# International Forum on Industrial Safety

## 3rd edition

*Innovating in safety*

July 6th and 7th 2010
Toulouse

FonCSI
FONDATION POUR UNE CULTURE DE SÉCURITÉ INDUSTRIELLE


# 3rd International Forum on Industrial Safety

## July 6 & 7, 2010

## Toulouse

Fondazione Politecnico di Milano

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## *Innovating in safety*

Innovation in technology, in the design process, in manufacturing and distribution, in the organization of socio-technical systems is a source of uncertainty. It raises new questions concerning the safety of new products, processes and organizations. Innovation is also required in risk management activities, in order to meet stakeholders' expectations of continuous improvement of the level of safety. The uncertainty which is inherent in innovation raises questions as to the guarantee of progress in safety.

How then to innovate in safety? In a sector where the "proven in use" notion and learning from experience and operational feedback underpin many safety cases, what scope is there to introduce innovation in safety management? What problems arise from the cohabitation of uncertainty and safety? What types of uncertainty exist, and what is their impact on safety? Which new requirements should be put in place to ensure that safety is guaranteed? How should this assurance be expressed? In the face of uncertainty, how can organizations ensure that they take appropriate decisions concerning risk management, and how should they justify these decisions to stakeholders?

The Forum organized by the FonCSI on July $6^{th}$ and $7^{th}$ 2010 does not aim to provide turnkey solutions to these difficult issues, but rather to analyze the problems raised and their implications for safety management practice. The Forum will allow different viewpoints to be presented, without censoring polemic opinions. Participants will thus obtain a deeper understanding of the specific questions raised by innovation in safety, which should later enable them to implement measures that are appropriate to their specific context.

Invited speakers from different disciplines (law, economics, engineering, mathematics, philosophy, psychology), working in industry or academia, shall present their viewpoint on these issues. Two "lightning talk" fast-track sessions will allow participants to propose novel – if not fully finalized – ideas, some of which may form the cornerstone of tomorrow's common knowledge.

Practical details concerning the Forum are detailed on our web site:

http://www.icsi-eu.org/english/event/2010/IFIS/

## July 6$^{th}$ 2010 morning: programme

| | |
|---|---|
| 9h30 | Welcome & registration |
| 10h00 | **IFIS opening address**<br>Gilles Motet, Scientific Director of FonCSI |
| 10h15 | *Facets of uncertainty and their impact on decision-making*<br>Saïna Farnoud (FonCSI–ENSTIMAC)<br>Fanny Girin (FonCSI–ENTPE)<br>Stéphanie Tillement (University of Grenoble)<br>Risk management requires anticipation of future events. It implies proactive rather than reactive responses to evolution of the environment. The success of this approach requires a good understanding of the notion of uncertainty. The presentation will provide a summary of definitions of uncertainty used in different scientific disciplines, and will characterize the relationship between risk and uncertainty. Starting from a number of industrial examples, we identify sources of uncertainty, propose a classification and illustrate their effects on decisions related to risk management. While uncertainty is generally perceived as a negative notion, we will show how it reintroduces degrees of freedom for people involved in risk management and the subsequent decision and can be seen as providing opportunities for action. However, such a change of viewpoint requires that uncertainty be explicitly integrated into and managed within the risk management framework. |
| 11h | Discussion |
| 11h15 | *Economic approaches to uncertainty and precaution*<br>Nicolas Treich (LERNA/Toulouse School of Economics)<br>To what extent does greater scientific uncertainty lead to more precautionary behaviour? We shall present and compare two models which allow investigation of this question. The first model is based on the notion of option value, a Bayesian approach in which a sequential decision rule allows the decision-maker to account for possible future information and the degree of flexibility available at each decision step. In the second "ambiguity aversion" model (which is non-Bayesian), scientific uncertainty is represented by the coexistence of different beliefs, rather than by the arrival of information over time. We will discuss the practical and conceptual difficulties arising from each approach, and analyze the impact for benefit-cost analysis and risk analysis. |
| 11h45 | Discussion |
| 12h | *Imprecise probabilities: a new tool for better assessments and decisions in risk analysis*<br>Didier Dubois (IRIT)<br>Uncertainty has long been a controversial notion. In particular, the prominence of probability theory in the scientific arena has blurred some distinctions that were present from its inception, namely between uncertainty due to the variability of physical phenomena and uncertainty due to a lack of information. The Bayesian school claims that whatever its origin, uncertainty can be modeled by a single probability distribution. This assumption has been questioned in the last thirty years or so. Indeed, the use of unique distributions so as to account for incomplete information leads to paradoxical uses of probability theory.<br>In the area of risk analysis, especially concerning environmental matters, it is crucial to account for variability and incomplete information separately, even if conjointly, in uncertainty propagation techniques. Indeed, the decision-maker should be able to distinguish between uncertainty due to partial ignorance (hence reducible by collecting more information) and uncertainty due to variability. We will present a new uncertainty theory which helps meet this challenge, where the unique distribution is replaced by a convex set of probabilities, this set being all the larger as less information is present. Special cases of such representations, which enable efficient calculation methods, are based on random sets and possibility theory (using fuzzy sets of possible values). The aim of this talk is to trigger interest in these new approaches, by explaining their epistemology and illustrating them on some applications. |
| 12h30 | Discussion |
| 12h45 | **Lunch** |

