European technology platform on industrial safety (ETPIS), a vision to gain safety for a sustainable industry growth

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EUROPEAN TECHNOLOGY PLATFORM ON INDUSTRIAL SAFETY (ETPIS), A VISION TO GAIN SAFETY FOR A SUSTAINABLE INDUSTRY GROWTH

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The paper that will be presented is an extract of the Strategic Research Agenda of the European Technology Platform Industrial Safety (ETPIS). It is a result of a collective work made by researchers from organisations that consider industrial safety as a strategic issue for the sustainable growth of the European Industry.

The list of the main organisations involved in the ETPIS, that participate in the preparation and endorse this text is available at **www.industrialsafety-tp.org**.

The paper will describe the rationale, the scope and the organisation of the initiative.

It will insist on the structuration and the organisation of a Strategic Research Agenda prepared by more than 150 organisations concerned by industrial safety.

In particular, the analysis of the broader situation, regarding industry and safety interactions and issues, led the ETPIS members to propose a RTD strategy that focuses on 6 major challenges. These have been identified wherever there is a clear need to develop basic knowledge in safety sciences.

- Developing new risk assessment and risk management methods addressing the complexity of industrial systems
- Improving methods and technologies to reduce risks at work and to prevent major accidents
- Understanding the impact of human and organisational factors in risk control
- Improving knowledge transfer to industry and in particular SMEs, education and training activities
- Understanding emergent risks and cross-cutting risk & safety issues
- Structural safety

Some industrial stakes are not concerning only one industrial sector, and should also take the knowledge and expertise from several Focus Group. To enable the mobilisation of the critical mass and attract the interested sectors, the TP has decided to create the concept of research HUB.A research HUB is a group of interest aiming at exchanging knowledge and launching projects after having defined a specific research agenda. The research HUB will take benefice from the Focus Groups and mobilise the interested industries. The first research HUB of the TP on Industrial Safety is the NANO-SAFETY HUB addressing the safety issue of nano-technologies and nano-materials.

KEYWORDS: industrial safety, research agenda, risk assessment

RATIONALE

SAFETY FOR EUROPEAN QUALITY OF LIFE AND COMPETITIVENESS

The European Union has been defining a number of objectives for the future of RTD activities, which require a variety of concerted actions. The Lisbon summit (2000) established the objective for Europe to become the most dynamic and most competitive knowledge-based economy by 2010, while in the Gothenburg summit (2001) emphasis was put on sustainable development, involving aspects of environment, health, economy and employment.

The achievement of these objectives for the European economy and quality of life requires that industry as a whole modernises itself, improving its efficiency, quality and safety. It also requires improvement in the efficiency, quality and safety of transport systems, as mobility is a requirement for the industrial development and also for the well-being of citizens. It is becoming more evident that the industrial and transport networks in Europe are transnational and increasingly more dependent on each other. Efficiency of industrial production is intimately related to the delivery of materials and products in a timely manner and this can only be viable with adequate logistic and transport infrastructures.

Safety is essential for human well-being but also to ensure the efficiency and competitiveness of the industrial and transport systems as a whole. Any disruption in the chain of production and transport has adverse consequences on the affected industries and transport systems, which may extend across country borders, as national economies are increasingly interlinked. It is therefore essential that in all European countries there is a unified approach to Safety and that this approach is also maintained consistently across the various industries and transportation facilities. This is not the present situation but should be a long-term objective that should mobilise efforts among all parties involved, from Governments to industry and academia, and from technology developers to the public at large.

AN EVOLVING CONTEXT

The performance of the European industry in many sectors is competing with other countries which are growing quickly thanks to structural and economic advantages such as growing market potential. Since Europe is a largely mature market which is not expanding rapidly, investment for expansion is taking place in other regions where there are market and sometimes economic advantages. Investment in Europe is 'plateau-ing' and new production capacity is built in Asia or in south America. This position creates challenges to maintain competitiveness and a proper socio-economic performance level in EU.

Part of the challenge is in meeting public expectations in safety and environmental protection while remaining competitive. New emerging technologies are providing and requiring new design, operation and assessment routes which need immediate considerations to maintain industrial safety. Furthermore, as European industrial installations are becoming older and technical expertise follows new investment and older experts are retiring, making education and training for industry a special issue.

