and strived for to be, a driving force for human factors and industrial processes. In this way, decisions can be better guided with real-time and complex information. As a last important point, it was remarked that both the prescriptive approach and the performance-based approach are needed to further enhancing safety.

17:30 – 17:45 *Rapporteur Summary*

Genserik Reniers ends the conference with a short summary of the day's talks. He sees a number of challenges for safety research and progress. The most important aspect to be able to improve safety within an organisation, is leadership. Furthermore, there are a number of very promising fields that need to be explored further to truly understand, conceptualise, and advance industrial safety. The next overview provides first the industrial safety research topic, and next to it the problem that it may provide an answer to:

- Ageing of people – problem of company memory
- Ageing of infrastructure – problem of maintenance
- ICT influences – problem of human factors and complexity
- Growth of risk aversion in population – problem of risk acceptance and license to operate
- Design based safety – problem of integrating safety in product and technology
- Safety nudges – problem of people making mistakes due to psychology and ergonomics
- Getting a better grip on the financial side of safety and the effects on productivity – problem of wrong perception of safety cost by managers
- Integration of safety and security for practical implementation in particular in SMEs – problem of safety within SMEs
- Developing guidelines and standards – problem of cooperation, harmonisation and standardisation of safety
- Safety being a part of CSR – problem of safety not always seen as the very important 'social' or 'People' pillar of CSR
- Resilience as a way forward – problem of systemic and complex risks
- Cross sectoral & company fertilisation – problem of cooperation, information-exchange, optimisation

He uses the saying 'the value is in the tail'. But safety has no tail, because it is a never ending story. In the end, safety is a matter of respect for all parties.

17:45 – 18:00 *Closure of the meeting*

5. APPENDIX 1. WORKSHOP AGENDA

24 September, 2014
Auditorium at MADOU EC building, Place Madou, Brussels
Chairperson: José-Lorenzo Vallés, Head of Unit, DG RTD / D2
Rapporteur: Genserik Reniers

Organizer:

Sébastien MORTIER

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Agenda of the day

8:30 – 9:00 Registration and welcome coffee

9:00 – 9:45 **Opening session**

Chairman of the day:

Jose-Lorenzo Valles, Advanced manufacturing DG RTD / D2

Welcome address

Clara de la Torre, Director – director Key Enabling Technologies
(DG RTD - D) – DG Research

Industrial Safety and the question of Risk

Ortwin Renn, President of EU-VRi & member of the STAC
committee

ETPIS Platform: Strategic Research Agenda 2013-2020

Olivier Salvi, EU-VRi General Manager & Secretary General of
ETPIS

09:45 – 10:30 *Session 1: Regulatory and Policy Aspects of Industrial
Safety*

Dionysios Tsiagkris, DG ENTR

Alexandros Kiriazis, Policy Officer DG ENV

Fabio Taucer, Ispra (Ipsc-ELsa unit), JRC

10:30 – 11:00 Coffee Break

11:00 – 12:00 *Session 2: Research and Innovation on Industrial Safety at
European Level*

11:00-11:15 *Areas of interest for Horizon 2020 and support provided by the EC in FP7*

Sébastien Mortier, DG RTD / D2

11:15-12:00 **Presentation of FP7 Industrial Safety Projects**

- *I-Protect*, **Piotr Pietrowski**
- *IRIS*, **Helmut Wenzel**
- *Integ-Risk*, **Aleksandar Jovanovic**
- *SAFERA*, **Carita Aschan**

12:00 – 13:00 Lunch Break

13:00 – 14:30 *Session 3: Industrial Safety within the sectors of the contractual PPPs*

Safety in Manufacturing (FoF/Manufuture)

- *Strategic priorities in Industrial Safety for FoF in H2020* (**Chris Decubber** - EFFRA)
- *Industrial Safety in anFP7 FoF project (ROBOMATE)* (**Michiel de Looze** – TNO)

Safety in Process Industries (SPIRE/SUSCHEM)

- *Strategic priorities in Industrial Safety for SPIRE in H2020* (**Roeland Adriaansens** – DOW Chemicals)
- *Safety Aspects in Chemical Industry in View of Modular, Mobile and Small-Scale Plants – Perspectives from the EU FP7 Project CoPIRIDE* (**Patrick Loebb** - IMM) -

Safety in the Construction Industry (EeB/ECTP)

- *Strategic priorities in Industrial Safety for ECTP/EeB in H2020* (**Miguel Segarra**– Dragados)
- *Industrial Safety in anFP7 construction project (SafeLife-X)* (**Bastien Caillard** – EU-VRi / **Christos Christoglou** - Bayer)

14:30 – 15:00 Coffee Break

15:00 – 16:00 *Session 4: Safety in Biotech and Nanotech Industries*

Safety in Biotech Industries

- *Strategic priorities in Industrial Safety for Biotech* (**Patrick Rüdelsheim** – PERSEUS)
- *Industrial Safety in FP7 biotech projects (BIOCORE, EUROBIORAF, SUPRABIO)* (**Guy Marlair** – INERIS)