## July 6$^{th}$ 2010 afternoon: programme

14h00 *When more uncertainty can lead to more safety*

Gudela Grote (ETH Zürich)

Safety has long been managed mainly by attempting to minimize uncertainties following the basic understanding of safety as minimal acceptable risk. However, minimizing uncertainties implies losing the organizational flexibility needed for resilient responses to disturbances and the openness to change needed for innovation. Therefore, newer approaches to safety management aim to combine different ways of handling uncertainties into strategies that improve the balance between stability and flexibility in line with the notion of loose coupling. Safety culture is seen as important for achieving loose coupling because culture can serve as a "soft" mechanism for coordination and integration in a formally decentralized organization. As there is much reluctance to embrace uncertainties as opportunities in high-risk organizations due to the basic assumption that individual autonomy furthers errors, the empirical evidence on the relationship between safety and autonomy is discussed and uncertainty postulated as an important moderator in that relationship. This provides further justification for approaching safety management and related design questions within a framework of uncertainty management. Following this thread, a new instrument and assessment procedure for evaluating and designing safety management and safety culture is proposed. The procedure emphasizes the importance of assessing the fit between uncertainties and their management and of changing organization design to improve the fit if needed. Change efforts should mostly worry about culture in terms of current belief systems getting in the way of establishing better organizational practices. However, in order to advance loose coupling, attention also needs to be paid to furthering culture as a mechanism for integration and coordination.

14h30 Discussion

14h45 *How can serendipity of discovery and safety coexist?*

Sophie Bougaret (Manageos) and Didier Gourc (ENSTIMAC)

The process of discovery in the pharmaceutical industry will be presented, focussing on the research and early development phase, most concerned by the paradox between safety and innovation. In this phase, hundreds of pharmacological entities – potentially active and toxic – are manipulated despite absence of information on their activity and toxicity. Which strategies are used to handle this uncertainty? We shall present current practice, and its historical evolution. We will discuss the watershed separating chemical pharma and its 100 years of accumulated wisdom integrated into risk management practice, from the young biotechnology sector which is changing safety paradigms. In this field, chance has led to many major discoveries: the list of molecules "discovered" due to a mistake is a long one. How therefore can we allow unintentional but positive effects to be discovered on research workbenches, despite the rigid controls put in place for safety reasons?

15h15 Discussion

15h30 Pause

16h *Uncertainty also affects risk management. How could the new ISO 31000 standard help decision-makers?*

Gilles Motet (FonCSI & INSA Toulouse)

Uncertainty is clearly the keyword of the new standard ISO 31000 *Risk management – principles and guidelines*. Uncertainty affects both an organization's risks and the risk management activities themselves. Its presence makes it illusory to aim to keep "everything under control", and is one of the primary causes of major accidents. Which types of uncertainty are an obstacle to effective risk management? How can a continuous improvement process reduce the impact on risk management activities? We will show how the principles underpinning the ISO 31000 standard can help risk managers and decision-makers confront these issues.