The market is evolving towards specialised production and complex manufacturing processes (speciality chemistry, aeronautics and services . . .) which require enhanced knowledge, adaptability and flexibility. If the required technological disciplines and hard science education do not attract enough people, it will be impossible to stimulate innovation.

NEED FOR CHANGES IN INDUSTRIAL SAFETY POLICIES

Policies addressing industrial systems, and in particular safety, must evolve from prescriptive policies to objective policies, because the key players able to implement the solutions are the industries themselves and it is no longer possible to prescribe solutions when the systems are so specific and so complex.

There is a need to harmonise the policies and ensure a consistent implementation throughout Europe, and in particular as theEuropean Union enlarges.

The public expects to take part in decision-making process related to safety and environmental protection issues of the ageing and emerging infrastructures and systems in Europe. There is always a residual risk related to new technologies, design, monitoring, structural assessment methods and human activities. It is important that industry and public authorities' decision making process are as transparent as possible and it is fundamental that it is comprehensible by the public. For that latter reason, there is a need to develop an open and ethical industrial risk (or safety) culture and explain risks and benefits that our society gains from industry.

The solutions to be developed to minimise both accidents and pollution must be integrated ones while maintaining the integrity of manufacturing and operation of industrial systems. The new systems that will be designed must take into account at conception, safety and environmental performance as major opportunities and requirements. Inherently safe and clean concepts should permeate industry at all levels of the life-cycle of manufactured products.

SCOPE OF THE EUROPEAN TECHNOLOGY ON INDUSTRIAL SAFETY

Scope

Industrial safety applies to installations, production systems, buildings, transport systems and safety related structural components And deals with

- Occupational health and safety of the workers in industry
- Environmental safety
- ✓ prevention of major accidents with off-site consequences
- ✓ protection of the environment and the society

Safety of society derives from properly addressing risks to the public, industrial risks and occupational risks, the nature of which changes with the target population to which it relates. Public risks are related to governmental decisions on major topics such as major diseases (e.g. AIDS and cancer), genetically modified products, climate change and natural hazards as examples. Industrial risks are related to the risk that the industrial activity brings to employees and the public in general, including transportation which is considered here as part of the industrial activity. In industrial activity, risks related to the introduction of new technologies (e.g. nanotechnology, hydrogen strorage and common use etc.) and design routes need particular attention as the new hazards need to be properly identified and assessed. Safety in this context results from Governmental regulations, technical codes & standards that generally define minimum acceptable safety levels (and sometimes enforce these levels) and from the various industrial actors that organise their activity in order to achieve the level of safety they consider compatible with their aims and responsibilities. Finally, occupational risks concern the accidents that occur within the industrial and related activities and thus they affect a smaller percentage of population at risk. They all depend on the policies, aims and performance of the various industrial sectors and Governmental regulatory activity.

The scope of the Industrial Safety Technology Platform provides an integrated approach to the safety related aspects of advanced design, production, operation processes and fitness-for-service assessment of industrial products and systems, dealing with technical and human, organisational and cultural aspects, as well as the actual systems and processes used for managing safety. The main emphasis is on the development of preventive technologies, damage assessment routes using risk-based methods for the optimal design of products, production facilities, industrial systems, activities and ageing and new advanced structures from the point of view of delivering recommendations in the form of "Best Practice Documents". These can be basis for development of CEN Norms by the respective Technical Committees for improved safety levels at acceptable costs.

THE VISION AND THE WAY TO ACHIEVE IT

SITUATION REGARDING INDUSTRIAL SAFETY

According to European Statistics (Eurostat, 2004), in EU-15, in 2001 there were 7.6 million accidents at work. 4.9 million of these resulted in more than 3 days of absence from work and 4,900 fatalities occurred. This means that one worker became a victim of an industrial accident every 5 seconds and one worker died every two hours. All industry sectors are concerned: manufacturing, energy, transport, construction, agro-industry, process industry.

The MARS database Major accident reporting system of the European Commission (Joint Research Centre, Ispra http://mahbsrv.jrc.it) records that, approximately 30 Major Accidents happen each year within the industry sectors covered by the Seveso 2 Directive. These accidents are not major contributors to the overall statistics but have a major impact on industry and society. The major accident, which occurred at Toulouse on 21st September 2001 killed 21 people on the site, 9 people off-site and injured 2,242 people. 27,000 homes and 1,300 companies suffered significant damage. 5,000 people needed treatment for acute stress. The economic cost exceeded €1 500 million.