Safety in Nanotech Industries

- *Strategic priorities in Industrial Safety for nanotech in H2020* (**Kai Savolainen** - TTL)

16:00 – 17:00 *Session 5: Organisational Aspects of Industrial Safety in Large Enterprises and SMEs*

- *An illustration of safety in Total Quality Management: TOSCA project* (**Marco Pontiggia** – d’Appollonia)
- *Integrated Management of Health, Safety & Environment* (**David Tjong** – Global Director HS&E, Ideal Standard International)
- *Resilience for adaptive safe performance* (**Johan Gort** – TNO)

17:00 – 17:30 *Final discussion*

17:30 – 17:45 *Rapporteur Summary*

17:45 – 18:00 *Closure of the meeting*

6. APPENDIX 2. OVERVIEW OF PARTICIPANTS

Name	First name	Organisation
Adriaansens	Roeland	DOW
Aschan	Carita	TTI
Bernard	Daniel	CEA
Caillard	Bastien	EU-Vri
Christoglou	Christos	Bayer
de la Torre	Clara	EC
de Looze	Michiel	TNO
Decubber	Chris	TECNALIA / FoF
Gort	Johan	TNO
Jovanovic	Aleksandar	EU-Vri
Kiriazis	Alexandros	EC
Loeb	Patrick	Fraunhofer
Marlair	Guy	INERIS
Taucer	Fabio	JRC-Ispra
Mortier	Sébastien	EC
Pietrowski	Piotr	CIOP
Pontiggia	Marco	d'Appollonia
Renn	Ortwinn	Stuttgart University
Rüdelsheim	Patrick	PERSEUS
Salvi	Olivier	EU-VRI / ETPIS
Savolainen	Kai	VTT
Segarra Martínez	Miguel José	Dragados
Tjong	David	Ideal Standard

Tsiagkris	Dionysios	EC
Vallés	José-Lorenzo	EC
Van Teunenbroek	Tom	TNO
Wenzel	Helmut	VCE
Beaudoint	Damien	UMONS
Bellamy	Linda	White Queen BV
Berbenni-Rehm	Caterina	Promis@service
Bodsberg	Lars	SINTEF
Bourdeau	Luc	CSTB/ECTP
Buskiewicz-Seferynska	Katarzyna	CIOP
Carbonell	Miquel	Fundiciones de Roda
Cipollaro	Antonio	EC
Cozzani	Valerio	Università di Bologna
de Hoogh	Maarten	TNO
Eriksson	Kerstin	SP
Fern	Antonio	BaseProtection srl
Fern	Gordon	IOM
Gentili	Andrea	EC
Gerbec	Marko	Jozef Stefan Institut
Gonzalez	Sara	CTMetal
Gonzalez Fernandez	David	Prodintec
Gulacsi	Andreea	CEN-CENELEC
Irazustabarrena	Ane	Tecnalia
Khodabandeloo	Koorosh	
Koivisto	Raija	VTT
Kudsk	Claus Erichsen	Teknologisk DK
Kylefors	Martin	SP

Lang	Jorgen	EVONIK Industries
Lexow	Juergen	BAM
Lopez de Ipina	Jesus	Tecnalia
Nieuwenhuis	Drewin	CEOC
Perlant	Frederic	EADS Astrium
Podgórski	Daniel	CIOP
Ramboer	Jan	EC
Segebarth	Nicolas	EC
Reinaud	Joséphine	CEMBUREAU
Reindorp	Theo	Clariant / EPSC
Reniers	Genserik	Univ Antwerp / TU Delft / KULeuven
Saraiva Martins	Carlos	EC
Simons	Keith	
Suikkanen	Johanna	UNEP
Van Berkel	Arij	TNO
Van Houtte	Henk	European Safety Federation
Winroth	Gustaf	EC
Huemer	Martin	EC
	Kurt	EC
Moulin	Lionel	Ministère de l'Écologie, du Développement Durable et de l'Énergie - France
Bharadwaj	Ujjal	TWI

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On 24th September 2014 the EC Workshop on Industrial Safety was held at Madou Building, Brussels.

The aim of the workshop was to discuss with the different industrial stakeholders the interest of taking safety into account as a cross-cutting issue in the different PPP topics, similarly to what is done with sustainability. The aim was also to sensitize the audience about the safety issues which are an everyday concern to the safety research community, but less familiar to the stakeholders in charge of industrial R&D in their respective sectors. Finally, bringing together different sectors to discuss safety issues also allowed addressing the question of sharing across the different sectors the best practices that have emerged (for instance in process industries).

During this workshop, a number of presentations were made, some of which are available here. A report of the workshop, also available for download, was written by an independent expert.

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