16h30 Discussion

16h45 *Lightning talks / Fast-track*

Obtaining significant progress in industrial safety will undoubtedly require reinventing elements of current thinking and practice. Such breaks with the past raise questions concerning the management of the uncertainty inherent in innovating in the safety domain. The IFIS aims to allow the expression of these new ideas, which may tomorrow become the foundation of common wisdom. During these lightning talk sessions, we will give participants the opportunity to present new safety-related ideas, questions, approaches, techniques, *etc.*. The aim is not to present finalized results but to provide a sounding-board for novel ideas which allow a change in viewpoint concerning industrial safety. Proposals are invited from academia, as well as from other stakeholders (NGOs, government officials, industry) who often have fewer outlets for their innovative ideas.

The list of lightning talks shall be provided in the final programme.

18h End of the first day

## July 7$^{th}$ 2010 morning: programme

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|---|---|
| 9h | *When innovation must succeed on the first attempt: the case of satellite systems*<br>Jean-Paul Blanquart (Astrium Satellites, EADS)<br>In space, safety and innovation are a necessity, despite a hostile environment which imposes many constraints. Among these constraints, we will focus in particular on the fact that it is impossible, before launch, to undertake exhaustive testing in conditions which are representative of operational conditions. Furthermore, it is extremely difficult to apply modifications to the satellite after launch. How then can one innovate safely in systems which must succeed on the first attempt? We will present the techniques generally used in satellite design, as well as their difficulties and limits, by analyzing a number of incidents and failures. |
| 9h30 | Discussion |
| 9h45 | *Change and innovation in the process industry*<br>Charles Milardo (LyondellBasell)<br>Innovation is both a source of progress and of new worries and constraints. In the process industries, the use of new types of equipment brings concerns regarding its reliability, its resistance to perturbations, the lack of field experience and accumulated competency. It gives rise to new constraints, concerning the necessary accompanying infrastructure, spare parts and training of operators and maintenance workers. The transition from pneumatic equipment to electro-mechanical then to electronic equipment has given rise to significant and rapid change. Evolution in safety equipment is slower, since new technologies are tested on process control equipment before being approved for safety applications.<br>What are the upcoming innovations in this sector? On the technological side, for instance, wired communications will be replaced by wireless technologies. How should these evolutions be managed? Which precautionary measures should be taken to ensure safety? When should change be introduced? We will give our viewpoint on these questions, based on lessons learned from the past. |
| 10h15 | Discussion |
| 10h30 | Pause |
| 11h | *Responsability, anticipatory knowledge and uncertainty, a philosopher's contribution*<br>Roland Schaer (UniverScience)<br>The imperative of anticipating risks does not arise solely from fear and a precautionary attitude, but also from a philosophy of collective human responsability, as outlined by the philosopher Hans Jonas. In exercising this responsability, the scientific community's work in building robust predictive models plays a central role. Despite being built on a rigourous scientific process, these models and bodies of knowledge contain uncertainty. The management of this uncertainty is becoming an increasingly sensitive issue in the social and political spheres. |
| 11h30 | Discussion |
| 11h45 | *Innovating in safety whilst preserving the balance of legal risks. The case of driver assistance systems in road transport*<br>Michèle Guilbot (INRETS)<br>Research undertaken in the Prédit programme has shown the positive impact of well managed legal liability for road users on road safety. As a continuation of this work, we will discuss the legal implications of driver assistance systems which are starting to appear in new cars and trucks. This new context requires a rethink of the limits to legal liability for a driver who no longer has complete control of all driving tasks. This example will serve as the basis for a discussion on liability issues on the industrial safety sector. |
| 12h30 | **Lunch** |

## July 7$^{th}$ 2010 morning: programme

14h *Binary decisions based on uncertain estimates. Illustration on new urban planning legislation in France*
Eric Marsden (FonCSI)

The risk assessment process for industrial plants involves the construction of accident scenarios and the estimation of their potential effects at different distances from the site. These estimations of severity of effects and scenario probabilities are based on uncertain input data, and lead to land use planning decisions which are essentially binary. How is this uncertainty integrated in the decision-making process and in the justification of the decision? To what extent is this uncertainty irreducible, since caused by physical phenomena which are intrinsically unpredictable, rather than on a lack of information and limitations of the underlying models?