Incidents and accidents disrupt the process of sustainable industrial development, directly through the remedial and prevention activity and indirectly through restrictions placed on the whole industry as a result of these failures. Failure of primary components of engineering structures such as nuclear, chemical, offshore and aeronautical industries can easily leads to significant losses in terms of human lives and economical value. It has a paramount significance to maintain the structural integrity of existing, ageing equipments as well as new advanced structures in Europe. Additionally, introduction of new design approaches and technologies brings new challenges, which need to be addressed before they impose added safety risks. Performance statistics for different sectors indicate that some industries are apparently much safer than others. The difference between the best performers and the average for all industry is often dramatic and cannot always be explained by the inherent hazards of the specific features of the structures and workplace or work activity. There are underlying reasons for failure and success which may be known, shared and acted upon within a sector, but no coherent effort has been made to address the failures of one sector by applying the success factors of another. Within sectors there is a wide variation of performance, which depends on many root cause factors including corporate tolerance, scale of operation and resources available for accident prevention and concerns about competitiveness. The new members of the European Union are in some cases at a different stage of development and performance in industrial safety. This presents some new opportunities and challenges.

Research projects on Industrial Safety are funded by a wide range of stakeholders including the European Commission and European member state governments. This investment has not been entirely successful because a Europe-wide life cycle process from problem definition through project activity to implementation and exploitation has not been applied consistently.

Legislation such as the Seveso and "safety at work" Directives has played a constructive role in setting requirements and standards. Consensus Technical Standard setting bodies such as C.E.N. and I.E.C. have been successful in promoting improvement.

The best performers have made their own decisions to be leaders. In so doing, they have initiated, carried out and exploited projects and implemented improved technical standards. In most cases they have developed risk based design, monitoring and advanced fitness-for-service assessment methodologies for their structures and adopted an accident free workplace philosophy and used effective training and education schemes. Harmonisation of all these aspects in Europe is a RTD challenge for coming decades.

THE VISION 2020

The platform will be a major industrial contribution to the design of European policies related to Safety and Health (particularly Framework Directive), SEVESO II Directive, ATEX Directive, IPPC Directive, transport of dangerous goods, REACH, GHS, etc.

The vision for industrial safety performance can be summarised as follows.

By 2020,

- ✓ a new safety paradigm will have been widely adopted in European industry. Safety is seen as a key factor for successful business and an inherent element of business performance. As a result, industrial safety performance will have progressively and measurably improved in terms of reduction of reportable accidents at work, occupational diseases, structural failures lead to environmental incidents and production losses. It is expected that an "incident elimination" and "learning from failures" cultures will be developed where safety is embedded in design, maintenance, operation, fitness-for-service assessment and risk management at all levels in enterprises. This will be identifiable as an output from this Technology Platform with following quantified objectives;
- ✓ >there will be structured self-regulated safety programmes in all major industrial sectors in all European Countries. These will have firm, measurable performance targets for improved structural performance, accident elimination and will meet the annual reduction rate stated in the Technology Platform objectives
- ✓ accident free workplaces will become the norm

This development will significantly contribute to the sustainable growth of all major industrial sectors in Europe by safer utilization of emerging technologies and life extension of ageing structures and and hence improvement of social welfare.

HOW CAN THE VISION BE REALISED?

Improved risk control supporting the sustainable growth of European industry needs a co-ordinated effort in research and in identifying and adapting successful practices. Many of the most respected risk assessment and control methodologies have originated or been developed in Europe. Examples include Hazard and Operability Study (HAZOP), Quantitative Risk Assessment (QRA) and Workplace Risk Assessment.

Research work should continue in these fields to develop existing methodologies further by taking into account of emerging technologies and respective risks as well as harmonising the best of them in Europe. The interaction and early involvement of technological knowledge (new technologies, smart structures etc.) in policy development needs improvement. This will lead to early identification of safety relevant issues and thus can guide introduction of new design and manufacturing technologies, life extension and structural performance assessment methodologies and policy/legislation development and improve the quality and sustainability of the final solutions.