14h30 Discussion

16h45 *Lightning talks / Fast-track*

Obtaining significant progress in industrial safety will undoubtedly require reinventing elements of current thinking and practice. Such breaks with the past raise questions concerning the management of the uncertainty inherent in innovating in the safety domain. The IFIS aims to allow the expression of these new ideas, which may tomorrow become the foundation of common wisdom. During these lightning talk sessions, we will give participants the opportunity to present new safety-related ideas, questions, approaches, techniques, *etc.*. The aim is not to present finalized results but to provide a sounding-board for novel ideas which allow a change in viewpoint concerning industrial safety. Proposals are invited from academia, as well as from other stakeholders (NGOs, government officials, industry) who often have fewer outlets for their innovative ideas.

The list of lightning talks shall be provided in the final programme.

16h00 **Forum conclusions**

## About the speakers

**Jean-Paul Blanquart** is a dependability engineer at Astrium Satellites (a division of EADS). His work concerns the dependability and security of space systems, in particular the onboard computer hardware, software, processes and system engineering. He has provided support to the definition and validation of the safety case for projects such as Ariane 5, the European ATV automated cargo craft which supplies the International Space Station, the Galileo ground segment and air traffic control components. Jean-Paul Blanquart is an active member of the industrial and scientific dependability and embedded systems communities, at the regional, national and international levels.

**Sophie Bougaret** runs Manageos, a consultancy in management of R&D project portfolios. After having worked as a R&D project manager for a large pharmaceutical company, she worked as project director for a biotechnology startup specialized in delivering genes and antigenes. Sophie Bougaret is president of the pharmaceutical project management commission of the French-speaking Project Management Association. She is an associated professor at the Institut National Polytechnique de Toulouse, is responsible for the *Competitive intelligence* master (in collaboration with the Toulouse Business School) and teaches in project management and risk management.

**Didier Dubois** is a researcher at IRIT, University of Toulouse who works for the French National Centre for Scientific Resarch (CNRS). He is the co-author, with Henri Prade, of two books on fuzzy sets and possibility theory, and more than 15 edited volumes on uncertain reasoning and fuzzy sets. He has contributed more than 200 technical journal papers on uncertainty theories and applications. He is a member of the Editorial Board of several technical journals, including *International Journal on Approximate Reasoning*, *IEEE Transactions on Fuzzy Systems*, and *Information Sciences*. Since 1999, he has been co-editor-in-chief of *Fuzzy Sets and Systems*. In 2002 he received the Pioneer Award of the IEEE *Neural Network Society*. His topics of interest range from artificial intelligence to operations research and decision sciences, with emphasis on the modelling, representation and processing of imprecise and uncertain information in reasoning and problem-solving tasks.

**Saïna Farnoud** is a PhD candidate at the Industrial engineering laboratory of the École des Mines d'Albi-Carmaux. After undergraduate studies in mathematics at the University of Ferdowsi (Mashhad, Iran), she graduated in cognitive science at the University of Nancy. Her PhD work is a part of FonCSI's "Risk, uncertainty and decision-making" research programme. Saïna Farnoud's research concerns the study of decision-making processes under uncertainty, with an application to decision-making processes in pharmaceutical development.

**Didier Gourc**, after a PhD at the University of Tours (1997) and teaching software engineering at the École d'Ingénieurs de Tours, has been associate professor at the École des Mines d'Albi d'Albi-Carmaux since 1997. He obtained the Habilitation in 2006, concerning the integration of the risk dimension in traditional operations management approaches. His research is carried out in the Industrial Engineering Center, where he heads a group of researchers working on organization, instrumentation and task scheduling. Didier Gourc's research concerns risk management in projects, in particular the development of methods and tools for project management under uncertainty, project risk management and project evaluation.

**Gudela Grote** is Professor of Work and Organizational Psychology in the Department of Management, Technology, and Economics at the ETH Zürich. She holds a Master's degree in psychology from the Technical University in Berlin and a PhD in Industrial/Organizational Psychology from the Georgia Institute of Technology, Atlanta. She has published widely on the interplay of organization and technology, safety management, and changing employment relationships. Gudela Grote is Associate Editor of the journal *Safety Science*. Special interests in her research are the increasing flexibility and virtuality of work and their consequences for the individual and organizational management of uncertainty.

**Michèle Guilbot** is a researcher in the Accident mechanisms department at INRETS, the French road safety research organization. She holds a PhD in law and an Habilitation. After having worked on repressive road legislation in the 1990s, her research now encompasses all elements of responsability which can be applied to contextualize the response to accidents. This work is driven by accident research which has characterized the influence of the road environment (vehicles and infrastructures) on driving; the environment may either encourage safe driving or on the contrary contribute to errors and failures of the driver, leading to accidents.

**Eric Marsden** is Programme manager at the FonCSI. After a PhD in dependable computing at LAAS-CNRS in Toulouse, he joined ICSI in 2004, then FonCSI upon its creation in 2005.

**Charles Milardo** has run a maintenance department on a Shell refinery in France in 1977, then managed engineering work on the refinery (1983). In 1990, he was responsible for the creation of an inspection, instrumentation and metrology division then ran an energy production unit (steam, water, pneumatics, electricity) on a petrochemical site. From 2000, he was the instrumentation expert responsible for safety systems on the Berre petrochemicals site, run successively by Shell Pétrochimie Méditerranée then LyondellBasell.

**Gilles Motet**, after a PhD at Université Paris VI and work as a research engineer at the CEA Saclay, joined the INSA Toulouse where he is a Professor. Since 2005, he has been Scientific Director of FonCSI. He participated in the working group which authored the new ISO 31000 standard "Risk management – principles and guidelines", and created the specialized master *Risk Engineering*. He lectures in safety and risk management at the INSA Toulouse, the University of Keio (Japan) and the Politecnico di Milano (Italy). His research concerns risk management principles and applications to fault prevention in computer systems.

**Roland Schaer** is the Science and Society director at Universcience, an organization resulting from the merger of the Cité des Sciences et de l'Industrie in Paris and the Palais de la découverte. A philosopher by training, he created the Collège de la Cité des Sciences, a series of conferences and public debates initiated in 2002. He was the coordinator of the european network *Citizen Participation in Science and Technology*, which aimed to foster active participation of citizens in the assessment of societal decisions arising from research developments and technological innovation.

**Stéphanie Tillement** is a PhD student at the PACTE laboratory of the University of Grenoble. She studied industrial engineering at the INP Grenoble and organizational sociology at Université Paris Dauphine. Her PhD is a part of FonCSI's research programme on sociocultural success factors of experience feedback, and the collaboration is pursued with FonCSI's "Risk, uncertainty and decision-making" programme. Her research concerns organisational reliability, operational experience feedback and project management.

**Nicolas Treich** is a senior researcher at INRA, working within the Toulouse School of Economics. His research concerns the precautionary principle, economic analysis of risk regulation, decision-making under risk and uncertainty and benefit-cost analysis. His work has been published in *International Economic Review*, *Journal of Public Economics* and the *Journal of Risk and Uncertainty*. He participates in the work of the *Sustainable finance and socially-responsable investment* chair managed by the École polytechnique et the Institut d'économie industrielle (IDEI).

The *International Forum on Industrial Safety* (IFIS) is neither a traditional scientific conference nor a public debate, but aims to provide a venue for pluridisciplinary discussion between academia, practitions and legislators on exciting new research into risk management and safety culture issues. The Forum does not aim to provide off-the-shelf solutions, but rather to analyze the problems raised and their implications for safety management practice. The Forum will allow different viewpoints to be presented, without censoring polemic opinions. Participants will thus obtain a deeper understanding of the specific questions raised by innovation in safety, which should later enable them to implement measures that are appropriate to their specific context.

After a first edition in Toulouse in 2008, the IFIS was hosted by Politecnico di Milano in 2009, and returns to Toulouse in 2010, hosted by the *Foundation for an Industrial Safety Culture*.

The *Foundation for an Industrial Safety Culture* (FonCSI) is a French research foundation created in Toulouse in 2005. It funds research concerning industrial safety, management of technological risks and safety culture, and works to make research accessible and useful to all stakeholders.

www.icsi-eu.org

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The *Fondazione Politecnico di Milano* is an operational vehicle created in 2003 by the Politecnico di Milano to promote technology transfer, develop applied research and stimulate the creation of new technology-oriented companies.

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