Recognising the challenge and opportunities, a group of experts from industry, unions, authorities, NGOs and research and academic organisations have undertaken an inititative to create a Technology Platform to achieve Safety for Sustainable European Industry Growth. This initiative obtained the principal supports of the DG Employment, DG Enterprise, DG Environment and DG Research of the Commission. This TP has prepared the strategic plan described within this document for research for development of new technologies and improvement of existing best practices as well as efficient implementation of R&D results across all major industrial sectors including SMEs. The European Technology Platform for Industrial Safety (ETPIS) has clear understanding of the role and needs of the SMEs for development and implementaion of the best practice procedures for industrial safety. ETPIS works with other European TPs using existing expert groups and contributes to form new groups as networks of National Platforms to ensure success. ETPIS offers a unique opportunity to focus European competences on needed research items and clearly defines how each project which it supports will play its part in delivering the vision.

The main objectives of the Technology Platform ETPIS, therefore, are:

- To gain 'Safety for the Sustainable Growth of all European Industry' by reducing the number of accidents & by supporting safe technological innovation. This has a major impact on cost of manpower, availability of production systems and therefore on the competitiveness of the Industry.
- To bridge the different aspects of "industrial safety" (Occupational health & safety of workers plus environmental safety including prevention of major accidents & protection of the environment).
- To facilitate and accelerate the breakthrough for progress in industrial environmental, health & safety (EH&S) via a co-ordinated, integrated research & implementation process.
- To valorise, exploit and implement results of research and innovative methods within Industry.

As described above, ETPIS addresses occupational and structural safety related with the industrial activity as a whole and has the vision to significantly reduce the level of accidents involving human and ageing & new structures (with emerging risks) in Europe by 2020 with realistic, measurable targets. The platform activities will result in a substantial improvement of occupational and structural safety in all major industries, including transportation systems and infrastructures while maintaining the profitability of the industry.

More specifically, ETPIS addresses the problem of ensuring the safety and cost-effectiveness of industrial products and services, transport systems and services, facilities and structures (made of metals – with or without welds and composite materials) across different industries. Several industries are faced with similar problems requiring solutions that are compatible with new work organisation, including the extended use of information technologies, and which impose no damage to the environment. Industries are also going through processes of consolidation, of relocation in different countries, including establishing industrial parks so that a proper interaction with urban planning and development becomes even more important and critical.

Safety and reliability aspects, which are critical to production efficiency and cost, need to be assured not only in the design and in the manufacturing phase, but also must be maintained during the operational and ageing phases of the products and facilities. Finally, in the long-term prospective (up to 20 years) a great deal of effort is to be directed to a change from the traditional approach of "hazard control" to "accident elimination" by developing and adopting new technologies and methods. Thus the development and evaluation of inherent safety principles and techniques is a long-term objective, together with ensuring their adoption by all stakeholders.

Moreover, a new threat potential has been added to the problem area of safety since the occurrence of tragic events like those of September 11, 2003 in New York and March 11, 2004 in Madrid: namely, the security of industrial systems and infrastructures. While safety aims at avoiding accidents and damage resulting from normal operation of installations, security aims at safeguarding the installations from voluntary illicit acts, often of a terrorist nature. Most of the focus in security is towards decreasing vulnerability of systems by better detection and early warning of the potential threats and/or by making systems more robust or eliminating weak links. In this respect, it is clear that public and industrial safety cannot be ensured if measures are not explicitly taken to also deal with these emerging threats. While some methodological aspects of risk assessment and management are the same, the hazard

identification requires new types of actions and thus the risk analysis methods and the resulting reduction measures also need to reflect these new threats. The experience in the nuclear sector's safeguarding may represent a good example in this direction.

This Technology Platform aims at improving the coherence of the approaches adopted by the different industries to deal with the above-mentioned problems, and it provides a strategic vision for identifying priority research in RTD and demonstration activities. It will also consider the importance and maturity of the technologies being developed and will contribute to the technology transfers among the sectors and to the much needed education and training activities.

The long-term objective of ETPIS is to improve the methodologies, technology and the practice, making them more integrated and consistent across industrial sectors and across European countries, as this is the only way of improving the overall level throughout. As long as there are sectors of activity, or countries, with less than satisfactory approaches to safety, the overall objective can be jeopardized. This is particularly critical with Small and Medium Enterprises (SMEs) in general as they often they do not always possess sufficient resources and may not be able to lead the processes of safety improvement. This Platform is transversal, crossing all industries and transportation modes, and aims at developing consistent methodologies of risk analysis and management for implementation in the various industrial and transport sectors. Concurrently, the specifics of application of the methods and the details of their implementation in the various industrial and transport practices will need to be dealt in conjunction with the industry-specific Platforms.

WHAT WILL BE DONE – THE GENERAL APPROACH

A general approach will be implemented to reach the objectives of the ETPIS:

- Act to gain the commitment from major industrial sectors and key safety related organisations to the accident elimination vision and the milestones of:
  - 25% reduction in accidents by 2020
  - Programmes to be in place by 2020 to continue accident reduction at a rate of 5% per year or better
- Set up consultation and analysis programmes, which identify needs and matches these to potential research projects for management through the Technology Platform. Use knowledge gained to expand the scope of the Technology Platform where needed.
- Carry out industry driven research within the following focus areas:
  - Risk Assessment and Management
  - Advanced Risk Reduction Technologies
  - Structural safety
  - Human and Organisational Factors
  - Emerging risks
  - Education and Training, and transfer to industry, in particular SMEs

The research agenda addresses needs of all industrial scales (from SMEs to major multi national companies) operating in the 27 member states of the European Union. Therefore, ETPIS aims to conduct collaborative works to:

- Identify *Best Safety Practices (BSP)* in individual industrial sectors which have potential for multiple sectors.
- Research on needs of identified *Best Safety Practices* to make them world-leading procedures by covering new technologies, methodologies and emerging risks and fully applicable across individual sectors and across multiple sectors.
- Continue a formal structure allowing communication and sharing among all Technology Platforms where occupational and structural safety are of concern.
- Provide intelligent information exchange from one sector to another to allow gaps, barriers and synergies to be identified.
- Require an implementation strategy to be included for the results of funded research endorsed by the Technology Platform.
- Provide newly developed or improved *European BSP documents* to give sector or problem specific guidance on new standards and regulations to achieve the desired improvements in a cost effective manner which delivers social and economic benefits which in-turn enhances the sustainability and competitiveness of the industry.
- Set up an best knowledge and industrial need driven programme which accomplishes:
  - Implementation of results of research and improvement programmes which meet the quantified progress measures in the Technology Platform Vision.
  - Developing European *Best Safety Practice (BSP)* Documents to provide basis for development and further improvement of unified standards
  - Developing and establishing European Safety Training and Education Network using material developed within European BSP Documents and existing standards
  - Progress measurement (and reporting) against the accident reduction goals in the Vision.
  - Installing the concept of accident statistics and economic assessment as an extension of and in addition to the key financial reporting activities for the enterprises (global safety indicator)
  - Reporting on the success of implementation for each project funded through or with the support of the ETPIS.

Needless to say that ETPIS will use the existing networks, associations and groups are already working in the wide-range of the indutrial safety topics to be addressed.

CHALLENGES TO GAIN INDUSTRIAL SAFETY FOR SUSTAINABLE INDUSTRY GROWTH

The experts of the European Technology Platform Industrial Safety have pointed out several challenges to radically improve safety in the industry:

- Improve methods for safety managers and practitioners
- Develop advanced technologies in the field of industrial safety
- Develop and validate new structural safety procedures
- Improve the safety culture within the enterprises and society
- Improve the knowledge transfer to the industry through new education and training tools and methods
- Develop knowledge, technologies and tools against emerging industrial risks

FOCUS AREAS OF THE ETPIS

The paragraphs hereunder introduce the choice of the focus group topics regarding where basic knowledge, methods and technologies need to be developed.

Developing new risk assessment and risk management methods addressing the complexity of industrial systems

Understanding hazardous phenomena to develop safety equipment and technologies; Development and validation of methods and tools to improve risk assessment and management; Impact of natural and man-made hazards on plant safety; Harmonisation in risk assessment; Reliability and safety of network systems; Methods for dynamic reliability assessment; Risk management and governance (new forms of participative governance); Multi-criteria analysis and decision support tools; Systemic methods to address the complexity of the industrial systems; Uncertainties in risk assessment and management.

Improving methods and technologies to reduce risks at work and to prevent major accidents

Technologies and methods for eliminating or reducing risks at source; Technologies and methods for inherently safe design and for inspection, monitoring and assessment of defects; Application of information technologies in advanced safety-related systems; Reducing risks by collective protective systems and devices; Advanced materials and technologies for developing personal protective equipment; Technologies and methods for preventing and reducing risks due to Major Industrial Accidents.

Structural safety

Structural reliability based design; Structural Health Monitoring (SHM) and risk-informed inspection; Structural Safety of Aged & Repaired Structures; Fitness-for-Service (FFS) of Structures; Integrity of Multi-Material (Hybrid) Structures; Structural Safety from Natural Hazards; Structural Safety from Accidental loads.

Understanding the impact of human and organisational factors in risk control

Human-Centred Design; Human Factors in System design and modernisation; Human-Technology Interfaces & Usability; Integrated Risk Assessment and Management Methods & Techniques; Human Factors in Emergencies and Crisis Management; Safety Culture & Safety Climate; Decision making process; Human Performance; Human Factors in Organisational and Managerial Safety - SME-related issues; Human Factors Knowledge Engineering & Management; Health & Social Issues; Data Retrieval; Operational feedback and learning from experience; Actual safety and perceived safety.

Understanding emergent risks and cross-cutting risk & safety issues

Unified/consolidated legislation, codes, standards; Reliable data; Economic Price & Value of risk (VAR – the Value-at-Risk concept, too) and risk management; New technologies; "Blind" application of tools; Old/aged plants; Globalisation; Integration of Life cycle; Risk perception, Political Price & Value of risk; "Forced" application of risk-based approaches; Impact of demography on industrial safety; Banking and Finance; Security Research.

ORGANISATION OF ETPIS

According to the above-listed challenges in safety sciences, ETPIS members have set up five topic-based focus groups.

- FG 1: Risk Assessment and Management Methods
- FG 2: Advanced Risk Reduction Technologies
- FG 3: Structural Safety
- FG 4: Human and Organisational Factors
- FG 5: Emerging Risks

As some industrial challenges involve several industrial sectors and/or expertise from several Focus Groups, the ETPIS has forged the concept of research HUB.

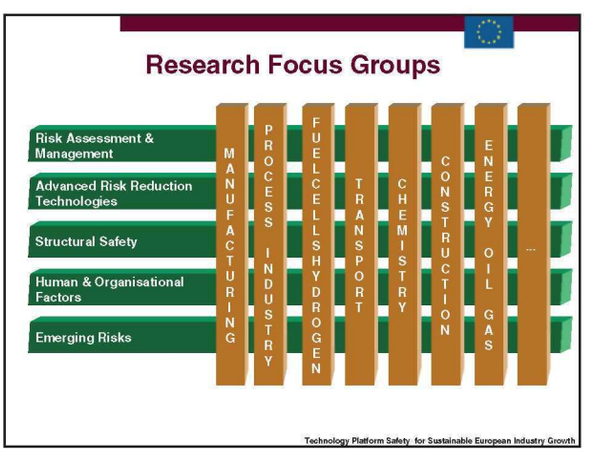

Figure 1. Organisation of the thematic Focus Groups applying to several industrial sectors

A HUB is a topic-based group of stakeholders aiming at both exchanging knowledge and starting projects, once they have defined a research agenda that is specific to their topic of interest.

Two HUBs have been created so far:

- HUB Education and Training. This HUB addresses issues related to basic knowledge, methods and technologies needed to maintain and develop safety-related skills. Approaches include: open platforms for education and training; virtual reality etc.
- HUB Safety. This HUB addresses safety-related issues in the field of nano-technologies and nano-materials. This HUB seeks support from industry partners.

CONCLUDING REMARKS

The European Technology Platform in Industrial Safety (ETPIS) is open to any interested bona fide organisation, the only requirement being active participation in the Focus Groups of interest. The request for access is freely available through the dedicated web site at www.industrial-safety-tp.org.

The content of the Strategic Research Agenda of ETPIS was presented in this paper. It will be updated regularly according to the evolving context and by taking into account the results of research and a specific review of stakeholder concerns and needs. Therefore, every second year the SRA will be reviewed and a new version will be edited after an open workshop gathering the members of ETPIS and the community of interest.

The Strategic Research Agenda is a tool for coordinating the RTD effort in industrial safety at European, national and regional level to prepare research programmes. The objective is to develop synergies between public and private sectors at European, national and regional level to optimise the resources allocated to research in industrial safety. The SRA constitutes therefore the RTD roadmap for industrial safety improvement. The national technology platforms on industrial safety will provide contribution in resources and work and this will be coordinated by the ETPIS.

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More information on Technology Platforms on: http://cordis.europa.eu/technology-platforms/home_en.html